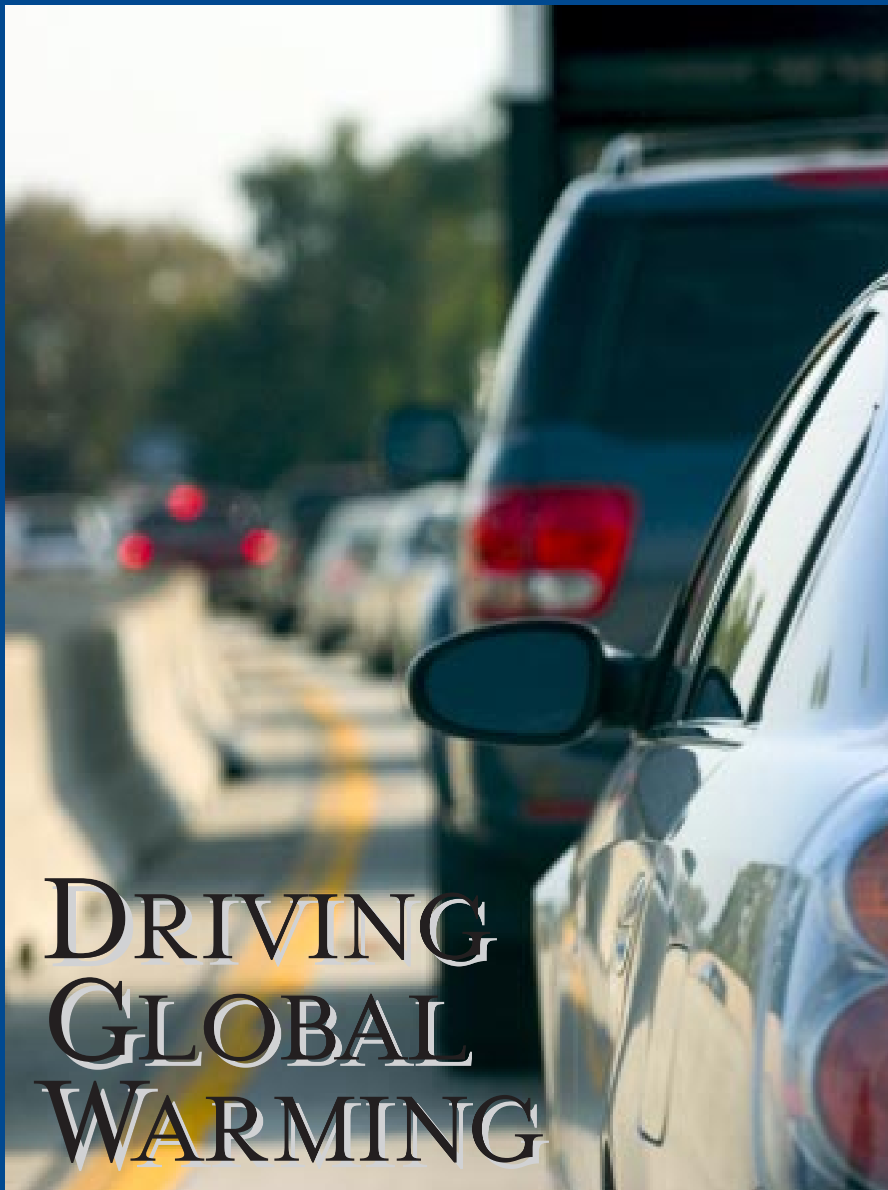

DRIVING GLOBAL WARMING

Commuting in New Hampshire and its Contribution to Global Warming

NHPIRG EDUCATION FUND

CLEAN WATER FUND

January 2006

Driving Global Warming

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With Contributions from the New England Climate Coalition Steering Committee

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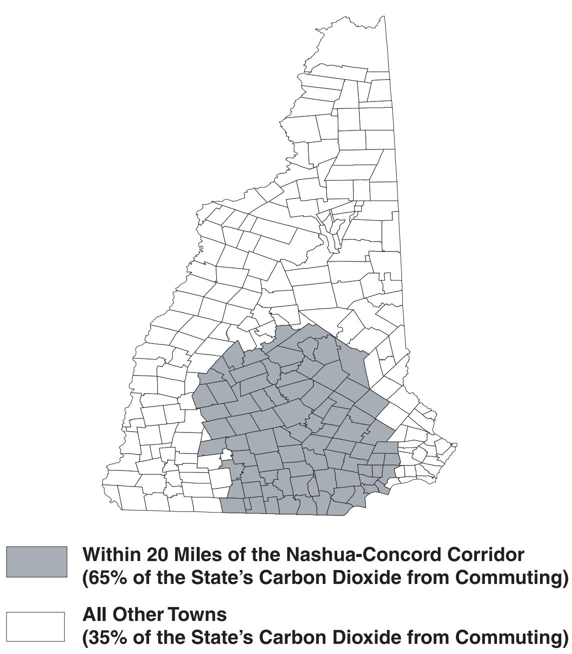
Executive Summary

Transportation is the leading source of global warming pollution in New Hampshire and the trips state residents make to and from work are a major part of the problem. Commuting is directly responsible for 7 to 9 percent of the state's carbon dioxide emissions and commuting-related decisions – such as where to live and where to work – influence other transportation choices as well. To reduce global warming pollution from cars and trucks, to meet the state's climate protection goals, and to prevent the potentially severe impacts of global warming, New Hampshire must find ways to reduce the global warming impact of commuting.

In order to find the right policy options for confronting global warming pollution from commuting, it is necessary to know who is commuting where and by what mode of transportation. A review of data collected by the U.S. Census Bureau identifies which towns in the state are responsible for the greatest amount of commuting-related emissions of carbon dioxide (the leading cause of global warming) and suggests ways that the state can effectively reduce emissions.

Figure ES-1. Southern New Hampshire Residents Generate Most of State's Carbon Dioxide Pollution
(by Town of Residence)



The bulk of New Hampshire's commuting-related carbon dioxide emissions come from residents of the Concord-Manchester-Nashua corridor of southern New Hampshire.

- Commuters living within 20 miles of the Concord-Nashua corridor produced nearly two-thirds of the state's commuting-related emissions. (See Figure ES-1.) Per commuter, residents of this corridor were responsible for 6 percent higher emissions than residents of other parts of New Hampshire.

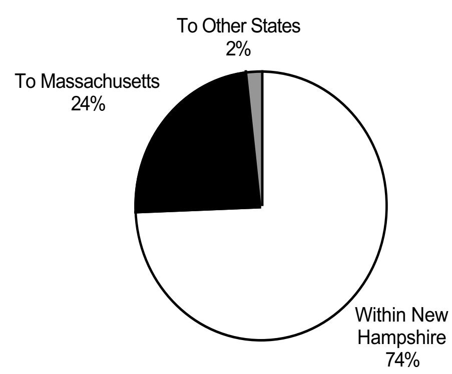
Massachusetts-bound commuters produced about one-quarter of the carbon dioxide emissions from all New Hampshire commuters. (See Figure ES-2.)

- About 13 percent of New Hampshire commuters travel to Massachusetts – more than to any other state. The average Massachusetts-bound commuter produces two to three times as much carbon dioxide as a commuter traveling within New Hampshire.

Commuters living in several small towns in eastern New Hampshire produce the state's highest levels of per-commuter emissions – with emissions three to seven times greater than those of workers living in the state's lowest emission towns. (See Figure ES-3.)

- The towns with the highest levels of per-commuter emissions generally have the longest commutes. The average commute from Wakefield, New Durham and Northwood is between 15 and 20 miles long while the average commute from Gorham, Lebanon and Hanover is between 5 and 6 miles long.

Figure ES-2. Carbon Dioxide Emissions from Commutes to Various States



The explosion of "exurban" residential development and the growing number of "stretch commutes" pose major challenges to the state's efforts to reduce global warming emissions.

- Sprawling exurban development decreases population density and dramatically increases the length of commuting trips. This is a worrisome trend given that the 5 percent of New Hampshire commuters who travel at least 30 miles to work produce a disproportionately large share – around 19 percent – of the state's commuting-related carbon dioxide emissions.

Shifting more commuting away from drive-alone trips, developing increased transit alternatives, and fostering pedestrian commuting and telecommuting can significantly reduce carbon dioxide emissions from transportation.

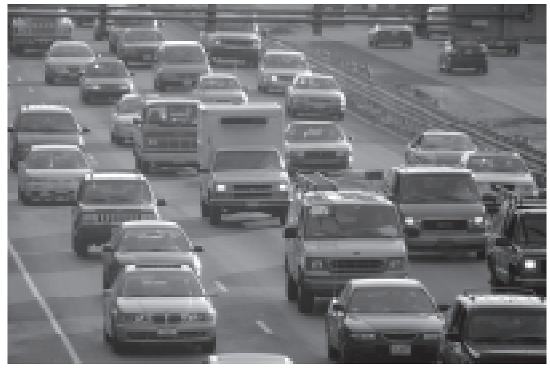
- Regardless of their location within the state, towns with low reliance on drive-alone trips tend to have lower per-worker emissions of carbon dioxide from commuting.

New Hampshire should take a series of immediate and long-term actions to reduce global warming emissions from commuting. Among other actions, the state should:

- Adopt vehicle emission standards for pollutants that cause global warming and adopt other measures to encourage the purchase of vehicles that produce less carbon dioxide per mile traveled.

- Further integrate the state into the regional transit network by developing regional rail service in New Hampshire. The proposed rail expansion from Lowell, Massachusetts to Nashua is an excellent first step. However, long-term transportation and global warming reduction plans should also include the expansion of regional rail north to Manchester and Concord.

- Encourage carpooling, vanpooling and other programs that reduce the number of drive-alone commutes, while discouraging highway expansion projects that encourage single-passenger commuting.



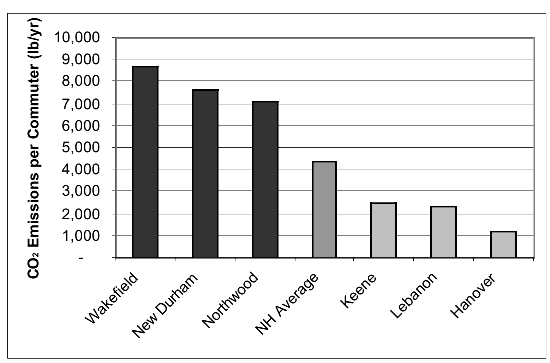
- Hold suburban workplaces accountable for the carbon dioxide pollution they generate by requiring employers to implement commute-trip reduction programs.

- Slow exurban development in rural areas by encouraging urban redevelopment, transit-oriented development, the creation of more affordable housing, and mixed-use planning in new and existing suburbs.

- Develop programs to encourage residents to live near their workplaces and to encourage employers to implement telecommuting.

Fig. ES-3. Annual Per-Worker Carbon Dioxide Emissions

(Towns with More Than 1,000 Commuting Residents)



Introduction

The New England states have taken a position of leadership in the effort to reduce the threat of global warming. Beginning with the adoption of the New England/Eastern Canada Climate Change Action Plan in 2001, and continuing through the adoption of state climate plans and the Regional Greenhouse Gas Initiative process, the region has taken important steps forward, inspiring other states around the country to consider similar actions.

One of the most promising series of developments has been with regard to transportation. All other New England states, except New Hampshire, have moved to adopt the Clean Cars program, which includes requirements for advanced-technology vehicles that are likely to have a reduced impact on the climate as well as emission standards for global warming pollution.

Under pressure from auto dealers and other interests, New Hampshire has thus far refused to follow suit, even though the emission reductions from the Clean Cars program would be great. By 2020, states adopting both the advanced-technology program and the global warming emission standards can expect pollution from light-duty cars and trucks to roughly stabilize at today's levels.

But regardless of New Hampshire's approach to reducing pollution from individual vehicles, the state will still need to act to reduce the rapid growth in vehicle travel in the state. Transportation-sector carbon dioxide emissions increased by 12 percent New England-wide between 1990 and 2001 and now represent the largest source of emissions in the region. Achieving the region's global warming pollution reduction targets will require the New England states to find ways to *reduce* global warming emissions from cars and trucks, rather than simply stabilizing them.

A thoughtful approach to reducing vehicle travel must begin from a detailed assessment of who is driving, how much they are driving, why and where. The U.S. Census Bureau collects detailed survey data that enable us to come up with a detailed portrait of one important source of vehicle travel: the journey to and from work.

The analysis that follows suggests that wise land-use and transportation policies can reduce carbon dioxide pollution from the daily commute and can have ripple effects on other sources of vehicle travel. Mustering the political will to implement those policies may be challenging, but if the region is serious about addressing global warming – and reducing the threats it poses to New England – the time to do so is now.

Commuting and Global Warming

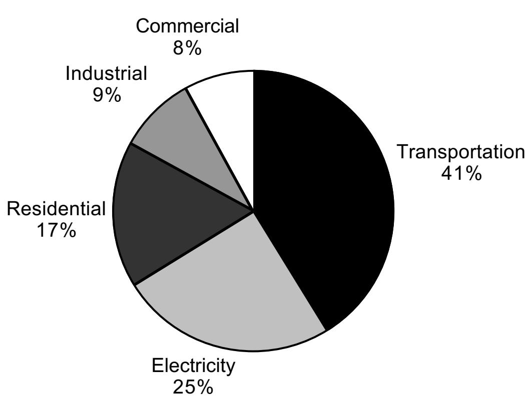
The journeys New Hampshire residents make to and from work have a large impact on the state's contribution to global warming. Reducing global warming pollution can have positive ripple effects both on other transportation-related pollution and on other aspects of quality of life in the Granite State.

