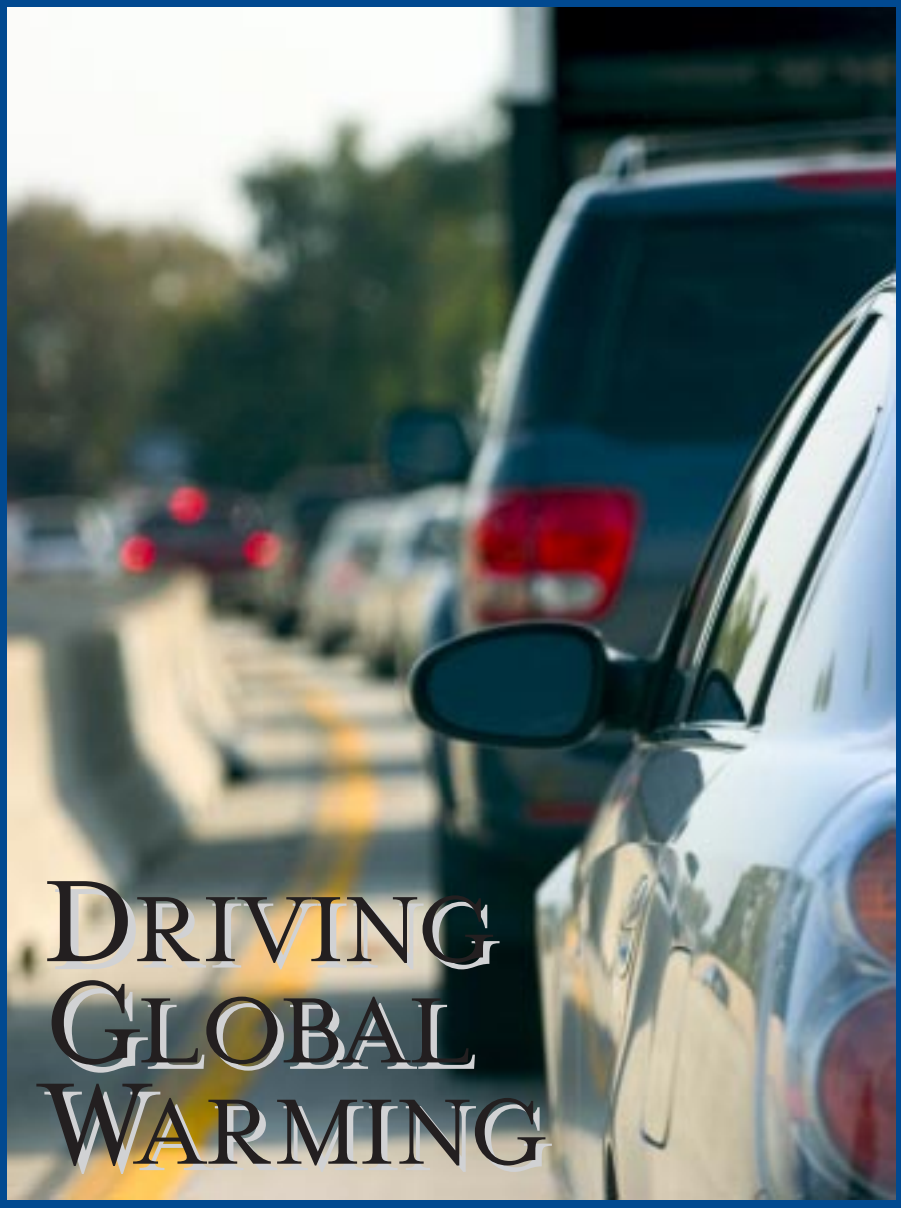

Driving Global Warming

Commuting in Connecticut and its Contribution to Global Warming

CONNPIRG EDUCATION FUND

CLEAN WATER FUND

January 2006

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With Contributions from the New England Climate Coalition Steering Committee

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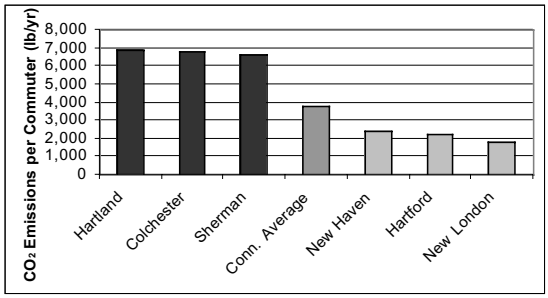
Executive Summary

Transportation is the leading source of global warming pollution in Connecticut, and trips to and from work are a major part of the problem. Just over a quarter of all vehicle miles nationally are driven on trips to and from work. To reduce global warming pollution from cars and trucks – and to meet the goals of the state's climate change action plan – Connecticut must find ways to reduce the global warming impact of commuting.

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.

Commuters in Connecticut's fast-growing "exurbs" produce about three times more carbon dioxide, on average, than commuters living in Connecticut's more densely developed cities.

Fig. ES-1. Average Annual Per-Worker Emissions by Residents of Three Exurban Towns and Three Traditional Cities
(pounds per year)



- Commuters living in Connecticut's oldest and most densely developed cities – such as Hartford, New Haven, and New London – produce the lowest emissions of carbon dioxide per worker in the state. By contrast, fast-growing "exurban" communities produce much greater per capita levels of emissions. (See Fig. ES-1.)

Drive-alone trips produce the majority of commuting-related global warming pollution in Connecticut.

