Greenhouse Gas Emissions in the New England and Eastern Canadian Region, 1990-2000

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Founded in 1967, NESCAUM is a non-profit association of the state air quality management offices of Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island, and Connecticut.

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Acknowledgements

I. Overview

This report provides an estimate of greenhouse gas (GHG) emissions for the New England and Eastern Canadian region from 1990-2000. It was produced by NESCAUM with support from the U.S. Environmental Protection Agency's State and Local Capacity Building Branch. The goal of this report is to provide current information on regional GHG emission trends, as called for in the Climate Change Action Plan adopted by the Conference of New England Governors and Eastern Canadian Premiers in 2001.[1]

A. Background

In recent decades, a growing consensus has developed that the earth's climate is being altered by increased concentrations of certain heat-trapping ("greenhouse") gases in the atmosphere as a result of human activity. In 1992, the United States signed and ratified the Framework Convention on Climate Change, an international agreement aimed at stabilizing GHG concentrations in the atmosphere "at a level that would prevent dangerous anthropogenic interference with the climate system." Since 1992, a growing body of scientific analysis and climatological evidence has continued to lend weight to these concerns.

Over the past decade, a number of states have undertaken their own policy responses to climate change. In 2001, the six New England states joined with the five Eastern Canadian provinces[2] to sign a regional climate action plan, under which the jurisdictions pledge to stabilize their cumulative GHG emissions at 1990 levels by 2010, and then to reduce them 10 percent below 1990 levels by 2020, with further emissions reductions in subsequent decades. The Action Plan recognizes that stabilizing atmospheric GHG concentrations at levels that do not pose a threat to the global climate is likely to require long-term emissions reductions of roughly 75-85% below current levels.

B. Purpose of Greenhouse Gas Inventories

Developing information on GHG emissions sources is a necessary first step in shaping options and strategies for reducing emissions. A standard GHG inventory identifies major sources of GHG emissions, and calculates emissions by sector (e.g., energy, agriculture, waste); by source within each sector (e.g., electricity generation, vehicle fuel combustion, manure management); and by gas (e.g., carbon dioxide, methane, nitrous oxide). Six greenhouse gases are typically included in current GHG emissions inventories:

- carbon dioxide (CO_2);
- methane (CH_4);

[1] The joint commitment to a regional climate action plan was undertaken by the Conference of New England Governors and Eastern Canadian Premiers (NEG/ECP). The NEG/ECP climate change action plan can be accessed online at http://www.cmp.ca/res/ccape.pdf.

[2] Nova Scotia, Newfoundland and Labrador, New Brunswick, Prince Edward Island, and Quebec.

- nitrous oxide (N_2O);
- hydrofluorocarbons (HFCs);
- perflourocarbons (PFCs); and
- sulfur hexafluoride (SF_6).

Emissions of gases other than carbon dioxide, the chief anthropogenic greenhouse gas, are converted into units of CO_2 equivalent by multiplying their weight by an index number representing each gas's "global warming potential" (GWP), or estimated climate impact over a specified period of time expressed as an equivalent release of CO_2. Total emissions are presented in either short tons or metric tonnes of CO_2 equivalent. For example, one ton of methane released to the atmosphere has 21 times greater global warming impact over 100 years than a ton of CO_2, so the GWP of methane is 21 tons, and one ton of methane would be treated in an inventory as 21 tons of CO_2 equivalent.

GHG inventories are typically conducted in a "top-down" process in which emissions are calculated based on total national or statewide measurements of GHG-producing activities, such as quantities of fossil fuels combusted or tons of municipal solid waste disposed in landfills. Governments can also analyze their GHG emissions profiles by developing registries in which individual sources, such as corporations or government agencies, record their estimated GHG emissions. With sufficient participation, this "bottom-up" approach can help a jurisdiction begin to approximate its total GHG emissions based on reports from many individual emitters, and including more fine detail from these emitters than would be possible in a top-down inventory. The NEG/ECP Action Plan calls for developing both regular GHG inventories and a GHG registry to measure and track regional GHG emissions.

GHG emissions inventories are important in helping jurisdictions such as the New England states and Eastern Canadian provinces to understand their relative contributions to climate change. With accurate inventories, jurisdictions can compare their emission profiles with national averages and with other states and provinces in terms of GHG production across various economic sectors, and relative to gross domestic product (i.e., how carbon-intensive their economies are). Inventories also enable governments to identify promising areas for GHG emission reductions. A single-year inventory can serve as a baseline from which reductions are measured: the NEG/ECP Climate Change Action Plan identifies 1990 as the baseline year, so states and provinces need accurate estimates of their 1990 emissions as starting points for setting targets and measuring emission reductions. Time series inventories of GHG emissions over a number of years are more useful, since they allow states to track and project emission trends, rather than planning from single-point estimates. This is especially important for analyzing sectors that are experiencing major structural changes (for example, fuel switching in the electric power sector) or where governments have adopted policies with the specific goal of reducing emissions.

Recognizing these benefits, Action Item 1 of the NEG/ECP Climate Change Action Plan calls for establishing a regional standardized GHG emissions inventory, beginning with 1990 emissions and updated at three-year intervals. As the Plan states, "A full understanding of the present circumstances and a complete assessment of opportunities for action, in all sectors of the economy, are essential for states and provinces to address climate change issues effectively."

C. Current Status of State and Provincial GHG Inventories

Developing standardized regional GHG inventories as called for in the NEG/ECP Action Plan will require improvements in regional capacity to estimate GHG emissions, mainly on the U.S. side. As parties to the 1992 Framework Convention on Climate Change, both the United States and Canada produce regular national GHG inventories which are developed according to international guidance. Environment Canada, which develops the Canadian national inventory, also produces emissions estimates at the provincial level, so the Eastern Canadian provinces have current information on their estimated GHG emissions.[3] However, the U.S. Environmental Protection Agency (EPA) does not produce similar state-level estimates for the U.S., so this task rests with state environmental agencies.