The Role of Transportation in Global Warming

Transportation is the number one contributor to global warming pollution in New Hampshire. In 2001, the transportation sector produced 42 percent of New Hampshire emissions of carbon dioxide – the leading global warming gas.[1] (See Fig. 1.) Transportation-sector emissions of carbon dioxide increased in the state by 39 percent between 1990 and 2001, while the state's population increased by only 13 percent.[2] No other New England state experienced as dramatic an increase in transportation-sector pollution during this period.

Given recent trends in vehicle travel and fuel economy (a major determinant of carbon dioxide emissions) carbon dioxide pollution from transportation can be expected to increase over the next several decades. Vehicle travel in New Hampshire increased 24 percent over the past decade, from 9.9 to 12.3 billion vehicle miles traveled. By 2025, vehicle travel in New Hampshire is projected to increase by another 40 percent, to 17.2 billion vehicle miles of travel.[3] Corresponding increases in carbon dioxide pollution from transportation can be expected.

Fig. 1. New Hampshire's Carbon Dioxide Emissions from Fossil Fuel Consumption, 2001[4]



Reining in carbon dioxide emissions from the transportation sector is a key part of the state's efforts to achieve the global warming targets adopted by the New England states.[5] These goals call for overall reductions in global warming pollution to 1990 levels by 2010 and to 10 percent below 1990 levels by 2020.

Although New Hampshire has taken several steps in the right direction, it has not yet made concrete plans for how it will reduce its contribution to global warming. The closest it has come was *The Climate Change Challenge,* a December 2001 report by the Department of Environmental Services. This report contained more than 70 recommendations, most of them voluntary, for ways that cities, businesses and individuals can reduce global warming emissions and energy use.[6]

Reducing global warming pollution from commuting can play a key role in lowering overall transportation sector emissions. It can also lead to changes in development patterns, modes of travel, and personal decisions that can reduce other, non-work related transportation pollution and produce other benefits for the state as well.

Why Commuting Matters

New Hampshire's transportation system is designed with many goals in mind, but foremost among them is enabling people to travel conveniently and safely to and from work. The effectiveness of the transportation system is largely judged by its ability to carry traffic at peak periods during the day – those periods during which most people are driving to or from work.

Transportation decisions have changed the state's landscape dramatically over the past several decades. The construction of Interstate highways, among other public policies, allowed workers who had long lived in urban areas to construct homes in distant suburbs. At the same time, those highways facilitated the movement of jobs and industry away from the urban core.

Cars and Global Warming: A Primer

Global warming is caused by the accumulation of gases that trap the sun's radiation near the earth's surface. Over the past 250 years – and particularly since World War II – the concentrations of heat-trapping gases accumulating in the atmosphere as a result of human activities, and particularly our burning of fossil fuels, have increased dramatically and the earth's surface temperatures have begun to rise.

Scientists believe that continued releases of global warming gases – the most significant of which is carbon dioxide – will lead to increasing global average temperatures in the decades to come. Among the potential impacts of global warming are rising sea levels, more severe storms, changes in precipitation, and effects on wildlife, ecosystems and public health.

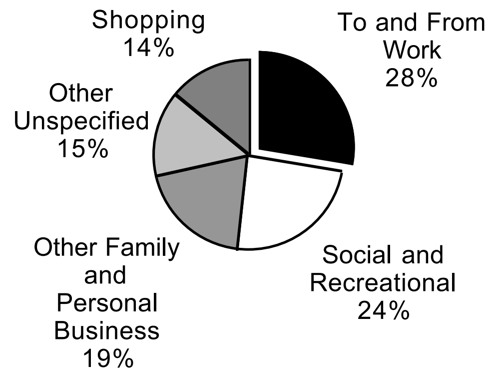
Carbon dioxide is released to the atmosphere mainly through the burning of fossil fuels, such as the gasoline consumed in cars and light trucks. Unlike other pollutants, which can be captured or otherwise eliminated through the use of emission-control devices, carbon dioxide is a direct product of fossil fuel combustion. As a result, there are three main ways to reduce carbon dioxide emissions from vehicles:

1) drive fewer miles
2) switch to low-carbon fuels
3) improve vehicle fuel efficiency.

Cars and trucks also release small amounts of other chemicals that contribute to global warming, such as methane and nitrous oxide, as well as fluorocarbons from vehicle air conditioning systems. Enhanced emission control systems and the substitution of coolants with less impact on the climate can reduce these types of emissions.

The result of these decisions has been more and longer commutes. Nationally, the average commute is 12 miles in length, compared with 8.55 miles in 1983. And while commuting makes up a smaller proportion of vehicle travel than it has in the past (28 percent in 2001 versus one-third in 1969), it is still the leading source of vehicle travel.[7] (See Fig. 2.)

Fig. 2. Vehicle-Miles Traveled by Trip Purpose, U.S., 2001



The personal decisions that determine commuting behavior, such as where to live, where to work and how to travel between home and work also impact other aspects of vehicle travel. Individuals who choose to live in densely populated neighborhoods are more likely to walk or bicycle to engage in shopping, recreation or other opportunities.[8] Conversely, residents of low-density suburbs likely have little choice but to drive their automobiles longer distances to conduct their daily non-work activities.

An individual's choice of travel mode for commuting (driving alone, carpooling, transit, etc.) could be expected to have an impact on other transportation behaviors as well. Transportation experts have noted the importance of "trip chaining" – the stringing together of trips for work, shopping, educational and other purposes. A typical trip chain might involve a worker who leaves home in the morning with his or her children, drops them off at school, stops by the dry cleaner, and picks up a cup of coffee before arriving at work. Again, a person living and working in a large city might be able to conduct this mix of activities by transit or on foot (or with a combination of driving and transit), while a suburban worker might conduct all of them by car.

The need to conduct chained trips can also influence a worker's choice of transportation mode. A worker who must pick up children at day care on the way home from work, for example, might be unable to conform his or her schedule to public transit timetables – even when transit would be a more efficient and effective way to get to and from work.

The links among the various factors that influence commuting behavior – and the links between commuting choices and choices for non-work travel – are complex. It is clear, however, that commuting and commuting-related choices play a large role in transportation global warming emissions in New Hampshire, and that policies that reduce carbon dioxide emissions from commuting may result in additional emission reduction benefits from other forms of travel.

Other Impacts of Commuting

While this report examines the global warming impact of commuting, work-related trips – especially single-passenger automobile commutes – have a series of other important impacts on the environment and society.

- **Air pollution** – Automobiles are major contributors to health-threatening air pollution in New Hampshire. Cars and light trucks are responsible for about one third of New Hampshire's emissions of nitrogen oxides (NOx) and about one fifth of emissions of volatile organic compounds (VOCs) – the two chemical components of ozone smog.[9] Vehicles also emit other health-threatening pollutants – such as particulate matter and toxic chemicals – in their exhaust.

- **Congestion** – Single-passenger automobile commutes are key contributors to congestion, particularly at peak travel periods. More than one-third (35 percent) of New Hampshire's urban highways were congested in 2002.[10] Congestion and traffic volume that results in significant rush hour delays have increased over the past decade. As a result, the typical commuter in New Hampshire now spends 28.3 more hours a year in traffic than he or she did 10 years ago.[11] Policies and practices that encourage single-passenger automobile commutes add to this congestion.

- **Highway expenditures** – Chronic congestion often brings calls for new or expanded road capacity – both major highways and local roads and streets. Expansion of road capacity imposes large costs on state and local governments. For example, the I-93 expansion project between Manchester and Salem has an estimated price tag of more than $400 million.

Policies that reduce global warming emissions from commuting can reduce many of these other costs as well.

Global Warming Emissions from Commuting in New Hampshire

About the Study

In this report, we use data collected by the U.S. Census Bureau during the 2000 decennial census to estimate the carbon dioxide pollution produced by commuters traveling to and from various locations in New Hampshire and neighboring states. This analysis, which uses a simple methodology, produces rough estimates of total and per-commuter emissions from commuting trips that are useful in evaluating how various factors influence commuting-related pollution.

However, the methodology has several limitations:

1) We use average carbon dioxide emission factors that are applied to all cars and transit vehicles in the state. As a result, this study does not take into account local variations in the amount of carbon dioxide produced per mile by vehicles – for example, the propensity of residents of one town to own less-efficient vehicles than those in another, or variations in ridership among commuter rail or bus lines.

2) To preserve individual privacy, the Census Bureau does not disclose information for trips that are taken by a small number of people. These low-frequency trips are not included in the analysis.

3) We use town-level geographic data to estimate the length of each trip. In effect, we assume that all trips are from the center of one town to the center of the other, and that trips within a town average the length of the radius of the town. The use of more detailed geographic data (for example, at the census tract level), might produce more robust results.

4) The Census Bureau survey allows only one choice of commuting mode and asks respondents to choose the mode used most frequently and for the greatest distance. As a result, for example, individuals who drive to a commuter rail line will generally list their mode of travel as "train." The automobile portion of this commute does not appear in the data and is not reflected in this analysis.

For a more detailed description of the methodology, see Appendix A. See Appendix A also for suggestions for further research to deepen and broaden the analysis presented here.

Commuting Emissions by Place of Residence

Statewide

Commuters residing in New Hampshire were responsible for about 1.17 million metric tons of carbon dioxide emissions in 2000.[12]

Commuters living in southeastern New Hampshire are responsible for the bulk of the state's commuting-related global warming emissions. (See map on page A of the color insert at the center of this report.) Indeed, the list of the top 15 cities and towns for commuting emissions is dominated by cities and large towns – such as Manchester, Nashua, Derry and Con-

Table 1. Commuting-Related Carbon Dioxide Emissions by Place of Residence, Top 15 Cities and Towns
(Metric Tons)

City or Town	Total CO_2 Emissions (metric tons)
Manchester	93,342
Nashua	86,387
Derry	48,196
Concord	34,847
Salem	32,118
Londonderry	31,048
Rochester	29,678
Merrimack	27,980
Dover	25,763
Hudson	23,931
Portsmouth	19,299
Hampton	18,431
Bedford	15,047
Raymond	14,506
Goffstown	13,821

cord – located along the southern Route 3/Everett Turnpike and I-93 corridors. (See Table 1.)

Although this list is dominated by the state's largest cities and towns, there are a few interesting exceptions. For example, Raymond (with just under 10,000 residents) was responsible for generating nearly the same amount of carbon dioxide emissions as Bedford, which has slightly more than double the number of residents.

The highest levels of emissions per commuter are produced by residents of two north-south bands, one to the west of I-93 and one to the east of I-93.[13] (See map on page B of the color insert.) Among the 125 communities with at least 1,000 residents who commute to work, the top 10 towns for per-worker emissions are predominantly located in southeastern New Hampshire in a broad corridor running between I-93 and Route 16. (See Table 2.)

By contrast, towns with the lowest levels of per-worker emissions are predominantly located in western and northern New Hampshire – Durham in the southeast corner of the state is the major exception. This list of towns is dominated by communities whose economies are centered either around colleges and universities (Hanover, Lebanon, Keene, Durham) or skiing and tourism (Gorham, Conway). (See Table 3.)

The degree of variation among residents of the state's towns is significant. According to these estimates, the average worker living Wakefield emits *more than seven times* the level of global warming pollution annually from his or her daily commute as the average worker living in Hanover.

Table 2. Top 10 Towns for Per-Commuter Carbon Dioxide Emissions
(Towns with More Than 1,000 Commuting Residents)

City or Town	CO_2 Emissions per Worker (lb/yr)
Wakefield	8,731
New Durham	7,681
Northwood	7,048
Strafford	6,965
Barnstead	6,743
Deerfield	6,678
Raymond	6,656
Weare	6,439
Alton	6,398
Fremont	6,331

Table 3. Lowest 10 Towns for Per-Commuter Carbon Dioxide Emissions
(Towns with More Than 1,000 Commuting Residents)

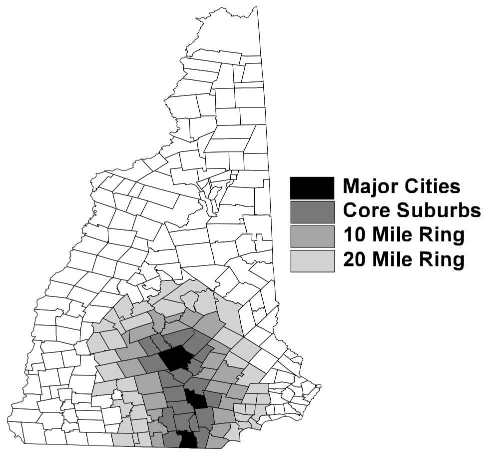
City or Town	CO_2 Emissions per Worker (lb/yr)
Hanover	1,200
Lebanon	2,322
Gorham	2,425
Keene	2,487
Swanzey	2,642
Durham	2,677
Hinsdale	2,701
Berlin	2,733
Conway	2,760
Laconia	2,772

A Closer Look: The Concord-Manchester-Nashua Corridor

In 2000, residents living in towns within 20 miles of Concord, Manchester or Nashua were responsible for nearly two thirds (65 percent) of commuting-related carbon dioxide emissions in the state.

We compared total and per-worker emissions from Concord, Manchester and Nashua, and three concentric rings around these cities, which we term the Core Suburbs (communities adjacent to Concord, Manchester, or Nashua); the 10 Mile Ring (within 10 miles); and the 20 Mile Ring (within 20 miles). (See Fig. 3.)