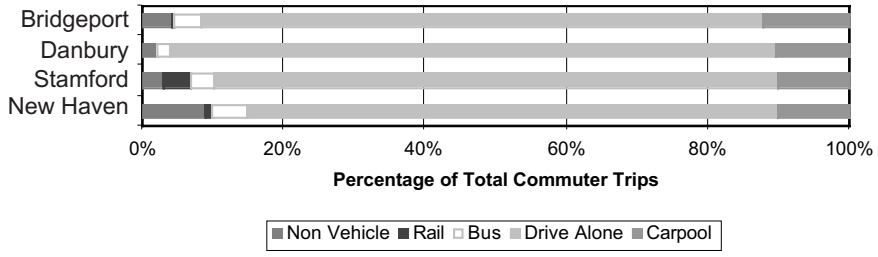
- About four out of every five Connecticut commuters drive to work alone. Towns with the greatest proportion of drive-alone commuters also tend to have the highest per-worker global warming emissions from commuting.

- While Connecticut has an extensive rail network, it fails to serve adequately the state's centers of employment. Although four of the five largest cities in Connecticut are located along the state's rail network, the majority of commuters traveling to these cities drive alone to work – less than 4 percent of these commuters ride the train. (See Fig. ES-2.)

Good transit service can reduce carbon dioxide emissions from commuting. For example, only 17 percent of commutes to Manhattan (the leading out-of-state draw for Connecticut commuters) occur via single-passenger automobile, leading to significantly lower emissions from these commutes.

- Commuters traveling into New York City make up the majority (78 percent) of all Connecticut commuters who ride commuter rail to work. The

Fig. ES-2. Transportation Mode Choice by Place of Work in Connecticut Cities with Commuter Rail Service



effectiveness of the regional rail network in transporting commuters to New York City should serve as a platform for increasing transit to communities located along the regional rail network and reducing Connecticut's total carbon dioxide emissions.

Connecticut should take a series of immediate and long-term actions to reduce global warming pollution from commuting. The state should fully implement the state's Climate Change Action Plan, which includes numerous policies for reducing global warming pollution from all forms of vehicle travel. Specific areas of focus should include:

- Extending the regional transit network to promote connections with residential and work locations in neighboring states and in areas currently underserved by transit.

- Encouraging transit-oriented development, improving transit service to centers of employment located along the existing regional rail network, and making the state's rail stations more accessible.

- Putting the brakes on exurban development in rural areas by revitalizing Connecticut's urban areas and encouraging compact, mixed-use development.

- Adopting vehicle global warming emission standards and incentives for the purchase of vehicles that produce less carbon dioxide per mile.

Introduction

The New England states have taken 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 unprecedented 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. Five of the six New England states, including Connecticut, have moved to adopt the clean cars program, which will require the production of advanced-technology vehicles and set global warming emission standards for all cars and light trucks. The impact of these initiatives will be substantial: by 2020, states adopting the full clean cars program can expect emissions from light-duty cars and trucks to roughly stabilize at today's levels.

But stability is not enough – transportation-sector carbon dioxide pollution increased by 12 percent in New England between 1990 and 2001 and now represents the largest source of emissions in the region. Achieving the region's global warming emission reduction targets will require the New England states to find ways to *reduce* global warming emissions from cars and trucks. And the most promising way to achieve that goal is by reducing the rate of growth in vehicle travel – particularly single-passenger travel in automobiles and light trucks.

Connecticut's Climate Change Action Plan, approved by the Governor's Steering Committee on Climate Change in February 2005, includes several approaches to reduce the rate of growth of vehicle travel in the state. Implementation of those proposals would be a strong first step.

A thoughtful approach to achieving further reductions in 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 enables 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 emissions 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 climate change – and reducing the threat it poses to New England – the time to do so is now.

The journeys that Connecticut residents make to and from work have a large impact on the state's contribution to global warming. Reducing global warming emissions from commuting can have positive ripple effects both on other transportation-related emissions and on other aspects of quality of life.

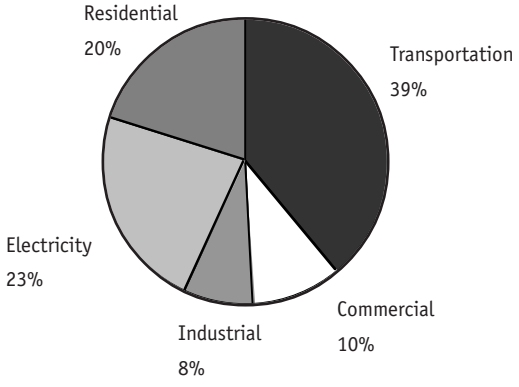
The Role of Transportation in Global Warming

Transportation is the largest source of global warming pollution in Connecticut. In 2001, 39 percent of Connecticut's emissions of carbon dioxide – the leading global warming gas – came from the movement of people and goods via automobile, truck, train or other mode of transportation.[1] (See Fig. 1.) Transportation-sector emissions of carbon dioxide increased in the state by 12 percent between 1990 and 2001.[2]

Connecticut's emissions of global warming gases from transportation are significant on a global scale. In 2000, the state's transportation system was responsible for more carbon dioxide emissions than the entire economies of 131 nations, including Jordan, Estonia, and Zimbabwe.[3]

Given recent trends in vehicle fuel economy (a major determinant of carbon dioxide emissions) and vehicle travel, carbon dioxide emissions from transportation in Connecticut can be expected to increase significantly over the next several decades. The total number of passenger vehicle miles traveled in Connecticut is projected to increase by 22 percent from 2000 to 2020 and over the next 45 years there is projected to be more than a 60 percent increase in carbon dioxide emissions from the transportation sector.[4]

Fig. 1. Connecticut's Carbon Dioxide Emissions from Fossil Fuel Consumption, 2001[5]



Reining in carbon dioxide emissions from the transportation sector is a key part of the state's efforts to reduce global warming pollution and meet the goals adopted by the New England states in 2001 and by the Connecticut Legislature in 2004. These goals call for overall reductions in global warming pollution to 1990 levels by 2010, to 10 percent below 1990 levels by 2020, and eventually by the 75 to 85 percent below current levels that scientists believe will be necessary to stabilize the concentration of global warming gases in the atmosphere.