During the 1990s, each of the New England states produced a GHG emissions inventory for one or two years, funded by grants from EPA. States covered two years at most because the process of developing GHG inventories was highly labor-intensive, requiring hundreds of individual calculations and data inputs from a wide range of sources. Moreover, because these inventories were produced at different times throughout the decade according to changing guidance from EPA, they used varying methods and conversion factors in their calculations. As a result, the initial New England state inventories are dated in terms of methodology and are not directly comparable even when they estimate emissions for the same year.

In early 2003, however, EPA released an Excel-based software package, called the State GHG Inventory Tool, which incorporates current emissions estimation methods and includes default data from federal sources for each of the 50 states from 1990 through 2000. In addition to incorporating current methodologies, the Tool eliminates the time-intensive requirement to collect data from scratch and hand-calculate emissions source by source. The software can be run using the default state data that EPA has provided, or alternatively, states can modify data in any sector for which they have more accurate information. In many areas, state-level data may be more reflective of trends in an individual state (e.g., a recent change in solid waste management policy or growth in a high-GHG-emitting industry) than data from national sources.

NESCAUM recently completed an updated 1990-2000 GHG emissions inventory for the state of Connecticut using the EPA software and incorporating data from the state or other sources for several sectors. For the regional inventory estimates in this report, NESCAUM used the Inventory Tool with default inputs to generate emissions estimates for the remaining New England states.[4] These estimates were added to Environment Canada's published GHG emissions inventories for the Eastern Canadian provinces to produce the regional totals discussed below.

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[3] Environment Canada's provincial inventories are online in summary table form at http://www.ec.gc.ca/pdb/ghg/ghg_tables_2001_e.cfm. Additionally, the province of Quebec produces its own GHG emissions inventories, which are generally quite similar to Environment Canada's estimates of provincial emissions; Quebec's inventory is available online at http://www.menv.gouv.qc.ca/air/changement/ges-en/index.htm. For consistency, however, Environment Canada's emissions estimates for all five eastern Canadian provinces were used in this report.

[4] NESCAUM adjusted inputs in one sector for these state estimates: fossil fuel consumption for electric power generation. Data sources and methods are discussed in Appendix B.

It should be noted that all inventories contain some level of inherent uncertainty, which varies depending on factors such as:

- Quality and availability of input data;
- Precision of the estimation methods and emission factors (e.g., carbon content of various fuels) that are used; and
- Scientific understanding of how various GHGs contribute to climate change.

As a result, GHG inventory values should be viewed as estimates, not as absolute measurements. Because the state emission estimates for this report (other than those for Connecticut) were generated largely with default data, they represent reasonable approximations that can be refined further for some sectors. Developing more detailed GHG emissions inventories for the New England states over the next several years, using common methodologies and uniform practices for all states, will help make it possible to produce unified inventories that accurately reflect GHG emission trends across the NEG/ECP region.

II. NEG/ECP Greenhouse Gas Emissions, 1990-2000

A. Total Emissions

As illustrated in Figure I-1, total GHG emissions for the NEG/ECP region rose from 332 million metric tons of CO_2 equivalent ($MMTCO_2E$) in 1990 to 367 $MMTCO_2E$ in 2000, an increase of 10.5 percent.[5] Within the NEG/ECP region, the New England states accounted for about 61 percent of annual regional emissions and the Eastern Canadian provinces for about 39 percent throughout the decade. This split is partly a function of population: in 2000, the NEG/ECP region had a population of approximately 23.7 million, with 59 percent of that total (13.9 million) in the New England states and 41 percent (9.8 million) in the Eastern Canadian provinces. However, as discussed below, many other factors influence the relative contributions of various jurisdictions to regional emissions in each major sector.

Total NEG/ECP regional emissions in 2000 were greater than those of all but ten industrialized countries reporting under the Framework Convention on Climate Change, and nearly equal to the national totals reported for 2000 by Poland and by Spain.[6] NEG/ECP emissions were 37 percent greater than the total emissions reported by the Scandinavian countries (Norway, Sweden, Finland, and Denmark). New England's emissions were slightly higher than those of the Netherlands, while the Eastern Canadian provinces' emissions were nearly equivalent to those reported by the Czech Republic.

The NEG/ECP region is less carbon-intensive than either the United States or Canada as a whole, and while its GHG emissions are increasing, they are growing more slowly than total U.S. and Canadian emissions. Total U.S. GHG emissions increased by 14.8 percent from 1990 through 2000, while Canadian national emissions rose by 20.1 percent. Residents of the NEG/ECP region generated an average of 15.5 metric tons of CO_2 equivalent (CO_2E) per person in 2000, compared to the U.S. national average of 25 metric tons of CO_2E per person and the Canadian national average of 23.7 metric tons of CO_2E per person. Within the region, the states were slightly more carbon-intensive than the provinces, generating per capita emissions of 16.11 metric tons CO_2E per person on the U.S. side in 2000 versus 14.64 metric tons CO_2E on the Canadian side.