Fig. 3. Suburban Belts Around Concord, Manchester and Nashua

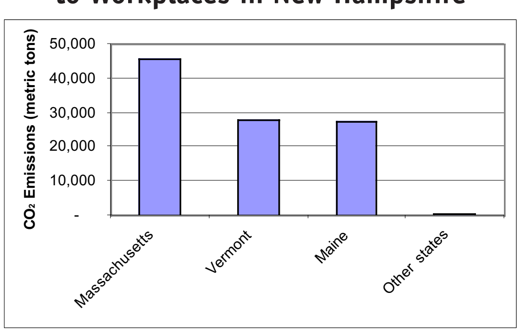


Per worker, commuters living in the Concord-Nashua corridor produce 18 percent more emissions than commuters living elsewhere in the state. However, residents of the three cities in the corridor produce significantly lower emissions than residents of the suburbs. Residents of towns in the 20-mile ring produce an average of 5,077 pounds of carbon dioxide from commuting each year versus 5,339 for residents of the 10-mile ring, 4,534 for residents of the core suburbs, and 4,049 for residents of Concord, Manchester and Nashua themselves.

Workers Commuting into New Hampshire from Other States

In addition to New Hampshire-based commuters, a number of people travel every day from surrounding states to workplaces in New Hampshire. These trips generate a significant amount of emissions – about 102,000 metric tons of carbon dioxide each year – or about 1/11th of the total emissions created by New Hampshire residents.

Fig. 4. Total Carbon Dioxide Emissions from Residents of Other States Traveling to Workplaces in New Hampshire



The majority of global warming emissions from out-of-state residents traveling into New Hampshire comes from residents of Massachusetts (45 percent), Maine (27 percent), and Vermont (27 percent). (See Fig. 4.)

Table 4. Top 10 Out-of-State Towns for Carbon Dioxide Emissions by Commuters Working in New Hampshire.

City or Town	Total CO_2 Emissions (metric tons)
Lowell, MA	4,984
York, ME	4,016
Boston, MA	3,973
Hartford, VT	3,659
Haverhill, MA	3,638
Berwick, ME	3,495
Methuen, MA	3,364
South Berwick, ME	3,110
Lebanon, ME	2,637
Lawrence, MA	2,337

The top 10 out-of-state towns for carbon dioxide emissions from New Hampshire-bound commuters are generally close to the New Hampshire border, particularly cities and towns in western Maine and the Merrimack Valley of Massachusetts, but with Boston as the obvious exception. (See Table 4.)

Not surprisingly, commuters traveling to New Hampshire for work produce substantially more emissions than commuters within the state – an average of 5,942 pounds of carbon dioxide per worker per year (compared to the in-state average of 4,392 pounds).

Commuting Emissions by Place of Work

Statewide

Carbon dioxide emissions from commuters traveling to work in New Hampshire totaled approximately 940,000 metric tons in 2000. The majority of commuters traveled to workplaces located either along the southern corridor between Concord and Nashua, or in the southeastern corner of the state between Portsmouth and Rochester. Scattered throughout the rest of the state there are also several other midsized towns

Table 5. Top 10 Destination Towns for Total Carbon Dioxide Emissions by Place of Work

City or Town	Total CO_2 Emissions (metric tons)
Manchester	104,637
Nashua	90,195
Concord	82,273
Portsmouth	62,684
Lebanon	33,685
Salem	31,933
Keene	26,171
Dover	23,990
Londonderry	23,400
Bedford	21,893

– such as Lebanon and Keene – that attract a significant number of commuters and carbon dioxide emissions. (See Table 5 and the map on page C of the color insert.)

The list of top cities and towns for inbound commuting emissions is a mix of larger, established cities (Manchester, Nashua, Concord, and Portsmouth), suburban towns close to these large cities (Salem, Dover, Londonderry), and mid-sized towns located in more rural parts of the state (Lebanon and Keene).

Per-worker carbon dioxide emissions by place of work vary widely throughout the state. Workplaces in four areas of the state – the southern I-93 corridor, the I-95/Route 16 corridor, the White Mountains and parts of the Connecticut Valley – tend to generate high per-worker carbon dioxide emissions, with Portsmouth and Concord leading the list. (See Table 6 and the map on page D of the color insert.)

The list of towns with the lowest per-worker emissions does not include any large cities, but is dominated by smaller suburban and semi-rural towns. (See Table 7.)

Working Along the Concord-Manchester-Nashua Corridor

Southern New Hampshire differs significantly from the traditional "hub-and-spokes" model of suburban development, in which center cities act as major centers of employment with suburbs acting primarily as bedroom communities. While Manchester, Nashua and

Table 6. Top 5 Towns for Inbound Carbon Dioxide Emissions per Commuter
(Towns with at least 1,000 workers)

City or Town	CO_2 Emissions per Worker (lb/yr)
Portsmouth	5,241
Concord	5,116
Newington	4,858
Lebanon	4,785
Lincoln	4,627

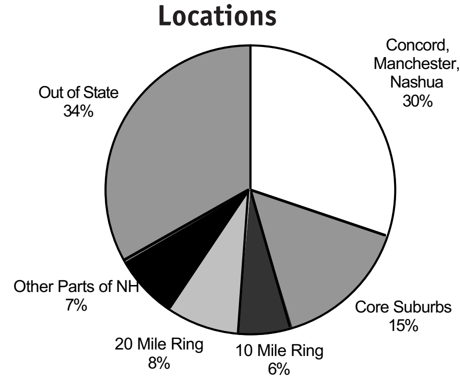
Table 7. Bottom 5 Towns for Inbound Carbon Dioxide Emissions per Commuter
(Towns With at Least 1,000 Workers)

City or Town	CO_2 Emissions per Worker (lb/yr)
Pelham	2,200
Newmarket	2,202
Rye	2,560
Charlestown	2,582
Swanzey	2,635

Concord are the largest employment centers in southern New Hampshire, the majority of workers living in the region do not work in one of the central cities, but rather work in other suburbs or outside the state.

In fact, commutes to other states (primarily Massachusetts) result in greater carbon dioxide emissions from residents of the Concord-Manchester-Nashua corridor than commutes to the three central cities. (See Fig. 5.)

Fig. 5. Carbon Dioxide Emissions Produced by Residents of the Concord-Nashua Corridor Commuting to Various Work Locations



This pattern has serious implications for New Hampshire's efforts to control global warming emissions, signifying that the task of addressing out-of-state and suburb-to-suburb commutes is as important as reducing emissions from trips to the state's major cities.

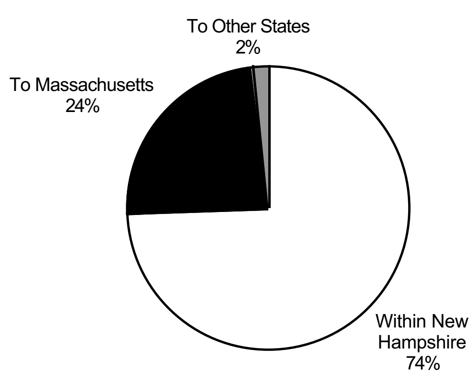
Residents of the greater Concord-Nashua corridor are significantly more likely to commute into Massachusetts than are people living elsewhere in New Hampshire – 15 percent of commuters living in this corridor commute to Massachusetts whereas only 4 percent of other New Hampshire commuters commute to the Bay State. Given that Massachusetts-bound commuters living along the Concord-Nashua corridor are responsible for 34 percent of carbon dioxide emissions from this region, the trend towards increased interstate commuting along I-93, I-95 and Route 3 presents a serious threat to the state's efforts to reduce global warming emissions.

Commutes Out of State

New Hampshire residents traveling to workplaces in other states generate more than one third of the emissions created by people working in New Hampshire – about 328,000 metric tons of carbon dioxide each year. These commuters are responsible for more global warming emissions than commuters traveling to Nashua, Manchester and Concord combined. The overwhelming majority of emissions created by out-of-state commuters are generated on trips made to Massachusetts. (See Fig. 6.)

Fully 15 percent of commuters living in the Concord-Manchester-Nashua corridor – or about one out of every eight – travels to Massachusetts for work.

Fig. 6. Carbon Dioxide Emissions from Commutes to Various States



Boston attracts more of New Hampshire's out-of-state commuters than any other town. Indeed, if Boston were a town in New Hampshire it would rank fifth on the list of communities generating the greatest amount of inbound global warming emissions.

A significant number of New Hampshire residents also commute to cities and towns near the Boston metropolitan core (Cambridge and Woburn), and to cities and towns in the Merrimack Valley (Lowell and Andover). (See Table 8.)

Table 8. Top 10 Cities and Towns for Carbon Dioxide Emissions Generated by New Hampshire Residents Commuting Out of State

City or Town	Total CO_2 Emissions (metric tons)
Boston, MA	70,977
Andover, MA	24,001
Billerica, MA	11,693
Lowell, MA	11,594
Cambridge, MA	11,546
Wilmington, MA	11,077
North Andover, MA	10,152
Woburn, MA	10,023
Burlington, MA	9,031
Waltham, MA	8,639

New Hampshire residents commuting to Massachusetts generate nearly three times as much global warming pollution as the average in-state commuter. These commuters also produce notably more carbon dioxide emissions than out-of-state commuters traveling to Vermont or Maine.

The continued tightness in the Boston-area housing market will continue to make living in New Hampshire an attractive option for many workers. Failing to provide transportation alternatives that can reduce emissions from these commuters – or, worse, dramatically expanding highway capacity to fuel further residential sprawl – could result in a dramatic increase in the state's global warming emissions in the years ahead.

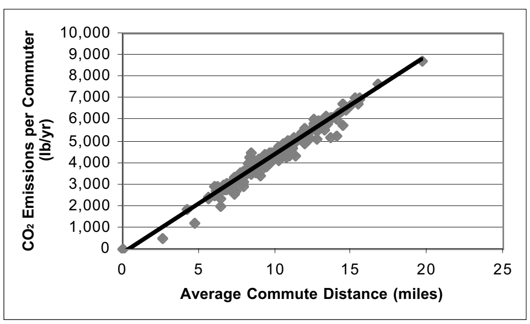
Factors Influencing Emissions

The variation in global warming emissions from commuting among New Hampshire's more than 200 cities and towns can be explained by two main factors: the degree to which commuters live near their work and the availability of transit service and other transportation alternatives.

Living Near Work

One simple, but often overlooked way to reduce global warming emissions from commuting is to encourage commuters to live closer to their place of work. In fact, average commute trip length appears to have the strongest relationship of any factor with carbon dioxide emissions by place of residence and by place of work. (See Fig. 7.)

Fig. 7. Average Commute Length vs. Average Carbon Dioxide Emissions per Commuter (by Place of Residence)

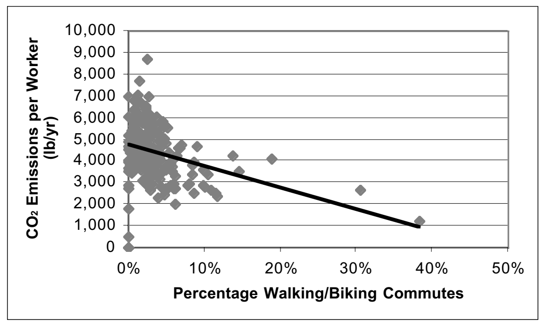


Thus, one of the most powerful steps New Hampshire could take to reduce global warming emissions from commuting would be to encourage workers to live nearer their places of work. Traditional New England town design encourages this by placing residences close to town centers and by mixing residential and commercial development.

In addition to decreasing the total number of miles traveled when commuting to work – which reduces the total amount of carbon dioxide produced by people driving or taking transit to work – shorter commute trips allow commuters to take advantage of non-polluting transit alternatives, such as biking and walking.

Looking more specifically at these types of non-vehicular commutes, the general trend is clear: towns with an increased percentage of pedestrian and bicycle commuting generate lower levels of carbon dioxide emissions per worker. (See Fig. 8.)

Fig. 8. Percentage of Biking and Walking Commuters vs. Average Carbon Dioxide Emissions per Commuter
(by Place of Residence)



These relationships underscore the logical conclusion that efforts to encourage pedestrian commutes, biking to work, and other zero-emission forms of commuting – such as telecommuting – have the potential to significantly reduce carbon dioxide emissions from commuting. As commuters are most likely to walk or ride their bike to work when their commute is short, encouraging people to live closer to work must be a key component of any plan to increase non-vehicular commutes and decrease global warming emissions in New Hampshire.

Living Near Work: College Towns

Residents of New Hampshire's college towns have some of lowest per-commuter carbon dioxide emissions in the state. For example, the average commuter living near Dartmouth College in Hanover produces 1,200 pounds of carbon dioxide per year – 73 percent below the state average.

A major reason for low per-commuter emissions among Hanover residents is the fact that the average commuter travels less than 5 miles to get to work. Towns near the University of New Hampshire

(Durham), Plymouth State University (Plymouth), Colby-Sawyer College (New London), and Keene State (Keene) also have shorter than average commutes to work. Because the average commute is quite short in college towns like Hanover, more residents are able to bike or ride to work. Hanover has the highest percentage of non-vehicular commutes in the state – 38 percent of residents walk or ride a bike to work. Similar patterns exist in Durham (31 percent non-vehicular commutes), Plymouth (19 percent non-vehicular commutes), and New London (15 percent non-vehicular commutes).

In some ways, college towns are unique cases. However, they provide valuable lessons for communities in New Hampshire. The short commute lengths and high percentage of non-vehicular commutes in these towns suggest the importance of living near work. Encouraging the development of town centers that can act as centers of employment and residence, creating a balanced mix of residential and commercial development, increasing residential population density, and designing incentives to promote living near work could all contribute to reducing carbon dioxide emissions from commuting. Such efforts may also provide a viable alternative to exurban patterns of development occurring elsewhere in New Hampshire.