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

Why Commuting Matters

Connecticut's transportation system is designed with many goals in mind, but foremost among them is enabling people to travel conveniently 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, which tend to be 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 in the 1950s and 1960s, 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 release of pollution that traps the sun's radiation near the earth's surface. Over the past 250 years – and particularly since World War II – the concentrations of these heat-trapping gases in the atmosphere 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 difficult-to-predict effects on wildlife, ecosystems and public health.

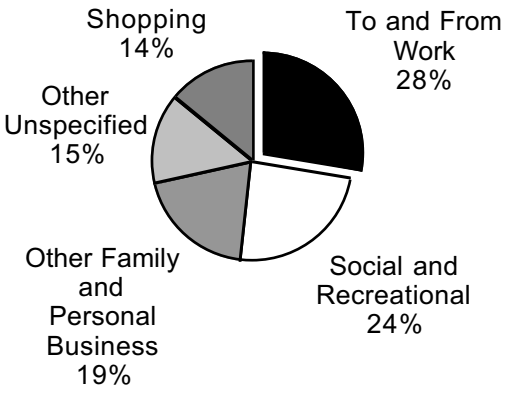
Carbon dioxide is released into the atmosphere mainly through the burning of fossil fuels, such as the gasoline consumed in cars and light trucks. Unlike other pollutants, carbon dioxide cannot currently be captured or otherwise eliminated through the use of emission-control devices. As a result, there are three main ways to reduce carbon dioxide emissions from vehicles:

1) drive fewer miles
2) switch to lower carbon fuels, such as biofuels
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, and 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 that consume more fuel and produce more global warming pollution. 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.[6] (See Fig. 2.)

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



The public policies that help shape commuting behavior – such as residential and commercial zoning and transportation infrastructure investments – also impact other aspects of vehicle travel. Individuals who live in densely populated neighborhoods are more likely to walk or bicycle to engage in shopping, recreation or other opportunities.[7] Conversely, residents of low-density suburbs often have little choice but to drive their automobiles longer distances to conduct their daily non-work activities.

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 an area of compact development 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 travel makes a large contribution to transportation global warming pollution in Connecticut, 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 adverse impacts on the environment and society.

- **Air pollution** – Automobiles are major contributors to health-threatening air pollution in Connecticut. Light-duty vehicles such as cars, pick-up trucks, minivans and sport utility vehicles (SUVs) are responsible for more than one-quarter of Connecticut's air emissions of nitrogen oxides (NOx) and volatile organic compounds (VOCs) – the two chemical components of ozone smog. Vehicles also emit other health-threatening pollutants – such as particulate matter and toxic chemicals – in their exhaust.[8] Nearly every resident of Connecticut is exposed to levels of air toxics that exceed the government's threshold for cancer risk, and smog levels in the state are often above levels known to damage the lungs and trigger asthma attacks.[9]

- **Congestion** – Single-passenger automobile commutes are key contributors to congestion, particularly at peak travel periods. In the Bridgeport-Stamford metropolitan corridor in 2002, the average rush-hour commuter spent 31 hours per year in traffic. The average peak-time commuter in New Haven spent 22 hours per year in traffic and the average Hartford commuter spent 17 hours per year in traffic. Congestion from these three metropolitan areas resulted in the consumption of 50 million excess gallons of gasoline and cost the region about $512 million in lost time and wasted fuel.[10] Policies and practices that encourage single-passenger automobile commutes (such as highway expansion and failure to support carpooling and alternative modes of transportation) add to this congestion.

- **Highway expenditures** – Chronic congestion often brings calls for new or expanded highway capacity – both major highways and local roads and streets. Expansion of road capacity imposes large costs on state and local governments, both for highway construction and for ongoing maintenance. In 2003 the state spent nearly $1.4 billion on highway construction, operation, and maintenance.[11] Highway expansion also frequently fails to solve the problem of congestion (at least in the long run) due to the propensity of new or expanded highways to generate additional vehicle travel – a phenomenon known as "generated traffic."[12]

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

Global Warming Emissions from Commuting in Connecticut

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 emissions produced by commuters traveling to and from various locations in Connecticut 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 emissions.

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 more 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 only allows 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 Connecticut were responsible for about 2.7 million metric tons of carbon dioxide emissions in 2000.[13] More than a third (37 percent) of these emissions came from residents of 20 cities and towns. (See map on page A of the color insert at the center of this report and Table 1, below.)

Many of the state's largest cities and towns dominate the list for total carbon dioxide emissions. In addition, many of these cities and towns lie in regional

Table 1. Commuting-Related Carbon Dioxide Emissions by Residence, Top 20 Towns

City or Town	Total CO_2 Emissions (metric tons)
Waterbury	81,078
Stamford	80,888
Bridgeport	79,814
Danbury	71,229
Norwalk	58,482
New Haven	52,114
Milford	50,553
Bristol	48,953
Manchester	45,357
Meriden	45,040
Fairfield	43,583
Enfield	42,193
Wallingford	41,385
Middletown	41,280
Hamden	40,807
Hartford	40,164
Stratford	39,810
New Britain	39,288
Southington	38,577
West Haven	37,677

clusters (Fairfield County and the Hartford and New Haven metropolitan areas) that could allow for the creation of effective regional transit networks to serve as an alternative to single-passenger automobile commuting. Notably, Hartford, which ranks sixth in terms of the total number of commuters, ranks only 16th in terms of total carbon dioxide emissions. Hartford's low level of emissions result from the fact that Hartford residents are less likely to drive to work alone than residents of any other city or town in the state, except for New Haven, and that the average Hartford commuter travels only 6 miles to work.