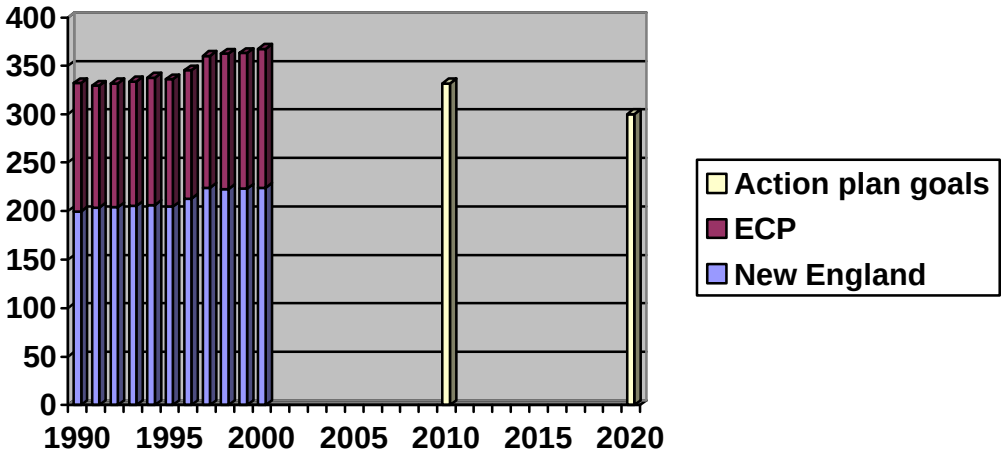
To meet the targets in the NEG/ECP Climate Change Action Plan, the region’s states and provinces will have to make significant additional cuts in GHG emissions. Stabilizing regional emissions at the 1990 level of 332 $MMTCO_2E$ by 2010 would require a reduction of 9.5 percent from the region's year 2000 emissions, while reducing emissions ten percent below that level by 2020 would require a cut of roughly 18 percent between 2000 and 2020. U.S. and Canadian national GHG emissions fell slightly from 2000 to 2001 (the most recent year for which national inventories have been completed), but this was only the second time since 1990 that either country's emissions had decreased from the prior year's level, and the declines were mainly due to reduced economic growth and low fossil fuel consumption as a result of unusually mild weather. In sum, absent significant actions by the states and provinces, GHG emissions in the NEG/ECP region are likely to continue rising.

[5] See Appendix B for yearly totals.
[6] See Appendix C for national totals.

Figure I-1

Total NEG/ECP regional GHG emissions, 1990-2000

(million metric tons CO_2 equivalent)



This initial regional inventory omits emissions from several sectors that are included in U.S. and Canadian national inventories:

- The amount of CO_2 sequestered (stored) through land use change and forestry activities is not estimated here because Canadian national inventories do not provide provincial figures for this sector or count it as part of total national emissions. Existing inventories for the Eastern Canadian provinces do include non-CO_2 emissions from prescribed burns and wildfires in wood production forests; these generally represent a fraction of a percent of total provincial emissions. Figures used in this report for New England state emissions represent gross (as opposed to net) emissions, i.e. they do not factor in sequestration through land use change and forestry.[7]
- U.S. national inventories do not provide state-level estimates for solvent use, and EPA's State GHG Inventory Tool does not cover this category. Estimates of solvent use in the Canadian provinces (which generally accounts for 0.1 percent or less of total provincial emissions) are included in the total emissions numbers presented in figure I-1 but are not treated further in this report.

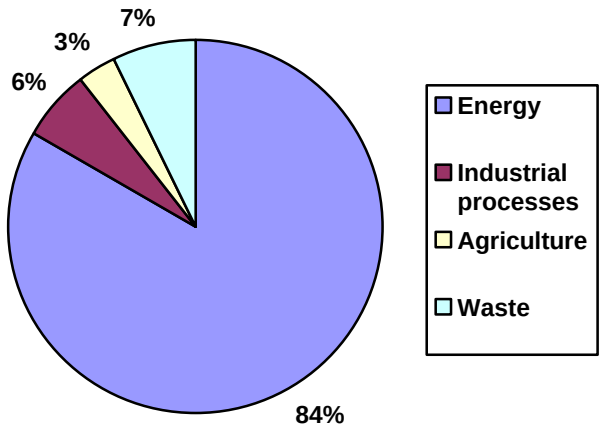
[7] The land use change and forestry (LUCF) sector is a net sink for Canada nationally and for most of the New England states, i.e., it stores more carbon dioxide than it emits. Following international guidance, Canada does not include LUCF in its national inventory totals. However, under the Kyoto Protocol (which Canada has ratified), sources and sinks from some LUCF activities may be included and accounted for separately during the first commitment period under the Protocol (2008-2012). The EPA State GHG Inventory Tool provides rough estimates of CO_2 emissions and sequestration from LUCF; EPA plans to update this software after agreement is reached on new methodologies at the international level.

- Canadian national inventories estimate HFC and PFC emissions at the national level but do not provide provincial subtotals (except for PFC emissions from aluminum production), whereas EPA's State GHG Inventory Tool estimates state HFC and PFC emissions. Estimates of emissions from industrial production processes in this report therefore are somewhat low because they do not include provincial HFC and PFC emissions.

Figure I-2 describes the breakdown of NEG/ECP emissions in 2000 by major sector. Energy activities (including fossil fuel combustion and oil and gas production) account for the great majority of regional GHG emissions (84 percent), followed in descending order by waste management, industrial processes and agriculture.

Figure I-2

NEG/ECP Regional GHG emissions in 2000 by Major Sector



When the states and provinces are compared, there is some divergence in the relative contributions from various sectors to regional emissions. As shown in Figures I-III and I-IV, energy and waste emissions play a more dominant role in the New England states, while in the Eastern Canadian provinces, contributions from agriculture and industrial production processes are relatively larger.