Living Far From Work: Fast-Growing "Exurbs"

New Hampshire has slightly more than 28,000 residents who regularly commute at least 30 miles to work – these long-distance commuters represent just under 5 percent of all commuters living in the state. Long-distance commuters are responsible for producing more than 220,000 metric tons of carbon dioxide emissions annually – or approximately 19 percent of New Hampshire's total commuting related emissions.

In New Hampshire and all across the country, commutes have steadily become longer in the past several decades. Nationally, the number of workers making "stretch commutes" (those of 50 miles or more) has swelled to more than 3 million. The vast majority of these commutes – about 96 percent – are by personal vehicles.[14]

A major driver of lengthening commutes is the rise of fast-growing "exurbs" in formerly rural areas of the state. Throughout New Hampshire there are numerous towns that serve as bedroom communities for commuters who travel long distances to work.

The town of Wakefield is a classic example of a long-distance bedroom community. More than half of all commutes from this formerly rural town are made to cities and regional employment centers located at least 20 miles away. (See Table 9.)

Table 9. Top 10 Destinations for Commuters from Wakefield, By Percentage of Total Carbon Dioxide Emissions

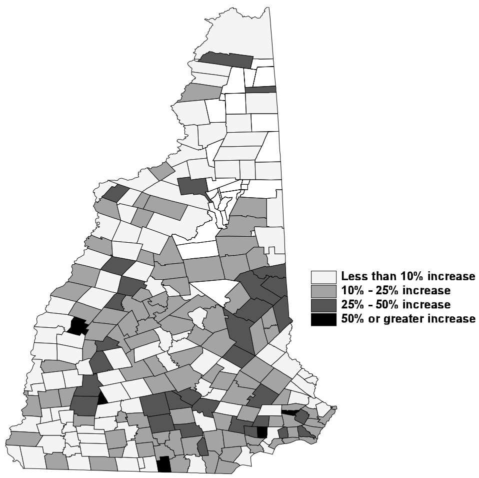
	Average Commute Length (miles)	Percentage of Wakefield's Total Outbound Emissions
Rochester	21	21%
Dover	29	15%
Portsmouth	39	8%
Conway	28	7%
Peabody, MA	74	5%
Newington	35	5%
Boston, MA	88	4%
Acton, MA	80	4%
Wolfeboro	9	4%
Somersworth	25	4%

Commuters traveling at least 20 miles to work produce 85 percent of the emissions from Wakefield residents. Most of these commuters travel south along Route 16 – the Spaulding Turnpike – when traveling to work. As there are almost no transit alternatives available to these commuters, 85 percent of them drive alone to work.

As sources of total emissions, towns like Wakefield (ranking 1st in terms of per-commuter emissions and 36th in terms of total emissions by place of residence) barely register on the map. Yet towns like Wakefield are sentinels of a broader movement toward exurban development in rural regions of the state. Wakefield's population grew by 39 percent between 1990 and 2000. This type of rapid population growth in an area with such high per-commuter emissions is an ominous trend for carbon dioxide emissions in the future.

Like Wakefield, many of New Hampshire's fastest-growing towns are in the southern and eastern portions of the state. (See Fig. 9.) With few exceptions, these fast-growing communities are also located in areas of the state with relatively high per-commuter global warming emissions.

Fig. 9. Population Growth by Town, 1990-2000[15]



This type of "exurban" development in formerly rural regions in the state poses a significant challenge to New Hampshire's ability to control carbon dioxide emissions from commuting.

Although much of this growth is driven by Massachusetts workers moving to New Hampshire, because of their distance from major regional centers and potential transit corridors, it is unlikely that conventional transit service or other alternatives will succeed in fully replacing single-passenger commutes from these communities. Therefore, adopting more compact development patterns, combining residential and commercial development, promoting transit oriented development, and reducing exurban development itself are potentially important steps the state could take to deal with this trend.

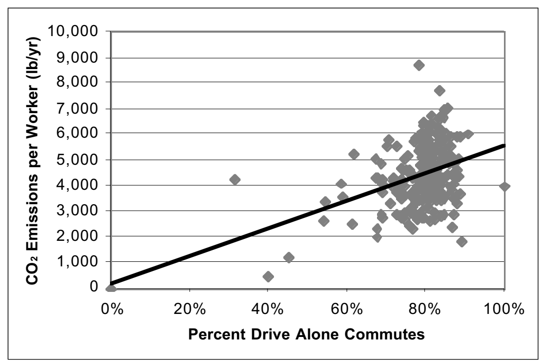
Use of Transit and Transportation Alternatives

The frequency with which commuters drive alone to work, and the degree to which commuters use transit, are major factors driving up global warming emissions around the state.

Drive-Alone Commutes and the Need for Transit Alternatives

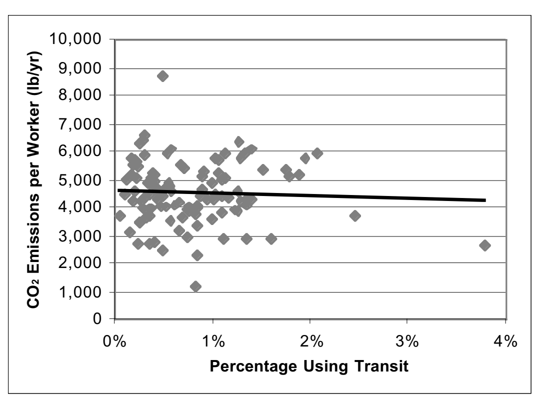
Across New Hampshire's cities and towns, there is a strong correlation between single-passenger commuting and per-worker carbon dioxide emissions. As Fig. 10 shows, global warming emissions per worker increase as the percentage of commutes made in single-passenger vehicles increases.

Fig. 10. Percentage of Drive-Alone Trips versus Carbon Dioxide Emissions per Worker by Place of Residence



Looking more specifically at transit use, emissions of carbon dioxide per commuter decline slightly as the percentage of workers taking any form of transit (bus or commuter rail) increases. (See Fig. 11.)

Fig. 11. Percentage of Transit Users versus Carbon Dioxide Emissions per Worker by Place of Residence



Unfortunately, there is not currently much transit available in New Hampshire. Were New Hampshire to have levels of transit ridership similar to neighboring states, the impact on carbon dioxide emissions would be significant. Even in the New Hampshire towns with the highest reliance on transit, only 3 to 4 percent of commuters take the bus or train. By contrast, around 30 percent of residents in Massachusetts' most heavily transit-reliant communities take the bus or train, and the statewide average is around 9 percent.

These relationships suggest that efforts to encourage transit use can yield significant reductions in carbon dioxide emissions from commuting. Thus, developing stronger transit networks and encouraging non-vehicular commutes must be key components of any plan to reduce global warming emissions in New Hampshire.

Transit Alternatives for Massachusetts-Bound Commuters

Although many New Hampshire residents commute to towns located along the Massachusetts Bay Transportation Authority's (MBTA) rail network, only 5 percent of Boston-bound New Hampshire commuters and less than 1 percent of all Massachusetts-bound commuters take the train.

Boston, Woburn, Wilmington and Billerica are all stops on MBTA's Lowell Line, which runs from Boston's North Station almost all the way to the New Hampshire border. Other towns with high per-commuter emissions, such as Cambridge, can be reached by taking the Lowell Line into Boston and then transferring to the subway system or to another regional rail line.

Although a significant number of New Hampshire commuters travel to towns that are part of MBTA's commuter rail network, this rail network does not extend into New Hampshire. Commuters interested in taking a MBTA commuter train must first drive across the border to Lowell, Massachusetts. Extension of existing commuter rail lines along southern New Hampshire's I-93 and Route 3 corridors and to rapidly-growing suburban areas in the southern portion of the state could divert many automobile trips to Massachusetts, lessen the strain on the region's highway system and reduce global warming pollution.

The New Hampshire Department of Transportation, the Nashua Regional Planning Commission, and the city of Nashua are currently developing a rail project that would enable direct access from Nashua to Boston via an extension of the MBTA's Lowell Line. Thus far, difficulties in securing financing, acquiring right-of-way for the tracks, and locating land for a park-and-ride have slowed the project's progress, though Nashua officials are hopeful that train service will begin in 2008 or 2009.[16] Restoring rail service between Manchester and Boston – which ended in the 1960s – is still a few years farther off.

In order to fully maximize the benefits of expanded commuter rail service, the region should promote transit-oriented development and explore ways of increasing transit connectivity between rail stations and centers of employment not directly served by commuter rail.

It is worth noting that the data presented here are for 2000, before the creation of Amtrak's Downeaster train service, which runs through eastern New Hampshire on its path between Portland and Boston. As of September 2005, trips between the three New Hampshire stations and Boston accounted for about 29 percent of the Downeaster's ridership.[17] With New Hampshire's recent decision to invest transportation funds in a new side track, the Downeaster will soon be able to add a fifth round-trip.[18] More trips, combined with faster speeds on the line, will enable the Downeaster to become an even more attractive option for commuters and other travelers in southeastern New Hampshire.

Transit Alternatives for Commutes Within New Hampshire

A closer look at commuting patterns for people working in Nashua (ranked 2nd highest for total carbon dioxide emissions, and 4th highest for percent of drive-alone commutes by town of work) illustrates how increased transit alternatives within the state could dramatically decrease global warming emissions.

The top five towns whose residents make the largest contributions to inbound carbon dioxide emissions in Nashua, are responsible for 40 percent of emissions among commuters working in the city. (See Table 10.)

The majority of these commutes are made by drive-alone commuters heading south on Route 3 and the Everett Turnpike. Decreasing the amount of per-commuter emissions between Manchester and Nashua along the Route 3 corridor would significantly reduce the total amount of global warming emissions produced by workers commuting to Nashua. In addition to reducing emissions from Manchester residents, transit alternatives – such as a commuter rail line, improved bus service, or greater incentives to carpool – along this corridor would also reduce emissions from Merrimack and Bedford residents who drive along the Everett Turnpike and Route 3 on their commutes to Nashua.

Table 10. Top Five Towns for Carbon Dioxide Emissions Generated From Commutes to Nashua

City or Town	Percent of Total CO_2 Emissions to Nashua	Percent Drive Alone
Nashua	14%	78%
Manchester	13%	91%
Merrimack	6%	91%
Milford	4%	92%
Bedford	3%	99%

Although expanding the regional rail network has the potential to decrease per-commuter emissions from commutes made within the state, expanded rail service will not fully correct the fact that in many parts of New Hampshire there is no regularly scheduled transit service. To effectively decrease global warming emissions from commuting, the state must develop additional transit alternatives to drive-alone commuting – such local and regional bus lines – and further facilitate vanpool and carpool programs.

Policy Recommendations

The data presented in this report point to several ways New Hampshire could reduce carbon dioxide emissions resulting from journeys to work.

Invest in Low Emission Transit Alternatives

New Hampshire should invest in its transportation infrastructure in ways that will lead to reductions in global warming pollution. Specifically, the state needs to invest more in transit – both through expanding regional rail and commuter bus services and improving transit connectivity. The state should spend less money on projects likely to lead to increased drive-alone automobile traffic, such as highway expansion. Expanding I-93 without dramatically expanding transit in this same region would promote long-distance commuting by single-passenger vehicles and could dramatically increase global warming emissions produced in the state.

Expand the Regional Rail Network

Bringing regional commuter rail service to New Hampshire has the potential to significantly reduce carbon dioxide emissions from commuting. Expanding rail service north along the I-93 and Route 3 corridors would allow New Hampshire commuters to use more easily existing commuter rail to the Boston metropolitan area.

Construction of the proposed commuter rail line to Nashua would be a good first step toward a truly integrated regional rail network in New Hampshire. Further expansion of rail toward Concord should also be considered. In addition to reducing carbon dioxide emissions from New Hampshire residents working out of state, expansion of the regional rail network has the potential to significantly reduce emissions from New Hampshire residents commuting within the state – especially commutes made along the I-93 and Route 3 corridors.

The success of rail depends on how it is integrated into the state's communities. Transit-oriented development – in which train stations are located in existing town centers or used to anchor compact, mixed-use developments where automobile use is unnecessary – can leverage the state's investment in rail transportation to promote more sustainable and less automobile-dependent communities.

However, the success of an expanded regional rail network as a global warming-fighting tool depends on the maintenance of high standards of service quality and affordable fares. Poor service quality or high fares that discourage transit use could set the region back in its quest to reduce transportation-sector global warming emissions and must be avoided.

Develop Transit Alternatives Within New Hampshire

The scarcity of transit alternatives in New Hampshire leads to an increased reliance on drive-alone commutes, higher per-commuter emissions of carbon dioxide, and increased global warming emissions. The state must begin providing transit alternatives, especially in southern New Hampshire, where residents are responsible for producing the largest amounts of carbon dioxide emissions from commuting. Options include, but are not limited to, local bus services, commuter bus routes, incentives to carpool, coordinated bus and rail transit operations, and expanded vanpool programs and networks.

Hold Large Workplaces Accountable for the Emissions they Generate

Suburban workplaces are responsible for a significant portion of the carbon dioxide emissions generated by people working in New Hampshire. Employers who choose to build in these areas must be required to mitigate the impact they have on the state's transportation network and the global climate.

One way to do this is to require that employers with a certain number of employees implement commute-trip reduction plans aimed at reducing the number of single-passenger automobile commuters. Smaller employers in a given area could be required or encouraged to join together to support joint commute-trip reduction efforts.