Towns producing the greatest amount of emissions generally lie along Connecticut's highway network, including Interstate 95 (between New York and New Haven), Interstate 91 (between New Haven and Hartford), Interstate 84 (between the New York border and Hartford), and along Interstate 395 in eastern Connecticut. Many of these communities have relatively low emissions per worker, but the sheer volume of emissions suggests that they are good candidates for action to reduce Connecticut's contribution to global warming.

On average, each commuter living in Connecticut produces 3,804 pounds of carbon dioxide per year. However, on a per-commuter basis, there is wide variation in carbon dioxide emissions among residents of the state's cities and towns. (See map on page B of the insert.) The lowest per-worker emissions are among residents in the Hartford and New London metropolitan regions, and in Fairfield County.

Among the 90 Connecticut communities with total emissions of greater than 10,000 metric tons per year, the top 10 towns for per-worker emissions are predominantly located in a large suburban ring around Hartford. (See Table 2.)

By contrast, the towns with the lowest levels of per-worker emissions (among those with 10,000 metric tons of annual emissions or greater) include larger cities such as Hartford and New Haven, as well as towns located adjacent to Hartford and New London, and in Fairfield County. (See Table 3.)

Table 2. Top 10 Towns for Per-Worker Carbon Dioxide Emissions by Place of Residence
(Towns with Annual Emissions Greater than 10,000 Metric Tons)

City or Town	CO_2 Emissions per Commuter (lb/yr)	Total CO_2 Emissions (metric tons)
Colchester	6,832	22,530
New Fairfield	6,154	18,238
Hebron	6,036	11,757
East Haddam	5,970	11,045
Stafford	5,947	14,571
Madison	5,859	22,011
Newtown	5,673	29,910
Tolland	5,628	17,038
Coventry	5,576	14,624
New Milford	5,472	34,471

Table 3. Lowest 10 Towns for Per-Worker Carbon Dioxide Emissions by Place of Residence
(Towns with Annual Emissions Greater than 10,000 Metric Tons)

City or Town	CO_2 Emissions per Commuter (lb/yr)	Total CO_2 Emissions (metric tons)
Hartford	2,194	40,164
New Haven	2,436	52,114
Groton	2,521	22,983
Wethersfield	2,639	14,257
West Hartford	2,797	35,098
New Britain	2,837	39,288
Waterford	2,854	11,456
East Hartford	2,893	29,740
Bloomfield	2,897	10,922
Norwalk	2,984	58,482

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

Commuting from Neighboring States into Connecticut

In addition to Connecticut-based commuters, approximately 60,700 commuters travel into the state to work. These trips are significant sources of emissions, responsible for about 221,000 metric tons of carbon dioxide emissions each year – or 8 percent of the total emissions created by people who work in Connecticut.

In terms of total emissions, the greatest amount of carbon dioxide comes from commuters from towns in New York, Massachusetts and Rhode Island. (See Fig. 3.) More carbon dioxide is generated by commuters living in Springfield, MA (19,230 metric tons) than from any other out-of-state city or town. However, if emissions from residents of the five boroughs of New York City are combined, they would account for nearly 36,800 metric tons of emissions, and become the largest source of emissions from out-of-state commuters traveling to Connecticut.

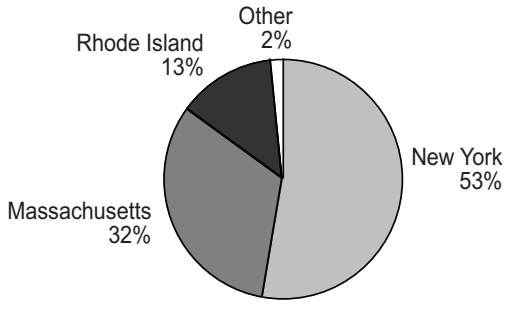
Unsurprisingly, commuters traveling to Connecticut for work produce substantially more emissions than commuters within the state – an average of 8,002 pounds of carbon dioxide per worker per year (compared to the in-state average of 3,804 pounds).

Commuting Emissions by Place of Work

Statewide

Commuters traveling to workplaces in Connecticut generated approximately 2.73 million metric tons of carbon dioxide emissions in 2000. (See map on page C of the insert.)

Fig. 3. Carbon Dioxide Emissions from Commutes to Workplaces in Connecticut from Neighboring States



Commuters heading to Hartford produced more emissions than did commuters traveling to any other town or city in the state – about 8 percent of the emissions from trips made to workplaces in Connecticut. About 37 percent of all emissions are from commutes to 10 Connecticut cities and towns. (See Table 4.)

Table 4. Top 10 Towns for Carbon Dioxide Emissions by Place of Work

City or Town	Total CO_2 Emissions (metric tons)
Hartford	220,145
Stamford	171,617
New Haven	112,457
Danbury	89,908
Norwalk	87,747
Greenwich	73,406
Bridgeport	68,671
Middletown	64,861
Groton	59,398
Waterbury	56,639

Cities and suburban communities located along the Connecticut's major highways are the leaders in per-worker carbon dioxide emissions by place of work. (See map on page D of the insert.) Among destination towns with commuting emissions of 10,000 metric tons or more, the leading communities for emissions per worker are suburban locations – most of them in the Hartford metropolitan area or along the I-84, I-95 and I-91 corridors. (See Table 5.)