Figure I-3

New England Regional GHG emissions in 2000 by Major Sector

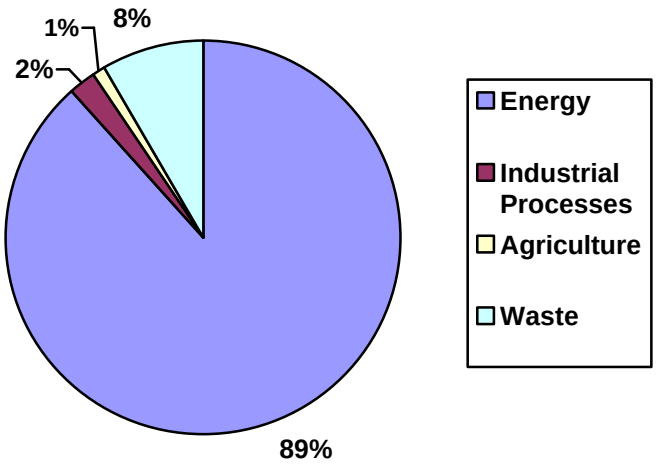


Figure I-4

Eastern Canadian Regional GHG emissions in 2000 by Major Sector

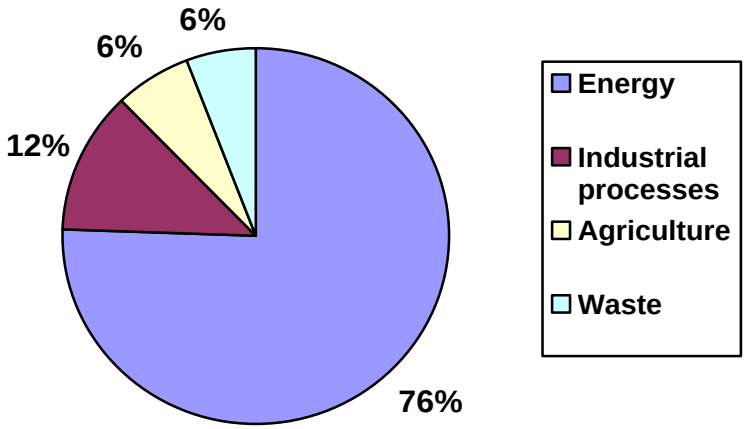
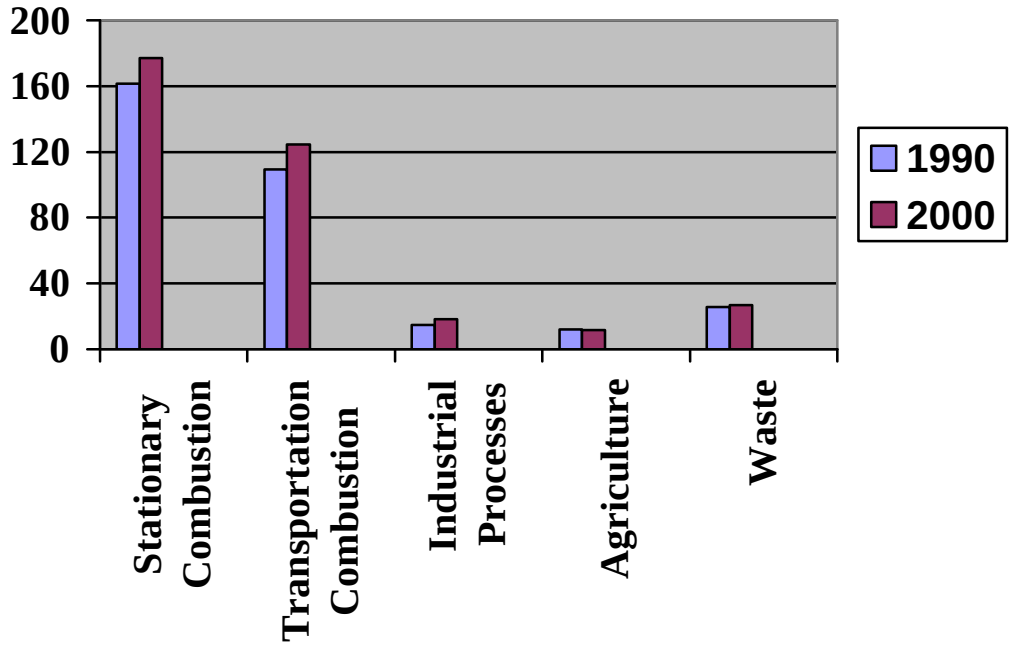


Figure I-5 illustrates the change in total NEG/ECP emissions from various sectors between 1990 and 2000. As discussed further below, stationary combustion and transportation combustion are the two major sub-categories of energy activities.

Figure I-5

NEG/ECP Greenhouse Gas Emissions by Sector, 1990 and 2000

(million metric tons CO_2 equivalent)



B. Energy Emissions

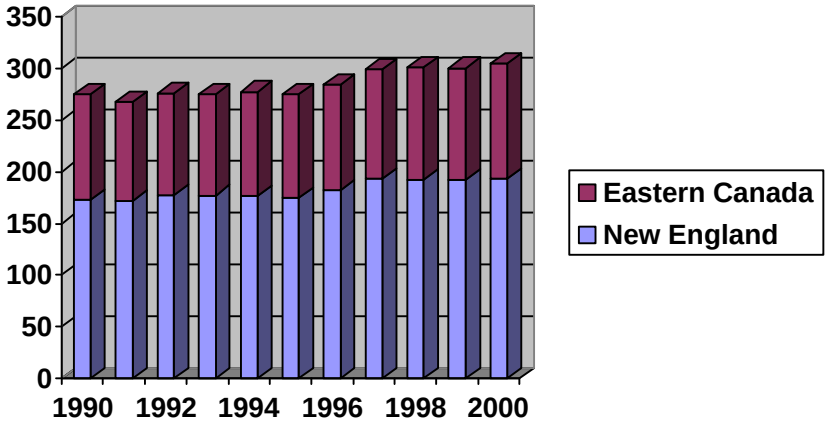
B.1 Total Energy Emissions

The greenhouse gases produced by energy-related activities include carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O). As illustrated in Figure I-6, energy-related GHG emissions in the NEG/ECP region increased from 274 $MMTCO_2E$ in 1990 to 305 $MMTCO_2E$ in 2000, a rise of 11.3 percent. The New England states accounted for approximately 64 percent of the region's annual GHG emissions from energy activities; the Canadian provinces accounted for about 36 percent. A major factor in the provinces' relatively low energy-related GHG emissions is that Quebec, the largest of the Eastern Canadian provinces, generates about 94 percent of its electricity from hydropower.