Encourage Mixed-Use Development, Live-Near-Work, and Telecommuting

Pedestrian commutes are often disregarded in transportation planning, but from a global warming perspective they are very important. However, pedestrian commutes are only possible when workplaces and residences are in close proximity and where pedestrian infrastructures (such as sidewalks and safe crossing points) exist. New England's traditional town centers provide a model of how to mix uses in a way that is beneficial to a community's character and its environment. The state and its towns should encourage mixed-use development in town centers and adopt practices – such as traffic calming techniques – that are friendly to pedestrian commuters. This is in contrast to the recent trend toward placing malls and big-box stores in former farm fields, increasing the need for people to drive to reach services.

These practices would be bolstered by efforts to encourage more compact suburban development and to encourage the redevelopment of urban areas. New suburban developments should be designed so that the automobile is not the sole means of transportation. Existing suburbs should be encouraged to promote "infill" development. And state investments should be directed to encouraging the redevelopment of existing properties in urban areas that would be sites for affordable housing or new commercial development.

The state, towns and employers should explore novel ways to encourage commuters to live near their work or near transit. Commuters who live near their place of work not only reduce global warming emissions, but also reduce the strain on the state's transportation infrastructure. They should be rewarded for their choices.

Telecommuting (working at home using high-speed internet services) also holds promise to reduce the number and length of commuting trips made. Employers should be encouraged to develop telecommuting alternatives for their employees.

Slow Exurban Development

The growth of "exurbs" – formerly rural areas that are now being converted into long-distance bedroom communities for multiple regional centers – is one of the most ominous trends for New Hampshire's efforts to reduce global warming emissions from transportation. These areas are unlikely ever to have the population density or truly mixed-use development that that can make alternatives to driving possible. They are likely to remain permanently automobile dependent.

Slowing exurban growth requires both carrots and sticks. Providing incentives for people to live closer to their place of work, and guaranteeing that there are affordable housing options near major centers of employment, would be part of the solution. For example, several states, including Massachusetts, have created programs to help people qualify for mortgages if they choose to live near transit lines.

Among the sticks that can be used to slow exurban development are policies that require sprawling developments to pay their own way. State or local tax revenue should not be used to support transportation and infrastructure improvements that will facilitate further sprawl, but should rather be targeted towards areas in which growth is desirable. The state should also investigate how to adopt tools developed in other states – such as municipal service boundaries and priority funding areas – to fit with in the New England's strongly held tradition of home rule.

Clean Vehicles

Even if New Hampshire immediately and fully acts on all of the above policy solutions, a significant number of New Hampshire commutes will continue be made in automobiles. Therefore, the state should take a series of immediate and long-term actions to reduce global warming emissions from cars, SUV's, and light trucks. New Hampshire should adopt strong vehicle global warming emissions standards, as well as measures to encourage the purchase of vehicles that produce less carbon dioxide per mile.

Appendix A: Methodology

Calculation of Carbon Dioxide Emissions

This analysis is based on journey-to-work data collected by the U.S. Census Bureau during the 2000 decennial Census. New Hampshire data for county subdivisions was downloaded from the Census Bureau on January 10, 2005.

Distance between towns was calculated based on latitude and longitude coordinates for each county subdivision downloaded from the Census Bureau on January 11, 2005. Distance in miles was calculated by applying the Haversine formula to the latitude and longitude coordinates in radians. The formula is as follows:

```
3956*(2*ASIN(MIN(1,SQRT(SIN((latwkrad-latresrad)/2)^2 + COS(latwkrad)*
COS(latresrad)*(SIN((longwkrad-longresrad)/
2))^2))))
```

Where:
latwkrad = The latitude of the work location in radians
longwkrad = The longitude of the work location in radians
latresrad = The latitude of the residential location in radians
longresrad = The longitude of the residential location in radians

For commutes within a town, we assumed that the average trip length equaled the average radius of the town, or SQRT(areares/3.14), where "areares" equals the land surface area of the town. This method could result in higher-than-warranted emission estimates for towns with a very large surface area and lower-than-warranted estimates for very small towns.

Pounds-per-mile carbon dioxide emission factors for each transportation mode were calculated as follows:

- **Drive-alone commutes**: Per-mile emissions were based on the assumption that a gallon of gasoline results in emissions of 19.6 pounds of carbon dioxide, per carbon coefficients and heat content data from U.S. Department of Energy, Energy Information Administration, *Emissions of Greenhouse Gases in the United States 2001*, Appendix B. Average, on-road fuel economy for cars and light trucks was based on year 2001 data obtained from U.S. Energy Information Administration, *Annual Energy Outlook 2004*. Emission factors for both cars and light trucks were estimated by multiplying carbon dioxide emissions per gallon of gasoline by the inverse of on-road MPG. These values were then weighted by the ratio of registered cars to light trucks in New Hampshire per Federal Highway Administration, *Highway Statistics 2003*.

- **Carpooling**: Emissions from carpools were obtained by dividing the emission factor for drive-alone commuters, calculated above, by the number of people in the carpool. For carpools of 4-5 commuters, 4.5-person carpools were assumed; for carpools of 6-7 commuters, 6.5; and for carpools of 7 and more, 7-person carpools were assumed.

- **Transit**: Emission factors for each transit mode were based on fuel consumption and passenger-miles data from the Federal Transit Administration, National Transit Database 2003. Data for New Hampshire transit agencies reporting energy use data to the data base were aggregated by mode, with the sum of energy use divided by passenger-miles for each mode to arrive at energy consumption per passenger-mile of travel. Carbon dioxide emissions were estimated by multiplying energy consumption by carbon coefficients from U.S. Department of Energy, Energy Information Administration, *Fuel and Energy Source Codes and Emission Coefficients* downloaded from www.eia.doe.gov/oiaf/1605/factors.html, 17 January 2005. Emissions from transit modes consuming electricity were based on the average electric-sector carbon dioxide emissions per kilowatt-hour derived from U.S. Energy Information Administration, *State Electricity Profiles 2002*. For transit modes in which New Hampshire transit agencies did not report energy use data, New England averages were used, calculated according to a similar methodology as described above.

- **Taxis and motorcycles**: Per-mile emissions from taxis were assumed to be the same as the per-mile emissions from cars and light-duty trucks derived above. Emission factors for motorcycles were based on an average fuel economy for motorcycles of 50 miles per gallon, per U.S. Environmental Protection Agency, *Updating Fuel Economy Estimates in MOBILE 6.3*, draft report, August 2002.

- **Non-motorized commutes and other**: Bicycling, walking and work-at-home commutes were assumed to produce zero emissions of carbon dioxide, as were commutes listed under the "other" category.

Other Notes

Emissions "per commuter" or "per worker" are based on total emissions from a place of residence or place of work, divided by the number of commuters driving to or from that town.

The definitions of the various "belts" around the Concord, Manchester and Nashua corridor were based on GIS mapping using ArcView 3.x. Towns included in each ring are those identified by ArcView as within 1, 10, or 20 miles of Concord, Manchester, or Nashua city limits.

Although it is likely that visitors traveling to towns with tourism-based economies generate significant amounts of carbon dioxide, the analysis of tourism-related emissions is beyond the scope of this report. However, exclusion of such emissions does not detract from the ability of tourism towns to serve as an example of how short commuter trips and the availability of no-emission transportation alternatives can reduce New Hampshire's global warming emissions.

Limitations and Suggestions for Further Research

As noted in the text, the simplified methodology used in this report appears to be sufficient to show general trends, but suffers from several limitations. We suggest several areas future researchers may wish to explore to add detail and depth to this analysis:

- Integrating vehicle registration data into the analysis to factor in variations in fuel economy among the vehicles used by residents of various towns.

- Accounting for regional differences in transit energy consumption and ridership to more accurately reflect emissions from transit modes.

- Using more detailed geographic analysis comparing transit use based on proximity to commuter rail lines and other sources of transit infrastructure.

- Integrating more recent population and transportation data to update this analysis prior to the next decennial census.

Appendix B: Emissions and Commuting Data by Town of Residence

City or Town	Pct. Drive Alone Commutes	CO_2 Emissions per Worker (lb/yr)	Per-Worker Rank	Total CO_2 Emissions (metric tons)	Total Emissions Rank
Acworth town	69%	4,298	128	612	197
Albany town	74%	3,599	186	417	211
Alexandria town	74%	4,203	136	1,150	161
Allenstown town	81%	4,223	133	4,578	65
Alstead town	78%	4,472	104	1,862	135
Alton town	81%	6,398	13	4,915	57
Amherst town	83%	4,633	92	10,414	24
Andover town	80%	5,667	39	2,601	104
Antrim town	82%	5,094	64	2,512	107
Ashland town	76%	4,614	95	1,900	134
Atkinson town	86%	5,047	70	6,309	41
Auburn town	88%	4,398	112	4,588	64
Barnstead town	81%	6,743	7	5,196	49
Barrington town	82%	5,327	52	9,141	27
Bartlett town	83%	4,091	145	2,462	110
Bath town	72%	4,207	135	752	187
Bedford town	86%	4,003	151	15,047	13
Belmont town	84%	3,599	185	5,669	43
Bennington town	81%	4,623	94	1,448	152
Benton town	76%	2,979	207	92	230
Berlin city	82%	2,733	221	5,142	50
Bethlehem town	79%	4,007	150	2,118	125
Boscawen town	80%	3,813	171	2,695	98
Bow town	87%	3,494	191	5,105	51
Bradford town	79%	6,519	10	2,125	123
Brentwood town	84%	4,932	75	2,679	99
Bridgewater town	84%	5,756	34	1,034	170
Bristol town	79%	4,792	81	2,669	101
Brookfield town	76%	5,180	60	502	204
Brookline town	84%	5,039	71	4,146	76
Campton town	81%	4,706	86	2,663	103
Canaan town	80%	4,699	88	3,354	92
Candia town	86%	4,940	74	4,165	75
Canterbury town	80%	4,977	73	2,253	118
Carroll town	74%	3,493	192	526	202
Center Harbor town	84%	3,424	195	716	192
Charlestown town	79%	3,892	165	3,901	80
Chatham town	68%	4,309	127	196	224
Chester town	83%	5,550	43	4,440	67
Chesterfield town	85%	3,471	193	2,532	106
Chichester town	80%	4,540	98	2,367	113
Claremont city	77%	3,206	203	8,810	28
Clarksville town	78%	3,926	164	241	222
Colebrook town	74%	4,280	131	2,193	121
Columbia town	69%	4,091	144	632	195
Concord city	81%	3,966	159	34,847	4
Conway town	80%	2,760	219	5,357	47
Cornish town	82%	4,166	137	1,606	147
Croydon town	81%	4,214	134	630	196
Dalton town	76%	3,638	182	595	198
Danbury town	79%	5,951	25	1,087	166
Danville town	84%	5,798	32	4,744	60
Deerfield town	85%	6,678	8	4,948	55
Deering town	80%	6,111	17	2,372	112

City or Town	Pct. Drive Alone Commutes	CO_2 Emissions per Worker (lb/yr)	Per-Worker Rank	Total CO_2 Emissions (metric tons)	Total Emissions Rank
Derry town	85%	6,096	18	48,196	3
Dorchester town	84%	5,319	53	297	217
Dover city	83%	3,979	158	25,763	9
Dublin town	71%	3,293	202	933	175
Dummer town	87%	4,865	79	296	218
Dunbarton town	85%	5,418	49	2,798	97
Durham town	54%	2,677	224	6,601	37
East Kingston town	81%	5,374	51	1,927	133
Easton town	79%	4,083	146	186	225
Eaton town	78%	2,757	220	169	226
Effingham town	73%	3,997	154	941	174
Ellsworth town	40%	503	234	2	234
Enfield town	81%	3,755	173	4,114	77
Epping town	81%	5,255	55	6,521	39
Epsom town	84%	5,085	65	4,392	70
Errol town	81%	4,702	87	286	219
Exeter town	78%	4,354	119	13,428	16
Farmington town	81%	5,756	35	6,397	40
Fitzwilliam town	80%	5,284	54	2,491	109
Francestown town	84%	6,758	6	2,080	126
Franconia town	74%	2,769	218	488	205
Franklin city	78%	4,355	118	7,028	33
Freedom town	82%	4,409	111	996	171
Fremont town	83%	6,331	14	4,763	59
Gilford town	86%	3,705	178	4,934	56
Gilmanton town	79%	5,926	27	3,758	83
Gilsum town	80%	3,587	187	541	200
Goffstown town	82%	3,722	176	13,821	15
Gorham town	87%	2,425	228	1,405	155
Goshen town	87%	4,497	101	646	194
Grafton town	71%	5,526	44	1,201	160
Grantham town	78%	5,377	50	2,234	120
Greenfield town	85%	4,988	72	1,775	141
Greenland town	88%	2,904	211	1,954	131
Greenville town	84%	5,243	56	2,121	124
Groton town	54%	3,395	197	207	223
Hale's location	NA	0	235	0	235
Hampstead town	89%	5,934	26	10,100	25
Hampton Falls town	82%	4,888	77	1,802	139
Hampton town	85%	5,715	38	18,431	12
Hancock town	82%	4,080	147	1,459	151
Hanover town	45%	1,200	233	2,318	116
Harrisville town	79%	3,872	167	928	176
Hart's Location town	100%	3,997	153	18	233
Haverhill town	75%	3,964	160	3,117	95
Hebron town	69%	3,735	174	277	220
Henniker town	79%	4,764	83	4,299	72
Hill town	81%	6,063	20	1,259	159
Hillsborough town	77%	5,733	37	5,329	48
Hinsdale town	78%	2,701	222	2,425	111
Holderness town	83%	5,598	41	2,346	115
Hollis town	86%	4,887	78	6,552	38
Hooksett town	82%	4,413	110	11,323	21
Hopkinton town	86%	4,484	103	4,963	54
Hudson town	88%	4,375	115	23,931	10
Jackson town	82%	3,416	196	531	201
Jaffrey town	78%	3,386	198	3,702	84
Jefferson town	77%	3,871	168	824	183