Table 5. Top 10 Destination Towns for Carbon Dioxide Emissions per Worker
(Total Emissions Over 10,000 Metric Tons)

City or Town	CO_2 Emissions per Worker (lb/yr)
Ledyard	5,047
Windsor	4,889
Stamford	4,787
Middletown	4,769
Rocky Hill	4,760
Wilton	4,747
Southbury	4,722
Bloomfield	4,655
Hartford	4,597
Greenwich	4,566

The list of towns with the lowest per-capita inbound emissions is dominated by smaller urban and suburban areas. (See Table 6.)

Table 6. Bottom 10 Destination Towns for Carbon Dioxide Emissions per Worker
(Total Emissions Over 10,000 Metric Tons)

City or Town	Total CO_2 Emissions (metric tons)
Plainville	2,888
Watertown	2,954
New London	2,992
Vernon	3,043
Hamden	3,062
Bristol	3,068
West Haven	3,081
Orange	3,081
Bethel	3,114
Waterbury	3,127

Commuting to Work Out of State

Just as many out-of-state residents commute to workplaces in Connecticut, a significant number of Connecticut residents travel to neighboring states to work. Nearly 62,700 Connecticut residents travel outside of the state to work – slightly more than the number of out-of-state residents who travel to work in Connecticut.

In 2000, commuters traveling to other states were responsible for about 211,700 metric tons of carbon dioxide, or roughly 7 percent of emissions from people living in Connecticut. The most significant source of out-of-state commuting emissions comes from Connecticut residents commuting to New York. (See Fig. 4.)

New York City and its surrounding suburbs are the leading attraction for Connecticut residents. In fact, if Manhattan were located in Connecticut, it would rank seventh for commuting emissions by place of work. New York City's five boroughs, if combined, would rank fourth. In Massachusetts, Springfield and Worcester are the leading draws. (See Table 7.)

Commuters traveling out of state for work produce substantially more emissions than commuters within the state – an average of 7,433 pounds of carbon dioxide per worker per year (compared to the in-state average of 3,804 pounds). However, there is great variation among out-of-state towns – even when their distance from Connecticut's borders is similar. For example, Connecticut commuters bound for Manhattan produce an average of only 5,480 pounds of carbon dioxide per year, while commuters bound for White Plains produce an average of 9,480 pounds. The difference has a great deal to do with the use of transit for Manhattan-bound commuters. (For more on transit use to Manhattan, see page 15.)

Fig. 4. Carbon Dioxide Emissions from Connecticut Residents Traveling Out of State for Work

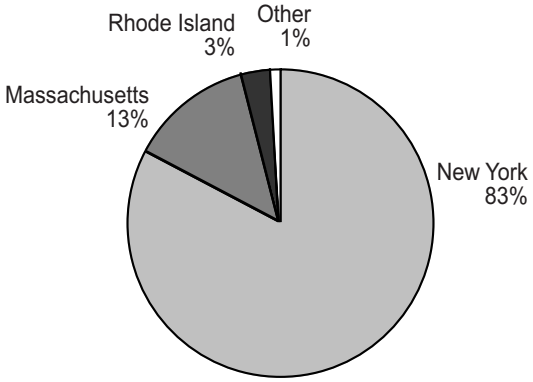


Table 7. Top 10 Out-of-State Cities for Carbon Dioxide Emissions from Connecticut Residents

City or Town	Total CO_2 Emissions (metric tons)
Manhattan, NY	69,415
White Plains, NY	15,621
Queens, NY	11,179
Greenburgh, NY	10,159
Harrison, NY	9,013
Bronx, NY	8,382
Springfield, MA	7,219
Mount Pleasant, NY	6,705
Brooklyn, NY	5,567
Worcester, MA	5,100

Factors Influencing Emissions

Across the state's 169 cities and towns, global warming emissions from commuting can be explained by several factors, specifically: the availability of alternatives to single-passenger commutes, land use patterns, and the distance commuters live from work.

Use of Transit and Transportation Alternatives

The availability of a variety of transportation options – including carpooling, rail and bus service – is a key factor in the amount of carbon dioxide emissions generated from transportation. Driving alone to work produces more carbon dioxide emissions than most other alternatives.

In much of Connecticut, the availability of viable alternatives to drive-alone commuting is limited. Connecticut's largest cities are roughly similar in the degree to which inbound commuters travel alone to work. Between 73 percent and 83 percent of commuters traveling to Connecticut's five largest cities and towns drive alone. (See Table 8.)

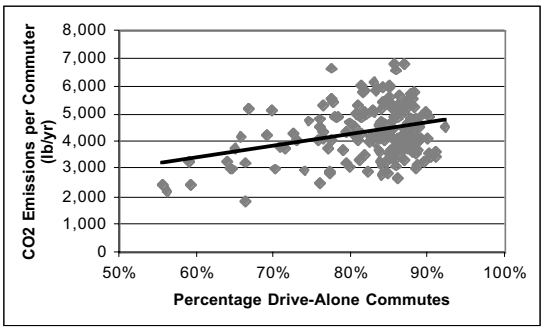
Table 8. Percentage of Drive-Alone Commuters Working in Connecticut's Five Largest Cities and Towns

City or Town	Number of Workers	Percent of Drive Alone Commuters
Hartford	105,349	79%
Stamford	78,864	77%
New Haven	74,629	73%
Bridgeport	45,685	77%
Danbury	45,279	83%

Alternatives to Drive-Alone Commuting

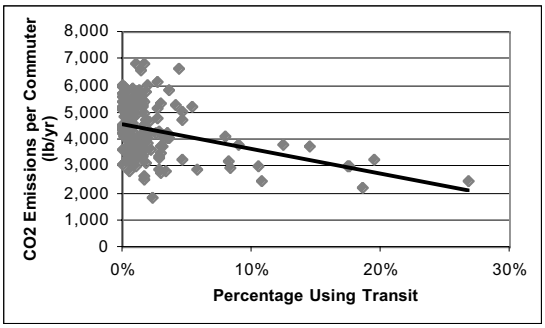
As Fig. 5 shows, global warming emissions per commuter increase as the percentage of commutes made in single-passenger vehicles increases.