Figure I-6

GHG Emissions from Energy Activities

(million metric tons CO_2 equivalent)



Energy-related activities included in state and provincial GHG emissions inventories fall into three major categories:

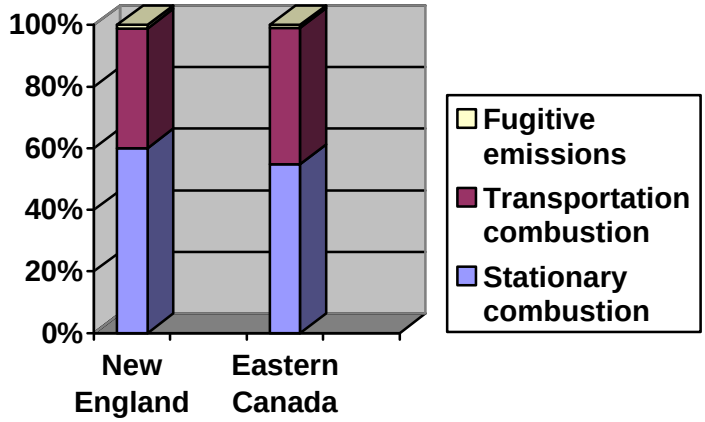
- stationary combustion (burning fossil and biomass fuels in electric power plants, factories, and residential, commercial and institutional buildings);
- transportation combustion (burning fossil fuels in all forms of vehicles, from light-duty automobiles to trains and airplanes), as well as small quantities of natural gas used as pipeline fuel; and
- fugitive emissions (leakage) from coal mining and oil and gas production and distribution.

Figure I-7 illustrates the relative contribution from each of these categories to New England and Eastern Canadian GHG emissions from energy activities in 2000.

Figure I-7

GHG Emissions from Energy Activities, 2000

(million metric tons CO_2 equivalent)



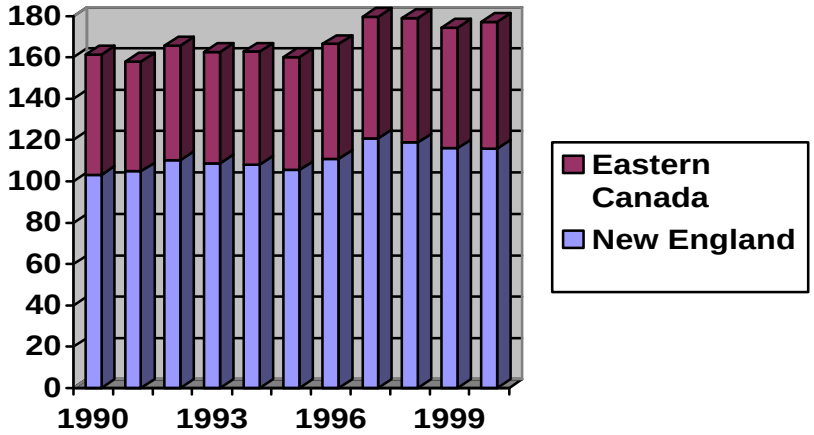
B.2 Stationary Combustion Emissions

As illustrated in Figure I-5 above, stationary combustion is the single largest source of GHG emissions in the NEG/ECP region. GHG emissions from fuel combustion in stationary sources increased from 161 $MMTCO_2E$ in 1990 to 177 $MMTCO_2E$ in 2000, a rise of about 10 percent. The New England states produced roughly two-thirds of regional emissions each year throughout the decade, reflecting their relatively higher dependence on fossil fuel for electricity production.

Figure I-8

NEG/ECP Stationary Combustion GHG Emissions, 1990-2000

(million metric tons CO_2 equivalent)



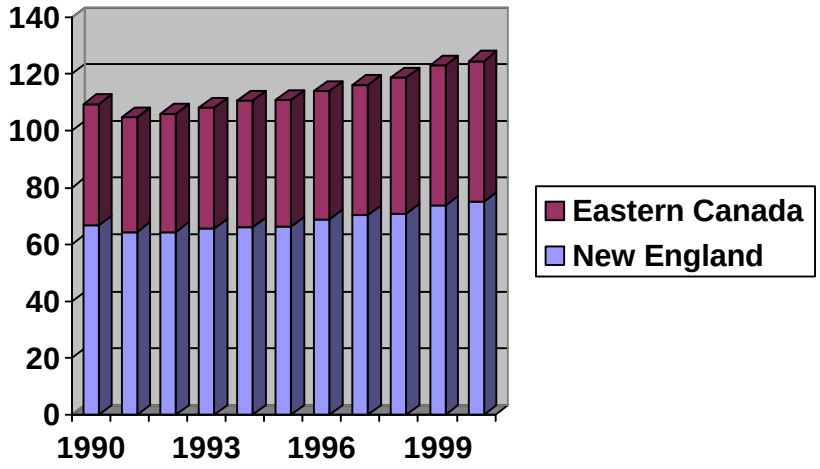
B.3 Transportation Combustion Emissions

GHG emissions from transportation combustion in the NEG/ECP region rose from 109 $MMTCO_2E$ in 1990 to 124 $MMTCO_2E$ between 1990 and 2000, an increase of about 13.7 percent. Emissions in this subsector are more equally balanced between the states and provinces. In contrast to stationary combustion emissions, transportation combustion emissions rose by a larger percentage on the Canadian side than in New England during the 1990s. Transportation combustion emissions are presented in Figure I-9.