City or Town	Pct. Drive Alone Commutes	CO_2 Emissions per Worker (lb/yr)	Per-Worker Rank	Total CO_2 Emissions (metric tons)	Total Emissions Rank
Keene city	76%	2,487	227	11,940	20
Kensington town	83%	4,523	99	1,624	146
Kingston town	81%	5,209	58	5,966	42
Laconia city	79%	2,772	217	9,242	26
Lancaster town	79%	3,366	199	2,005	129
Landaff town	68%	2,343	229	164	227
Langdon town	87%	4,117	141	513	203
Lebanon city	77%	2,322	230	6,872	35
Lee town	79%	4,119	140	3,539	90
Lempster town	73%	5,519	46	1,061	169
Lincoln town	69%	2,892	213	827	182
Lisbon town	73%	2,867	214	890	178
Litchfield town	88%	4,650	91	7,420	32
Littleton town	75%	2,943	209	3,638	87
Londonderry town	87%	5,922	28	31,048	6
Loudon town	76%	4,488	102	4,498	66
Lyman town	76%	3,105	205	303	215
Lyme town	77%	3,727	175	1,340	158
Lyndeborough town	79%	5,126	63	1,750	143
Madbury town	80%	3,550	188	1,137	163
Madison town	80%	4,287	130	2,024	127
Manchester city	81%	3,836	169	93,342	1
Marlborough town	82%	2,979	208	1,406	154
Marlow town	81%	5,054	68	714	193
Mason town	81%	6,135	16	1,481	150
Meredith town	78%	3,458	194	4,252	74
Merrimack town	88%	4,511	100	27,980	8
Middleton town	80%	6,410	12	1,835	137
Milan town	88%	3,328	201	965	172
Milford town	83%	3,960	161	12,430	18
Millsfield township	NA	0	236	0	236
Milton town	81%	5,557	42	3,966	78
Monroe town	75%	5,047	69	743	189
Mont Vernon town	85%	4,384	113	1,804	138
Moultonborough town	83%	4,612	96	3,805	82
Nashua city	83%	4,348	121	86,387	2
Nelson town	81%	3,606	184	426	209
New Boston town	81%	5,206	59	4,780	58
New Castle town	77%	4,454	107	741	191
New Durham town	83%	7,681	2	3,593	89
New Hampton town	79%	4,367	116	1,755	142
New Ipswich town	81%	5,645	40	4,631	63
New London town	59%	3,537	189	2,315	117
Newbury town	84%	6,199	15	2,249	119
Newfields town	87%	4,382	114	1,372	156
Newington town	78%	2,909	210	479	206
Newmarket town	84%	4,288	129	8,801	29
Newport town	81%	3,141	204	3,676	86
Newton town	85%	5,754	36	5,061	52
North Hampton town	81%	4,072	148	3,684	85
Northfield town	82%	4,429	109	4,288	73
Northumberland town	75%	3,610	183	1,662	145
Northwood town	86%	7,048	3	5,398	46
Nottingham town	83%	6,076	19	5,054	53
Orange town	91%	6,045	22	327	213
Orford town	79%	6,058	21	1,537	149
Ossipee town	82%	3,998	152	2,671	100
Pelham town	86%	5,151	61	12,268	19

City or Town	Pct. Drive Alone Commutes	CO_2 Emissions per Worker (lb/yr)	Per-Worker Rank	Total CO_2 Emissions (metric tons)	Total Emissions Rank
Pembroke town	84%	4,340	123	6,984	34
Peterborough town	81%	3,992	155	4,718	61
Piermont town	81%	5,805	31	813	185
Pittsburg town	62%	5,238	57	905	177
Pittsfield town	79%	5,496	47	4,434	68
Plainfield town	78%	3,672	180	1,955	130
Plaistow town	87%	5,148	62	8,448	30
Plymouth town	59%	4,121	139	4,701	62
Portsmouth city	80%	3,881	166	19,299	11
Randolph town	84%	2,842	215	160	228
Raymond town	83%	6,656	9	14,506	14
Richmond town	75%	4,611	97	945	173
Rindge town	72%	3,950	163	3,636	88
Rochester city	82%	4,724	85	29,678	7
Rollinsford town	84%	3,682	179	2,192	122
Roxbury town	89%	1,820	232	86	231
Rumney town	74%	4,624	93	1,343	157
Rye town	81%	4,784	82	3,936	79
Salem town	89%	5,054	67	32,118	5
Salisbury town	84%	7,008	4	1,844	136
Sanbornton town	82%	4,434	108	2,550	105
Sandown town	87%	5,522	45	5,660	44
Sandwich town	74%	3,815	170	890	179
Seabrook town	80%	4,351	120	7,595	31
Sharon town	78%	3,979	157	251	221
Shelburne town	89%	3,669	181	299	216
Somersworth city	86%	4,463	106	10,650	22
South Hampton town	80%	3,957	162	590	199
Springfield town	77%	4,316	124	863	180
Stark town	88%	4,361	117	327	212
Stewartstown town	61%	2,536	226	432	208
Stoddard town	78%	5,850	30	1,080	168
Strafford town	85%	6,965	5	5,525	45
Stratford town	67%	5,081	66	820	184
Stratham town	87%	3,799	172	4,429	69
Sugar Hill town	75%	2,682	223	315	214
Sullivan town	79%	3,038	206	478	207
Sunapee town	84%	4,341	122	2,664	102
Surry town	85%	2,893	212	426	210
Sutton town	80%	5,955	24	1,949	132
Swanzey town	81%	2,642	225	3,819	81
Tamworth town	80%	4,696	89	2,359	114
Temple town	67%	4,310	126	1,142	162
Thornton town	74%	4,693	90	2,022	128
Tilton town	77%	3,495	190	2,494	108
Troy town	78%	3,982	156	1,796	140
Tuftonboro town	74%	4,045	149	1,572	148
Unity town	85%	4,160	138	1,110	165
Wakefield town	78%	8,731	1	6,687	36
Walpole town	81%	4,099	142	3,009	96
Warner town	83%	6,038	23	3,340	93
Warren town	69%	4,888	76	751	188
Washington town	71%	5,773	33	795	186
Waterville Valley town	68%	2,011	231	59	232
Weare town	81%	6,439	11	10,478	23
Webster town	79%	4,835	80	1,712	144
Wentworth location	NA	0	237	0	237
Wentworth town	85%	5,430	48	827	181

City or Town	Pct. Drive Alone Commutes	CO_2 Emissions per Worker (lb/yr)	Per-Worker Rank	Total CO_2 Emissions (metric tons)	Total Emissions Rank
Westmoreland town	81%	3,360	200	1,133	164
Whitefield town	73%	3,721	177	1,417	153
Wilmot town	83%	4,751	84	1,082	167
Wilton town	80%	4,469	105	3,423	91
Winchester town	82%	4,098	143	3,130	94
Windham town	88%	5,876	29	13,409	17
Windsor town	31%	4,268	132	113	229
Wolfeboro town	72%	4,313	125	4,313	71
Woodstock town	69%	2,800	216	742	190

Appendix C: Emissions and Commuting Data by Town of Work

City or Town	Pct. Drive Alone Commutes	CO_2 Emissions per Worker (lb/yr)	Per-Worker Rank	Total CO_2 Emissions (metric tons)	Total Emissions Rank
Acworth town	28%	496	221	20	210
Albany town	73%	2,831	101	167	170
Alexandria town	55%	1,551	188	104	183
Allenstown town	82%	2,496	131	589	111
Alstead town	58%	1,831	171	319	149
Alton town	69%	2,913	91	1,164	85
Amherst town	79%	3,147	72	5,778	32
Andover town	69%	3,991	23	1,152	86
Antrim town	69%	2,368	139	603	109
Ashland town	76%	2,648	119	861	99
Atkinson town	75%	3,042	79	1,388	77
Auburn town	68%	2,411	136	947	92
Barnstead town	61%	1,514	190	248	159
Barrington town	68%	2,333	141	1,023	89
Bartlett town	78%	3,654	37	1,749	69
Bath town	63%	1,641	182	123	177
Bedford town	86%	3,920	28	21,893	10
Belmont town	80%	2,983	82	2,748	53
Bennington town	82%	3,561	43	510	120
Benton town	65%	2,661	117	89	187
Berlin city	86%	3,434	54	7,294	28
Bethlehem town	68%	2,283	145	545	116
Boscawen town	86%	3,627	39	1,429	76
Bow town	81%	4,349	12	7,243	29
Bradford town	63%	2,919	88	271	157
Brentwood town	79%	3,611	42	1,863	65
Bridgewater town	76%	1,596	186	90	186
Bristol town	78%	3,181	67	2,036	62
Brookfield town	42%	563	216	15	214
Brookline town	59%	2,687	112	578	113
Cambridge township	NA	0	235	0	235
Campton town	73%	2,109	159	477	126
Canaan town	60%	1,775	175	406	134
Candia town	67%	2,237	147	411	133
Canterbury town	51%	2,279	146	321	147
Carroll town	74%	4,389	11	1,175	84
Center Harbor town	84%	2,568	125	483	125
Chandlers purchase	NA	0	236	0	236
Charlestown town	79%	2,582	123	1,629	73
Chatham town	20%	410	225	4	227
Chester town	49%	1,633	183	275	156
Chesterfield town	72%	2,530	128	600	110
Chichester town	60%	1,993	162	303	151
Claremont city	80%	2,833	99	7,586	27
Clarksville town	80%	1,674	180	19	212
Colebrook town	74%	3,625	40	1,821	67
Columbia town	55%	1,388	198	69	189
Concord city	85%	5,116	2	82,273	3
Conway town	84%	3,970	25	12,391	18
Cornish town	65%	1,725	177	204	165
Croydon town	50%	912	209	17	213
Dalton town	73%	1,845	170	108	182
Danbury town	43%	1,073	205	21	209
Danville town	35%	542	218	49	199
Deerfield town	68%	2,229	148	456	129
Deering town	11%	173	229	3	229

City or Town	Pct. Drive Alone Commutes	CO_2 Emissions per Worker (lb/yr)	Per-Worker Rank	Total CO_2 Emissions (metric tons)	Total Emissions Rank
Derry town	80%	3,175	69	11,588	20
Dixville township	57%	4,629	5	505	122
Dorchester town	50%	911	210	12	217
Dover city	83%	3,620	41	23,990	8
Dublin town	70%	2,323	143	565	114
Dummer town	27%	501	220	3	228
Dunbarton town	31%	481	222	28	207
Durham town	66%	2,787	107	8,980	24
East Kingston town	56%	1,225	201	150	172
Easton town	0%	0	244	0	244
Eaton town	67%	1,415	195	29	206
Effingham town	68%	2,740	110	405	135
Ellsworth town	40%	503	219	2	231
Enfield town	75%	2,523	129	935	93
Epping town	73%	3,072	77	1,771	68
Epsom town	68%	1,926	166	336	143
Errol town	86%	3,523	48	112	181
Exeter town	84%	4,112	16	17,508	14
Farmington town	82%	3,340	60	2,634	55
Fitzwilliam town	67%	2,340	140	356	141
Francestown town	48%	1,776	173	193	167
Franconia town	84%	3,333	61	1,091	87
Franklin city	81%	3,349	59	5,043	36
Freedom town	77%	2,696	111	324	145
Fremont town	68%	2,001	161	322	146
Gilford town	80%	2,885	94	3,673	43
Gilmanton town	54%	1,264	200	149	173
Gilsum town	72%	1,713	178	69	190
Goffstown town	74%	2,823	103	6,267	31
Gorham town	86%	2,833	100	2,127	61
Goshen town	80%	1,443	194	49	200
Grafton town	41%	1,119	203	48	201
Grantham town	74%	2,927	87	624	108
Greenfield town	80%	3,774	34	914	95
Greenland town	85%	4,096	18	3,584	44
Greenville town	78%	1,979	163	184	168
Groton town	33%	580	215	8	222
Hale's location	75%	1,533	189	14	215
Hampstead town	82%	2,788	106	2,255	57
Hampton Falls town	77%	2,589	122	823	102
Hampton town	81%	4,002	22	9,891	21
Hancock town	66%	1,734	176	240	161
Hanover town	63%	3,936	26	16,306	15
Harrisville town	52%	743	213	39	204
Hart's Location town	NA	0	233	0	233
Haverhill town	78%	3,652	38	3,292	48
Hebron town	38%	457	223	13	216
Henniker town	72%	2,907	93	1,867	64
Hill town	43%	683	214	11	219
Hillsborough town	70%	3,549	44	3,110	50
Hinsdale town	74%	2,221	149	991	91
Holderness town	70%	2,117	158	476	127
Hollis town	81%	3,273	63	3,399	46
Hooksett town	83%	4,404	10	14,382	17
Hopkinton town	80%	4,055	20	2,853	51
Hudson town	85%	3,510	49	18,042	13