Fig. 5. 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 as the percentage of workers taking any form of transit (bus, commuter rail, or other) increases. (See Fig. 6.)

Fig. 6. Percentage of Transit Users versus Carbon Dioxide Emissions per Worker by Place of Residence



These relationships show that towns with fewer drive-alone commuters and more transit users produce lower levels of per-commuter carbon dioxide emissions. This suggests that efforts to reduce drive-alone commuting and promote transportation alternatives can yield significant reductions in carbon dioxide emissions from commuting. Therefore, developing stronger transit networks must be an integral component of any plan to reduce global warming emissions in Connecticut.

Riding the Commuter Rail to Work in Connecticut

While Connecticut's commuter rail network does a good job of transporting workers to and from New York City, it is far less successful in serving the needs of commuters traveling to Connecticut cities for work. The number of drive-alone commuters traveling to cities located along the MTA's New Haven Line (New Haven, Stamford and Bridgeport) is only slightly lower than the number of drive-alone commuters traveling to Hartford, which has no commuter rail service. A look at the five Connecticut cities with the highest number of workers who commute to work by train further highlights the fact that relatively few commuters use the regional rail network to travel to workplaces in Connecticut. (See Table 9.)

Table 9. Top Five Towns with the Greatest Number of Inbound Commuters Traveling by Train

Town	Number of Commuters Traveling by Train	Percent of Commuters Traveling by Train
Stamford	2,993	4%
Greenwich	1,148	3%
Norwalk	654	2%
New Haven	643	1%
Westport	212	1%

Less than 5 percent of workers commuting to these cities and towns – each of which is fairly large and is directly serviced by the MTA's New Haven Line – take the train. An even smaller percentage of commuters take the train to workplaces to towns along the New Canaan, Danbury, and Waterbury branch lines.

Even along Connecticut travel corridors where commuter rail service is fast and frequent in both directions, few commuters travel by train. For example, Bridgeport residents traveling to work in Stamford (an average roundtrip commute of more than 40 miles) are responsible for a larger percentage of Stamford's inbound emissions than commuters from any other town, yet only 7 percent of these commuters ride the commuter rail to work.

Fairfield County and Commutes Into New York City

Nowhere can the benefits of a strong transit network be seen more clearly than in the southern part of Fairfield County, which has some of the state's lowest per-commuter carbon dioxide emissions by place of residence. In a ranking of Connecticut's 169 cities and towns by per-worker carbon dioxide emissions, Westport ranks 146th, New Canaan ranks 154th, Greenwich ranks 155th, Stamford ranks 156th, Norwalk ranks 158th, and Darien ranks 166th.

Of the 10 Connecticut towns with the highest percentage of transit users, nine of these towns are located in the southern part of Fairfield County. More than 15 percent of commuters from Fairfield County towns such as Darien, Westport, New Canaan and Greenwich commute using some form of transportation other than the automobile – the majority of these commuters ride the train while traveling to workplaces in Manhattan.

The Metropolitan Transit Authority's (MTA) Metro-North Railroad transports 72 percent of the more than 20,000 Connecticut residents who routinely travel to work in Manhattan. If each of these commuters drove alone, the region's highways would be significantly more crowded and the amount of carbon dioxide produced by Connecticut residents would be substantially higher.

New York City is obviously a special case as a draw for commuters – both the extreme levels of traffic congestion and the sheer volume of jobs in Manhattan drive extensive use of commuter rail. However, this example also shows that investment in transit infrastructure can significantly reduce carbon dioxide emissions from transportation and Connecticut should look for ways to extend the success of the region's rail network in serving New York City to serving other destinations for Connecticut workers.

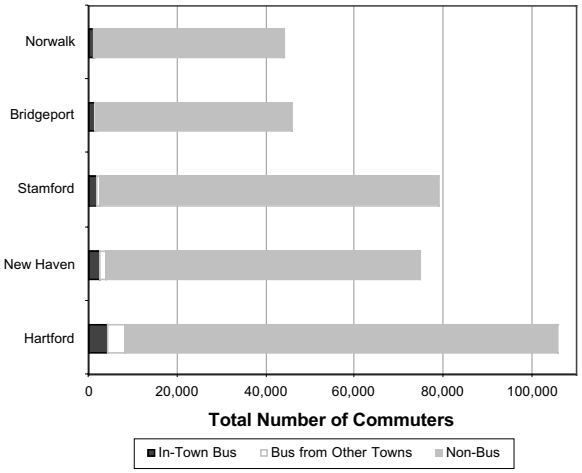
Connecticut's failure to maximize the potential of its rail network represents a missed opportunity to reduce global warming emissions and alleviate highway congestion. Getting large numbers of Connecticut-bound workers to switch to rail will require a number of actions, including maintaining the affordability and reliability of rail service, encouraging transit-oriented development near existing stations, and improving the accessibility of rail stations from homes and workplaces. Easing the parking crunch at commuter rail stations and using shuttle bus services to link residential neighborhoods and office parks with rail service are among the steps that can be taken to expand access to rail within the state.