Figure I-9

NEG/ECP Transportation Combustion GHG Emissions, 1990-2000

(million metric tons CO_2 equivalent)



C. Industrial Process Emissions

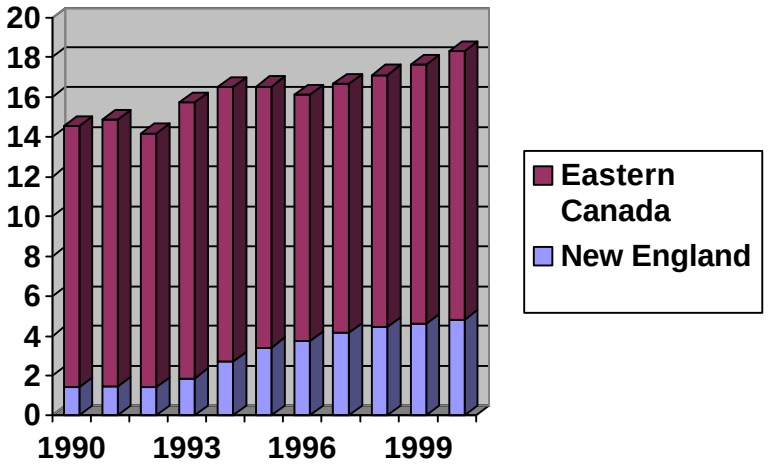
NEG/ECP regional emissions from industrial production processes rose from approximately 14.5 $MMTCO_2E$ in 1990 to 18.3 $MMTCO_2E$ in 2000, an increase of about 19 percent. This category includes a range of industrial activities, from cement production to semiconductor manufacture. GHG emissions from industrial processes include CO_2, HFCs, PFCs and SF_6. As noted above, Canadian HFC and PFC emissions are reported only at the national level, so these figures somewhat underestimate provincial emissions relative to those of the states. Figure I-10 presents estimated GHG emissions from industrial processes.

Emissions in this sector are dominated by the province of Quebec, which is the only NEG/ECP jurisdiction that is home to high-emitting industries such as aluminum, magnesium and adipic acid production. Quebec accounted for nearly all of the region's industrial process emissions at the start of the 1990s, with its share falling to just under 75 percent by 2000 as the states increased their consumption of HFCs and PFCs.

Figure I-10

NEG/ECP Industrial Process GHG Emissions, 1990-2000

(million metric tons CO_2 equivalent)



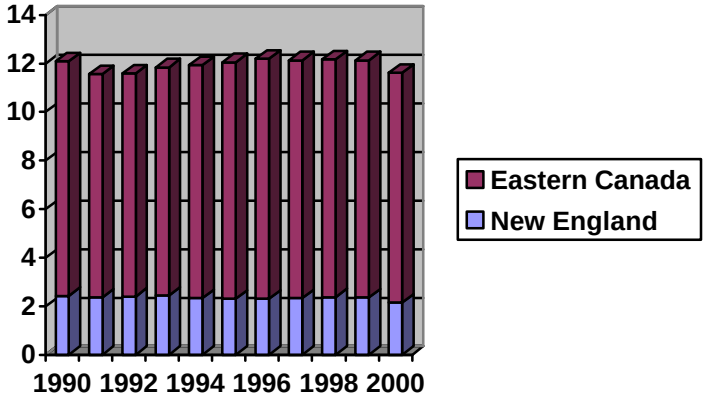
D. Agriculture emissions

Regional GHG emissions from agriculture remained essentially flat through the 1990s, ranging between 11.6 and 12.2 $MMTCO_2E$. Agricultural activities that produce GHG emissions include enteric fermentation (digestion by ruminant animals), manure management and fertilizer use. These activities produce CH_4 and N_2O. Provincial agriculture emissions were roughly four times those of the states each year, with Quebec accounting for the great majority. Figure I-11 depicts NEG/ECP agricultural emissions from 1990-2000.

Figure I-11

NEG/ECP Agriculture GHG Emissions, 1990-2000

(million metric tons CO_2 equivalent)



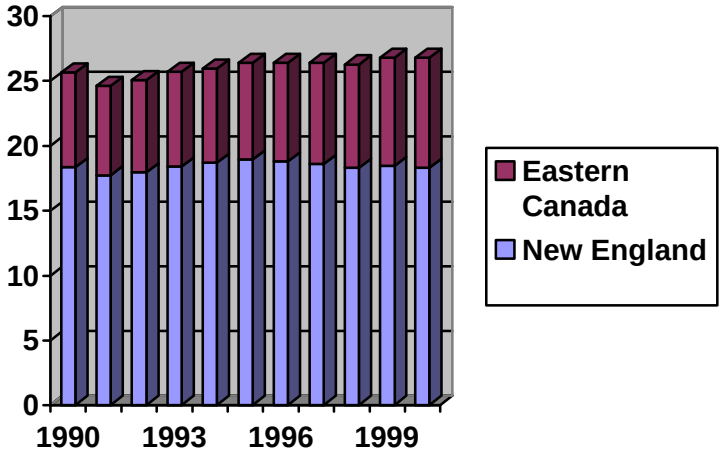
E. Waste emissions

GHG emissions from waste increased only slightly in the NEG/ECP region between 1990 and 2000, from 25 $MMTCO_2E$ in 1990 to nearly 27 $MMTCO_2E$ in 2000, or about 4.3 percent. These figures include emissions from disposing of municipal solid waste either in landfills, which produces CH_4, or through combustion in incinerators or waste-to-energy plants, which produces CO_2 and N_2O. It also includes municipal wastewater treatment, which produces N_2O and CH_4. New England accounted for roughly 70 percent of annual regional GHG emissions in this sector throughout the decade. Figure I-12 presents GHG emissions from waste management.