City or Town	Pct. Drive Alone Commutes	CO_2 Emissions per Worker (lb/yr)	Per-Worker Rank	Total CO_2 Emissions (metric tons)	Total Emissions Rank
Jackson town	81%	4,085	19	871	98
Jaffrey town	78%	2,861	96	3,332	47
Jefferson town	61%	1,950	165	172	169
Keene city	81%	3,209	66	26,171	7
Kensington town	44%	1,081	204	117	178
Kilkenny township	NA	0	237	0	237
Kingston town	74%	2,916	89	1,968	63
Laconia city	83%	3,101	75	14,631	16
Lancaster town	80%	3,067	78	2,232	58
Landaff town	77%	3,363	57	138	176
Langdon town	73%	1,690	179	114	180
Lebanon city	81%	4,785	4	33,685	5
Lee town	62%	2,466	133	1,014	90
Lempster town	50%	1,001	207	54	197
Lincoln town	68%	4,627	6	3,460	45
Lisbon town	71%	2,662	116	903	96
Litchfield town	73%	2,123	157	463	128
Littleton town	78%	4,421	9	9,349	23
Londonderry town	85%	4,482	8	23,400	9
Loudon town	66%	2,637	120	915	94
Lyman town	81%	2,665	115	96	184
Lyme town	75%	3,368	56	732	105
Lyndeborough town	6%	140	230	4	226
Madbury town	71%	2,796	105	413	131
Madison town	71%	2,390	137	505	121
Manchester city	84%	3,846	30	104,637	1
Marlborough town	61%	1,958	164	390	138
Marlow town	75%	1,776	174	65	195
Mason town	63%	2,178	155	198	166
Meredith town	78%	2,931	85	4,183	41
Merrimack town	85%	3,927	27	19,516	12
Middleton town	44%	1,665	181	68	192
Milan town	72%	2,369	138	229	163
Milford town	81%	3,825	31	12,090	19
Millsfield township	100%	3,239	65	6	225
Milton town	68%	2,060	160	293	152
Monroe town	65%	866	211	39	203
Mont Vernon town	78%	2,876	95	392	137
Moultonborough town	75%	2,783	108	1,460	75
Nashua city	86%	3,990	24	90,195	2
Nelson town	62%	1,629	185	59	196
New Boston town	73%	2,909	92	747	104
New Castle town	15%	43	232	1	232
New Durham town	72%	3,427	55	522	118
New Hampton town	75%	2,671	114	520	119
New Ipswich town	68%	2,852	97	1,245	82
New London town	74%	3,500	50	4,547	39
Newbury town	47%	1,576	187	117	179
Newfields town	82%	3,290	62	1,027	88
Newington town	84%	4,858	3	9,636	22
Newmarket town	73%	2,202	153	1,368	78
Newport town	80%	2,941	84	5,060	35
Newton town	64%	1,897	169	241	160
North Hampton town	80%	3,538	47	2,779	52
Northfield town	81%	3,079	76	1,299	81
Northumberland town	76%	2,953	83	1,239	83
Northwood town	63%	1,631	184	411	132

City or Town	Pct. Drive Alone Commutes	CO_2 Emissions per Worker (lb/yr)	Per-Worker Rank	Total CO_2 Emissions (metric tons)	Total Emissions Rank
Nottingham town	40%	1,265	199	138	175
Orange town	NA	0	242	0	242
Orford town	67%	2,929	86	285	155
Ossipee town	78%	3,867	29	3,175	49
Pelham town	77%	2,200	154	1,300	80
Pembroke town	77%	3,269	64	2,743	54
Peterborough town	83%	4,112	15	8,939	25
Piermont town	56%	1,506	191	72	188
Pinkhams grant	NA	0	238	0	238
Pittsburg town	62%	3,460	52	313	150
Pittsfield town	81%	3,166	70	1,603	74
Plainfield town	60%	2,457	134	542	117
Plaistow town	84%	3,693	36	6,990	30
Plymouth town	68%	3,140	74	5,220	34
Portsmouth city	86%	5,241	1	62,684	4
Randolph town	72%	1,806	172	44	202
Raymond town	83%	4,179	14	4,149	42
Richmond town	18%	404	226	10	220
Rindge town	67%	2,840	98	2,159	60
Rochester city	85%	3,823	32	20,435	11
Rollinsford town	79%	2,172	156	488	124
Roxbury town	NA	0	234	0	234
Rumney town	69%	2,213	151	292	154
Rye town	70%	2,560	127	1,330	79
Salem town	86%	4,104	17	31,933	6
Salisbury town	46%	2,467	132	93	185
Sanbornton town	81%	2,829	102	495	123
Sandown town	50%	547	217	67	193
Sandwich town	64%	2,561	126	360	140
Sargents purchase	NA	0	239	0	239
Seabrook town	85%	4,238	13	7,868	26
Sharon town	33%	1,445	193	20	211
Shelburne town	78%	3,695	35	156	171
Somersworth city	81%	2,673	113	5,369	33
South Hampton town	65%	1,396	197	54	198
Springfield town	47%	1,396	196	66	194
Stark town	50%	1,046	206	10	221
Stewartstown town	75%	2,758	109	557	115
Stoddard town	32%	744	212	25	208
Strafford town	60%	3,452	53	392	136
Stratford town	72%	3,799	33	345	142
Stratham town	80%	3,543	45	4,290	40
Success township	NA	0	240	0	240
Sugar Hill town	53%	1,165	202	68	191
Sullivan town	20%	312	227	7	223
Sunapee town	70%	2,292	144	666	107
Surry town	33%	455	224	6	224
Sutton town	65%	2,205	152	261	158
Swanzey town	78%	2,635	121	1,848	66
Tamworth town	69%	2,654	118	726	106
Temple town	19%	250	228	12	218
Thornton town	50%	1,484	192	148	174
Tilton town	80%	3,478	51	4,903	37
Troy town	65%	2,331	142	448	130
Tuftonboro town	55%	1,926	167	367	139
Unity town	75%	2,420	135	330	144
Wakefield town	66%	2,214	150	579	112
Walpole town	78%	2,915	90	1,742	70

City or Town	Pct. Drive Alone Commutes	CO_2 Emissions per Worker (lb/yr)	Per-Worker Rank	Total CO_2 Emissions (metric tons)	Total Emissions Rank
Warner town	76%	4,036	21	1,633	72
Warren town	74%	3,002	81	292	153
Washington town	50%	964	208	35	205
Waterville Valley town	80%	4,585	7	782	103
Weare town	69%	3,153	71	1,702	71
Webster town	58%	2,508	130	209	164
Wentworth location	NA	0	241	0	241
Wentworth town	80%	3,357	58	319	148
Westmoreland town	75%	3,180	68	837	101
Whitefield town	72%	3,027	80	857	100
Wilmot town	8%	118	231	3	230
Wilton town	74%	3,142	73	2,178	59
Winchester town	79%	2,580	124	877	97
Windham town	82%	2,799	104	2,270	56
Windsor town	NA	0	243	0	243
Wolfeboro town	79%	3,539	46	4,809	38
Woodstock town	63%	1,915	168	235	162

NOTES

1. Based on data from the U.S. Department of Energy, Energy Information Administration, *State Energy Data Consumption Tables, 2001,* compiled for New England Climate Coalition, *Getting on Track: New England's Rising Global Warming Emissions and How to Reverse the Trend*, February 2005. See www.newenglandclimate.org for a copy of the report.

2. Global warming emissions based on data from the U.S. Department of Energy, Energy Information Administration, *State Energy Data Consumption Tables, 2001,* compiled for New England Climate Coalition, *Getting on Track: New England's Rising Global Warming Emissions and How to Reverse the Trend*, February 2005. Population change based on U.S. Census Bureau, *Intercensal Estimates*, downloaded from www.census.gov/popest/archives/2000s/vintage_2001/CO-EST2001-12/CO-EST2001-12-33.html, 26 May 2005 and U.S. Census Bureau, *Table 1: Annual Estimates of the Population of the United States and States, and for Puerto Rico: April 1, 2000 to July 1, 2004*, 22 December 2004.

3. The Road Information Program, *New Hampshire's Roads And Bridges: The Need to Further Modernize The Backbone of the State's Transportation System*, February 2004.

4. See note 1.

5. Conference of New England Governors and Eastern Canadian Premiers, *Climate Change Action Plan 2001*, August 2001.

6. New Hampshire Department of Environmental Services, *The Climate Challenge,* December 2001.

7. U.S. Department of Transporation, Federal Highway Administration, *Summary of Travel Trends: National Household Transportation Survey 2001*, December 2004.

8. See Jayanthi Rajamani, Chandra Bhat, et al, *Assessing the Impact of Urban Form Measures in Nonwork Trip Mode Choice After Controlling for Demographic and Level-of-Service Effects*, presented at 2003 Annual Meeting of Transportation Research Board, 15 January 2003; and similar studies.

9. Based on U.S. Environmental Protection Agency, *AirData* database, downloaded from www.epa.gov/air/data, 26 May 2005. Data are for 1999.

10. Federal Highway Administration, *Highway Statistics 2002*, downloaded from www.fhwa.dot.gov, April 2005.

11. See note 3.

12. This figure includes emissions from residents of New Hampshire commuting to workplaces in other states. See "Methodology" for more details.

13. The choice of estimation method for in-town and other commutes overestimates emissions from towns that cover a large area—such as the town of Pittsburg in far northern New Hampshire.

14. U.S. Department of Transportation, *BTS Reports that 3.3 Million Americans are "Stretch Commuters" Traveling at Least 50 Miles One-Way to Work*, press release, 12 May 2004.

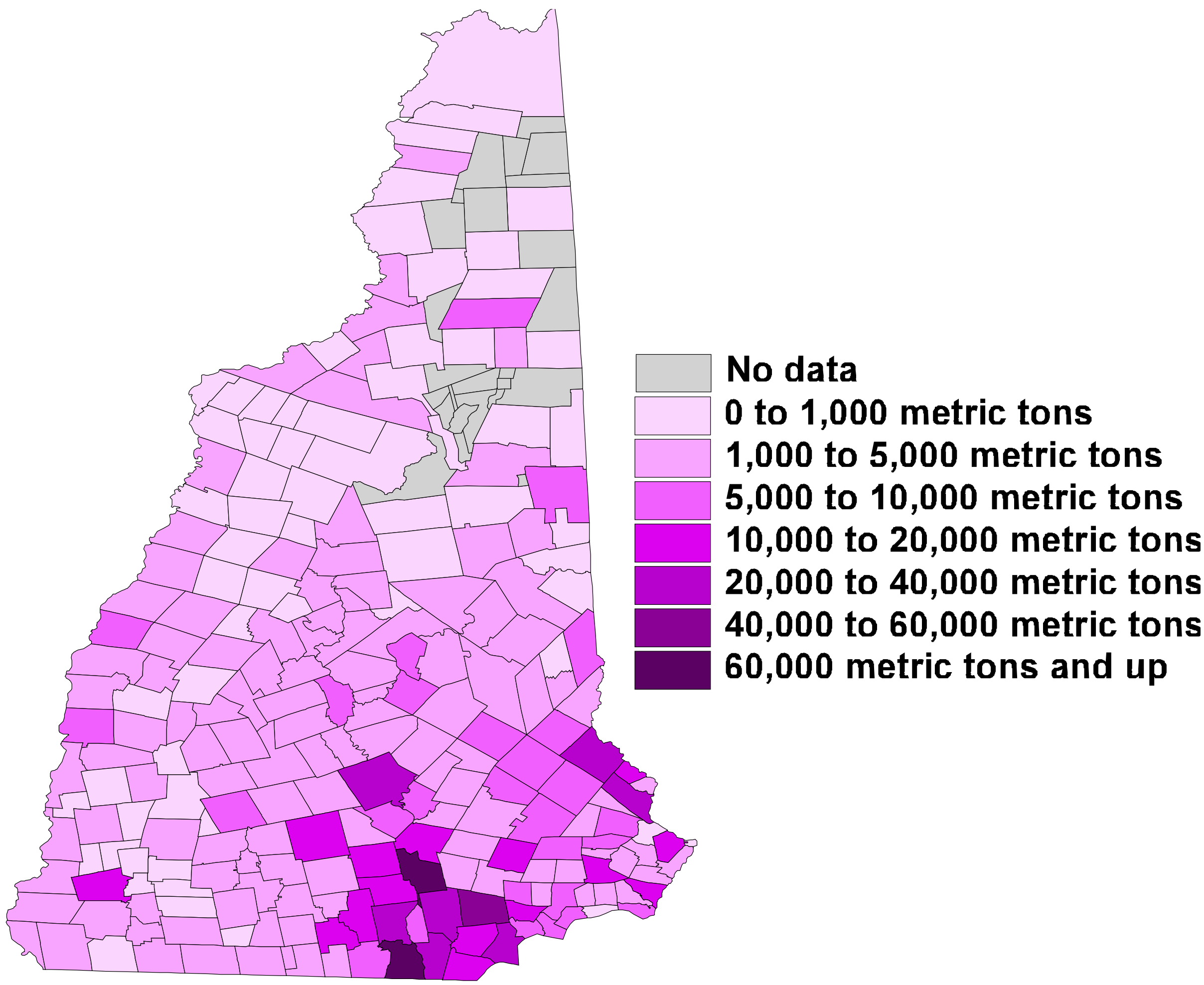
15. New Hampshire Office of Energy and Planning, State Data Library, www.nh.gov/oep/programs/DataCenter/library, downloaded 11 March 2005.