Expanding Commuter Rail and Bus Service

Making better use of the region's rail network has the potential to significantly reduce carbon dioxide emissions from commutes between cities served by rail. But expansion of the state's rail and transit network is also vitally important.

Many of the towns with the highest per-worker and total carbon dioxide emissions from inbound commuters lie along the Interstate 91 corridor linking New Haven, Hartford and Springfield, Massachusetts. Yet, this region is currently the only major metropolitan corridor within the state with no commuter rail service. Extension of commuter rail from New Haven to Hartford and Springfield (with effective connections to Bradley Airport, a major center of employment) could serve to reduce commuting emissions in this heavily traveled corridor. Other dormant rail corridors in the state might also benefit from reinstatement of rail service.

Fig. 7. Top Five Towns (by place of work) with the Greatest Number of Commuters



Expansion of bus service could also play a role in reducing commuting-related emissions. Connecticut's largest cities and towns currently have the greatest number of number of commuters who take the bus to work. (See Fig. 7.) However, a quick look at ridership numbers suggests that there is significant room for Connecticut to develop better local and commuter bus networks.

Traveling by Bus

Hartford has the most extensively developed bus network in the state – not only do more people take the bus to work in Hartford than any other town, but Hartford also has the highest percentage of workers who commute by bus (8 percent of people who work in Hartford ride the bus to work).

Across the state, the majority of bus commutes are short in-town trips. However, because long-distance commutes produce significantly more carbon dioxide emissions than shorter commutes, developing a long-distance commuter bus network has the potential to significantly reduce carbon dioxide emissions – particularly for bedroom communities that are too small, or that send commuters in too many directions, to support rail transit.

A commuter bus network that brings workers long distances to large employment centers would be similar in nature to the commuter bus network developed to bring workers to the Foxwoods Casino in Ledyard. Long-distance commutes to Ledyard are among the reasons why the town has the highest level of per-worker emissions Connecticut by place of work. But the impact of those commutes has been muted somewhat by the fact that the town has the second highest percentage of commuters who travel to work by bus (nearly 8 percent), demonstrating that expanding commuter bus opportunities can reduce the impact of large regional employment centers on global warming.

Land-Use Patterns

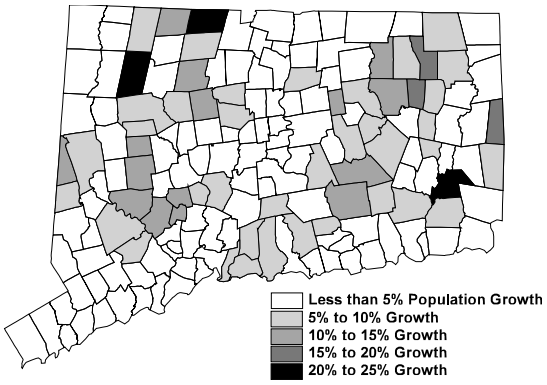
Population density and residential land use patterns have played a major role in increasing commute lengths and, by extension, increasing global warming emissions in Connecticut.

Exurban Development

The growth of formerly rural "exurban" communities is characterized by low-density development. This type of growth is the dominant development pattern found in Connecticut.

In the last 10 years, three significant exurban development hot spots have emerged in Connecticut: the suburbs northwest of Hartford, the northern fringes of New Haven and Fairfield counties, and a north-south band stretching from northwestern New London County to northeastern Windham County. (See Fig. 8.)

Fig. 8. Population Growth in Connecticut, 1995-2005



With few exceptions, residents living in Connecticut's fastest growing communities are responsible for some of the highest per-commuter carbon dioxide emissions in the state.

From a global warming perspective, the fast growth in these exurban communities creates several problems. First, by increasing distances between homes and jobs, exurban growth leads to increases in average commute length and in total vehicle miles traveled – which, by extension, results in more global warming emissions. Second, many exurban developments are distant from existing transit infrastructure, meaning longer commutes that are less likely to occur via transit.

The impact of exurban development can be seen in the growth of "stretch commutes" – trips to work of 30 miles or more. In several Connecticut communities – primarily those located on the New York state border – stretch commutes are responsible for one-third to one-half of all commuting-related emissions. (See Table 10.)

One of these communities is the town of Sherman, which saw its population increase by 11 percent between 1995 and 2005. Sherman ranks third in the state for per-worker carbon dioxide emissions from commuting (6,656 pounds per commuter). More than half or Sherman's outbound emissions were generated by commuters traveling more than 30 miles to work – with commuters bound for Manhattan, 61 miles away, generating the greatest emissions. (See Table 11.)

Table 10. Top Five Towns for Average Commute Length

City or Town	Average Commute Length (miles)	Percent of Emissions from "Stretch Commutes"
Sherman	18.3	55%
Cornwall	16.7	37%
Sharon	16.1	45%
Colchester	15.6	2%
New Fairfield	15.4	39%

Table 11. Top 10 Work-Related Commuter Destinations from Sherman, by Total Carbon Dioxide Emissions

City or Town	Total CO_2 Emissions (metric tons/yr.)	Distance (miles)	Percent of Total Emissions
Manhattan, NY	911	61	19%
Danbury, CT	651	12	13%
Queens, NY	460	62	9%
Greenburgh, NY	263	41	5%
Harrison, NY	260	41	5%
Greenwich, CT	199	37	4%
Stamford, CT	199	34	4%
New Fairfield, CT	186	7	4%
Brookfield, CT	163	9	3%
Ridgefield, CT	162	19	3%