Figure I-12

NEG/ECP Waste GHG Emissions, 1990-2000

(million metric tons CO_2 equivalent)



Appendix A
Sectoral Comparison for State and Provincial GHG Inventories

As parties to the Framework Convention on Climate Change, both Canada and the United States follow guidance from the Intergovernmental Panel on Climate Change (IPCC) in developing their national GHG inventories. However, there are modest differences between the U.S. and Canadian activities that are included in certain sectors of this inventory. There are several reasons for these differences.

First, Environment Canada counts emissions from industrial use of fossil fuels for non-energy purposes (i.e., activities in which the fuel is not combusted, such as using asphalt to build roads) as part of industrial process emissions, whereas the EPA State Inventory Tool includes these uses in the category of energy activities. As a result, total NEG/ECP emissions are not affected, but comparisons of U.S. and Canadian emissions in the relevant sectors are slightly skewed.

Second, Environment Canada estimates emissions from consumption of HFCs and PFCs at the national level, but does not break this sum down into provincial totals, so those emissions are not included in this regional inventory. As a result, estimated total NEG/ECP emissions and industrial process emissions from the Eastern Canadian provinces in this report are slightly low. Conversely, Environment Canada's GHG inventories for the provinces include non-CO_2 emissions in the land use change and forestry sector (emissions from prescribed burns and wildfires in wood production forests), which are not addressed in the state inventories.

Finally, some activities occur in one part of the NEG/ECP region but not another; for example, there is no coal mining or oil and gas production in New England, and only Quebec has high-GHG-emitting industries such as aluminum production. This divergence does not affect the accuracy of estimates in this report, but may explain what appear to be disproportionately high state or provincial emissions in some sectors.

The following comparison illustrates where reporting procedures differ between Environment Canada's provincial emissions estimates and the State GHG Inventory Tool, and identifies activities that take place only in either the United States or Canada. It is intended to illustrate the major degree of commonality between state and provincial GHG emissions estimates, and to identify areas where the states and provinces may wish to work together to reduce existing variances in GHG emissions reporting.

Sector	U.S.	Canada – Provincial Summary Tables
Energy		
A. Stationary sources	-- CO_2 from fossil fuel combustion in residential, commercial, industrial, and electric power sectors	-- CO_2 from fossil fuel combustion in residential, commercial, industrial, and electric power sectors

	-- CH_4 and N_2O from fossil fuel and biomass combustion in residential, commercial, industrial, and electric power sectors -- CO_2 emissions from non-energy consumption of fossil fuels (e.g., asphalt and road oil) -- No oil or gas production in New England	-- CH_4 and N_2O from fossil fuel and biomass combustion in residential, commercial, industrial, and electric power sectors -- CO_2 from fossil fuel combustion in the oil and gas industry
B. Mobile sources	-- CO_2 from fossil fuel combustion in the transportation sector -- CH_4 and N_2O from fossil fuel combustion in the transportation sector -- Pipeline fuel (included in total estimates of state fossil fuel consumption) -- No estimates of international bunker fuel use in NESCAUM estimates for this report, but states can use State Inventory Tool to determine intl. bunker fuel use with appropriate data	-- CO_2 from fossil fuel combustion in the transportation sector -- CH_4 and N_2O from fossil fuel combustion in the transportation sector -- Pipeline fuel -- International bunker fuel (fuel sales to foreign-registered carriers) excluded from national inventory totals, but not factored into provincial estimates
C. Fugitive sources	-- Coal mining; oil and gas production, processing, storage, distribution (natural gas distribution is the only applicable activity in New England)	-- Coal mining; oil and gas production, processing, storage, distribution
Industrial processes	-- Cement and lime production; limestone and soda ash use; nitric acid and adipic acid production; iron, steel, aluminum, and magnesium production -- Semiconductor manufacture; HFC and PFC	-- Cement and lime production; nitric acid and adipic acid production; iron, steel, aluminum, and magnesium production -- Emissions from HFCs, PFCs, limestone use and soda ash use reported at

	substitution for ozone-depleting substances; SF_6 use for electric power transmissions	national level -- CO_2 emissions from non-energy consumption of fossil fuels (e.g., asphalt and road oil)
Agriculture	-- Enteric fermentation -- Manure management -- Agricultural soil	-- Enteric fermentation -- Manure management -- Agricultural soil
Waste	-- Municipal solid waste -- Wastewater treatment	-- Municipal solid waste and wood waste landfills -- Wastewater treatment -- Waste incineration
Land use change and forestry	-- State estimates not included in this report, but State Inventory Tool can be used to estimate CO_2 emissions/sequestration from this sector -- State Inventory Tool does not address non-CO_2 emissions from this sector	-- Non-CO2 emissions from prescribed burns and wildfires in the wood production forest[8] included in provincial inventories -- CO_2 emissions/ sequestration from this sector estimated nationally but not included in national inventory totals

[8] Canada's wood production forest is that portion of the timber productive forest that is non-reserved and accessible.