16. Nashua Regional Planning Commission, *Nashua-Lowell Commuter Rail Fact Sheet*, 1 September 2005.

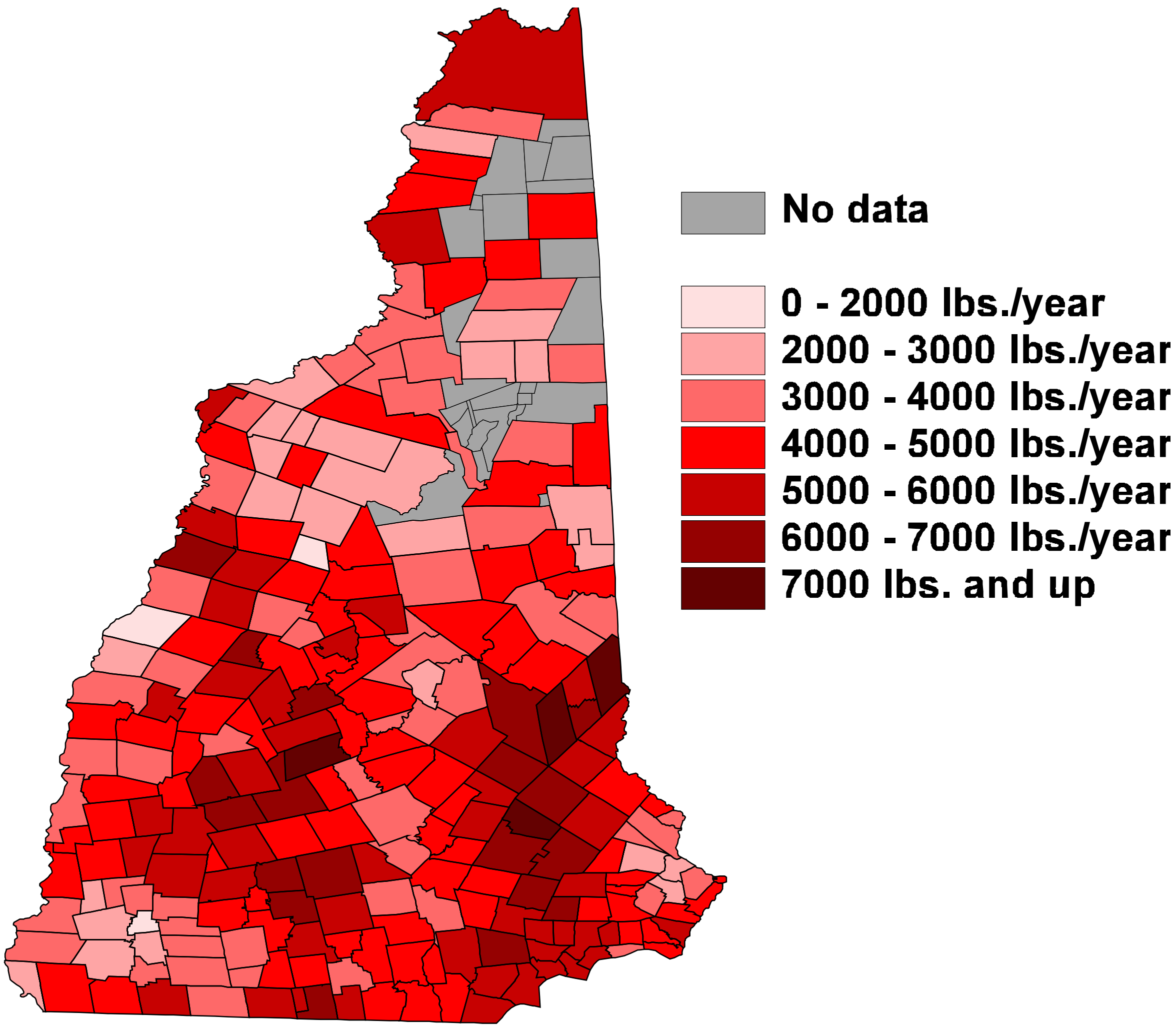
17. Northern New England Passenger Rail Authority, *Performance Report – September 2005*, undated.

18. "New Side Track Will Enable Downeaster to Add Fifth Round-Trip Run," *Associated Press*, 18 November 2005.

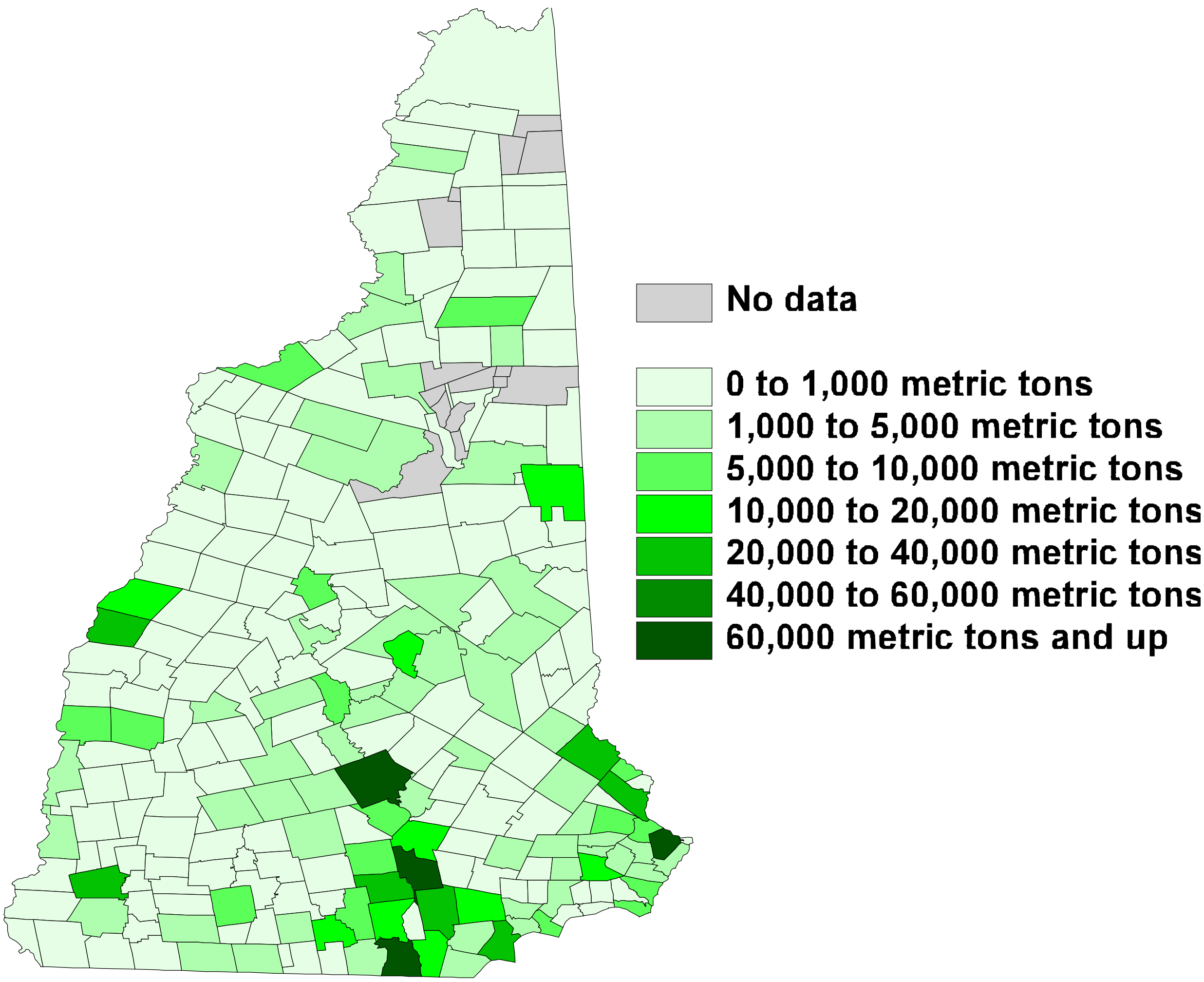
Total Carbon Dioxide Emissions by Place of Residence



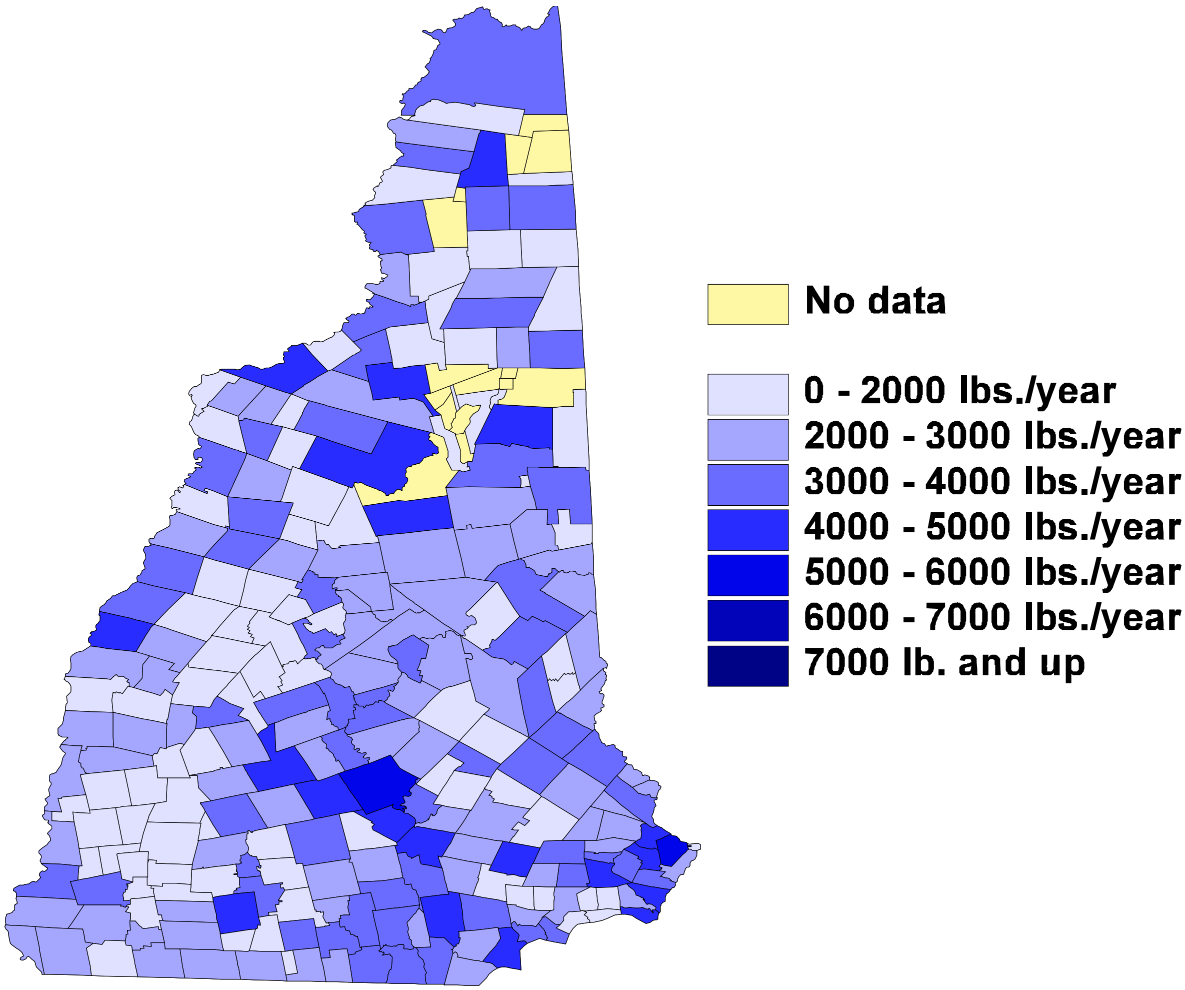
Per-Worker Carbon Dioxide Emissions by Place of Residence



Total Carbon Dioxide Emissions by Place of Work



Per-Worker Carbon Dioxide Emissions by Place of Work



The New England Climate Coalition

The New England Climate Coalition (NECC) is a coalition of state and local environmental, public health, municipal and religious organizations concerned about the effects of global warming. NECC supports reductions in emissions of global warming gases sufficient to protect the region's environment and economy from the dangers posed by global warming.

For more information about NECC visit our web site at www.newenglandclimate.org, or contact the following NECC founding organizations:

Connecticut

- Clean Water Fund, 645 Farmington Avenue, 3rd Floor, Hartford, CT 06105, 860-232-6232, www.cleanwateraction.org/ct
- ConnPIRG Education Fund, 198 Park Road, 2nd Floor, West Hartford, CT 06119, 860-233-7554, www.connpirg.org

Maine

- Natural Resources Council of Maine, 3 Wade Street, Augusta, ME 04330, 207-622-3101, www.maineenvironment.org
- Environment Maine Research & Policy Center, 39 Exchange St., #301, Portland, ME 04101, 207-253-1965, www.environmentmaine.org

Massachusetts

- Clean Water Fund, 262 Washington St., Room 301, Boston, MA 02108, 617-338-8131, www.cleanwateraction.org/ma
- MASSPIRG Education Fund, 44 Winter Street, 4th Floor, Boston, MA 02108, 617-292-4800, www.masspirg.org

New Hampshire

- Clean Water Fund, 163 Court St., Portsmouth, NH 03801, 603-430-9565, www.cleanwateraction.org/nh
- NHPIRG Education Fund, 30 S. Main St., Suite 101, Concord, NH 03301, 603-229-3222, www.nhpirg.org

Rhode Island

- Clean Water Fund, 741 Westminster St., Providence, RI 02903, 401-331-6972, www.cleanwateraction.org/ri
- RIPIRG Education Fund, 11 South Angell Street, #337, Providence, RI 02906, 401-421-6578, www.ripirg.org

Vermont

- Vermont Public Interest Research & Education Fund, 141 Main St., Suite 6, Montpelier, VT 05602, 802-223-5221, www.vpirg.org