Appendix B
Data by Year and Sources

GHG emissions estimates used in this report were derived from two sources:

- New England estimates were developed for each state by NESCAUM using the State GHG Inventory Tool, a software package developed by the U.S. Environmental Protection Agency (EPA). Figures for Connecticut were taken from an inventory produced by NESCAUM for the state in August 2003. For the other states, NESCAUM used the EPA software to estimate state emissions, relying on the default values and estimation methods provided in the software, with one exception: data on state consumption of fossil fuels for electric power generation was derived from the Electric Power Annual 2001 spreadsheets on state fossil fuel consumption, in order to account for fuel use by nonutility power producers and combined heat and power facilities.[9]
- Provincial figures were obtained from Environment Canada's provincial GHG emissions tables for 1990-2001.[10]

Tables 1 through 7 on the following pages present the estimated regional emissions produced by adding these state and provincial figures, with all inputs rounded to two decimal places. All estimates are in million metric tons of CO_2 equivalent.

[9] Online at http://www.eia.doe.gov/cneaf/electricity/epa/epa_sprdshts.html.
[10] Online at http://www.ec.gc.ca/pdb/ghg/ghg_tables_2001_e.cfm.

Table 1[11]

Total NEG/ECP Regional GHG Emissions, 1990-2000

(million metric tons CO_2 equivalent)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
New England	199.88	203.66	204.24	205.41	206.31	204.84	212.88	224.28	222.81	223.32	224.01
Eastern Canada	132.70	126.14	127.75	128.45	131.42	131.40	132.63	135.96	139.69	139.89	143.51
TOTAL	332.58	329.8	331.99	333.86	337.73	336.24	345.51	360.24	362.5	363.21	367.52

Table 2

NEG/ECP Energy GHG Emissions, 1990-2000

(million metric tons CO_2 equivalent)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
New England	172.38	171.83	177.15	176.83	176.71	174.33	182.18	193.28	191.83	192.03	192.87
Eastern Canada	102.26	95.31	98.49	97.89	100.53	100.30	101.71	105.55	109.00	108.37	111.98
TOTAL	274.64	267.14	275.64	274.72	277.24	274.63	283.89	298.83	300.83	300.4	304.85

Table 3

NEG/ECP Stationary Combustion GHG Emissions, 1990-2000

(million metric tons CO_2 equivalent)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
New England	103.29	104.86	110.36	108.60	108.11	105.48	110.79	120.83	118.74	115.96	115.78
Eastern Canada	58.06	53.10	55.34	53.88	54.53	54.55	55.58	58.69	60.28	58.33	61.45
TOTAL	161.35	157.96	165.7	162.48	162.64	160.03	166.37	179.52	179.02	174.29	177.23

[11] Because inputs were rounded to two decimal places, values reported here for the Eastern Canadian provinces may differ slightly from Environment Canada estimates.

Table 4

NEG/ECP Transportation Combustion GHG Emissions, 1990-2000

(million metric tons CO_2 equivalent)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
New England	66.54	64.38	64.42	65.70	66.03	66.33	68.87	70.32	70.81	73.81	74.96
Eastern Canada	42.82	40.48	41.58	42.56	44.58	44.56	44.95	45.77	47.75	49.18	49.62
TOTAL	109.36	104.86	106.00	108.26	110.61	110.89	113.82	116.09	118.56	122.99	124.58

Table 5

NEG/ECP Industrial Process GHG Emissions, 1990-2000

(million metric tons CO_2 equivalent)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
New England	1.41	1.47	1.40	1.87	2.71	3.41	3.73	4.17	4.46	4.60	4.82
Eastern Canada	13.13	13.40	12.77	13.86	13.80	13.13	12.41	12.49	12.65	13.03	13.48
TOTAL	14.54	14.87	14.17	15.73	16.51	16.54	16.14	16.66	17.11	17.63	18.30

Table 6

NEG/ECP Agriculture GHG Emissions, 1990-2000

(million metric tons CO_2 equivalent)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
New England	2.43	2.37	2.40	2.45	2.34	2.31	2.31	2.34	2.38	2.36	2.15
Eastern Canada	9.66	9.20	9.20	9.39	9.6	9.74	9.89	9.79	9.79	9.77	9.47
TOTAL	12.09	11.57	11.60	11.84	11.94	12.05	12.20	12.13	12.17	12.13	11.62

Table 7

NEG/ECP Waste GHG Emissions, 1990-2000

(million metric tons CO_2 equivalent)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
New England	**18.36**	**17.75**	**17.98**	**18.41**	**18.71**	**18.96**	**18.81**	**18.62**	**18.32**	**18.47**	**18.30**
Eastern Canada	**7.30**	**6.87**	**7.10**	**7.30**	**7.25**	**7.45**	**7.60**	**7.78**	**7.96**	**8.34**	**8.51**
TOTAL	**25.66**	**24.62**	**25.08**	**25.71**	**25.96**	**26.41**	**26.41**	**26.4**	**26.28**	**26.81**	**26.81**

Appendix C
Reported Greenhouse Gas Emissions from Annex I Countries, 2000 (million metric tons CO_2 equivalent)[12]

Nation	Emissions
United States	7,001.2[13]
Japan	1,386.3
Germany	991.4
Canada	726.3[14]
United Kingdom	649.1
France	550.0
Italy	546.9
Australia	500.9
Poland	386.2
Spain	386.0
[NEG/ECP region]*	367.5
[New England]*	224.0
Netherlands	216.9
Belgium	152.4
Czech Republic	147.7
[Eastern Canada]*	143.5
Greece	130.1
Portugal	84.7
Hungary	84.3
Austria	79.8
New Zealand	77.0
Finland	74.0
Sweden	69.4
Denmark	68.5
Ireland	67.0
Norway	55.3
Switzerland	52.7
Slovakia	49.2

*As estimated for this report

[12] United Nations Framework Convention on Climate Change, Greenhouse Gas Inventory Database, online at http://ghg.unfccc.int/.
[13] The United States revised this figure in its 2003 data series to 7,047.4 MMTCO2E.
[14] Canada revised this figure in its 2003 data series to 730 $MMTCO_2E$