Table 12. Top 10 Destination Towns for Carbon Dioxide Emissions by Colchester Residents

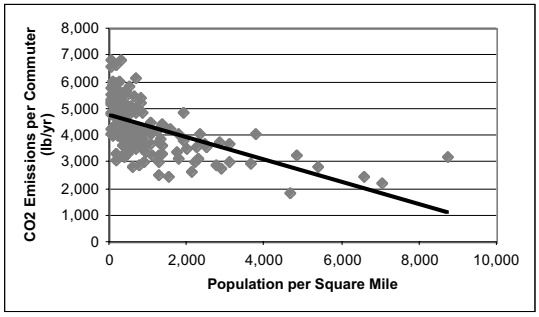
City or Town	Total CO_2 Emissions (metric tons/yr.)	Distance (miles)	Percent of Total Emissions
Hartford	3,688	22	16%
Groton	1,435	22	6%
East Hartford	1,381	20	6%
Middletown	1,060	17	5%
Glastonbury	1,031	15	5%
Colchester	955	4	4%
Norwich	929	14	4%
Waterford	873	18	4%
Manchester	754	18	3%
Windsor	685	26	3%

Exurban development and long commutes are not only features of the western part of the state. Colchester in New London County was the 10th-fastest growing town in the state between 1995 and 2005 and ranked first for average carbon dioxide emissions per commuter by place of residence. While very few Colchester commuters undertake the marathon commutes typical of Sherman residents, many travel 20 or more miles to work. (See Table 12.)

Continued exurban development poses a significant challenge to Connecticut's ability to control carbon dioxide emissions from commuting. Limiting the further spread of exurban sprawl in Connecticut's rural areas could enable the state to meet this challenge.

Another potential solution is to encourage the revitalization of Connecticut's cities and to promote more compact development in new and existing suburban areas. Cities and towns with greater residential population density tend to have lower per-capita global warming emissions from commuting – largely because they enable shorter commutes and the provision of more effective transit service. (See Fig. 9.) By encouraging new growth in already built-up urban areas and adopting "smart growth" policies in new and existing suburbs, Connecticut would be more likely to develop communities that are less dependent on the automobile and that provide additional transportation options to commuters.

Fig. 9. Population Density vs. Carbon Dioxide Emissions per Worker by Place of Residence



Policy Recommendations

The data presented in this report point the way to several conclusions regarding how Connecticut can reduce carbon dioxide emissions resulting from journeys to work.

Implement the Connecticut Climate Change Action Plan

In 2005, the Governor's Steering Committee on Climate Change adopted a plan to reduce global warming emissions in the state, including a number of steps to reduce transportation-sector emissions. Specifically, the plan called on the state to:

- Adopt California's standards for advanced-technology cars and light trucks and its standard for tailpipe emissions of global warming gases.
- Implement a "feebate" program to reward consumers who purchase vehicles with lower carbon dioxide emissions.
- Provide incentives for state and local purchase of low-greenhouse gas vehicles.
- Raise awareness among the public of the availability of low-greenhouse gas emitting vehicles.
- Develop a comprehensive hydrogen infrastructure research and demonstration program.
- Implement a package of transit improvements, land-use policies and incentives to reduce vehicle travel by 3 percent below the 2020 baseline.
- Embark on a multi-state intermodal freight initiative.
- Reduce emissions of "black carbon" by establishing a Connecticut clean diesel program.[14]

Connecticut has already begun to make progress on some of these policy options, having adopted California's advanced-technology vehicle standards, moved toward adoption of vehicle global warming emission standards, and passed legislation paving the way for a "feebate" incentive plan for low-carbon vehicles. Implementation of the remaining sections of the plan would put the state on the right course to reducing the global warming impact of commuting and all forms of vehicle travel.

Invest in Low-Emission Transit Alternatives

Connecticut should invest in its transportation infrastructure in ways that will lead to reductions in global warming emissions. Specifically, the state needs to invest more in transit – through expanding regional rail, developing commuter bus services, and improving transit connectivity – and spend less on projects likely to lead to increased drive-alone automobile traffic, such as highway expansion.

However, the success of transit as a global warming-fighting tool depends on the maintenance of high standards of service quality and affordable fares. The rail and bus fare increases that went into effect in 2005, and the potential for reduction in some local bus services, are steps in the wrong direction, discouraging people from using transit at a time when transit should be encouraged. Reductions in service quality or significant increases in fares could set the region back in its quest to reduce transportation-sector global warming emissions and must be avoided.

In addition, Connecticut should seek out ways to expand the reach and level of participation in ridesharing programs, such as vanpooling and carpooling.

Improve the Effectiveness of The Regional Rail Network

Connecticut already has a fairly extensive regional rail system – albeit one that is primarily designed to bring commuters into New York City. One of the most promising ways to reduce global warming emissions in Connecticut is by improving this system so that it more effectively brings commuters to workplaces in communities located along existing rail networks.

Connecticut could make better use of its existing transit infrastructure by encouraging development in and around transit stations. The creation of new commercial and residential opportunities within walking dis-

tance of transit would reduce the need to use automobiles to "trip chain" and create mini-hubs that would be primarily served by transit, not the automobile.

Parking shortages at commuter rail stations are a major impediment to the use of rail for many commuters. However, dramatically expanding parking capacity can make it more difficult to create effective transit-oriented development near transit stations and may encourage exurban development. While some additional parking capacity is likely necessary at many Connecticut rail stations, the state should also explore alternative ways to get commuters to transit stations. Programs such as the "Commuter Connection" shuttle bus can effectively tie suburban residences and workplaces into the state's existing transit network. In addition, enhancing pedestrian and bicycle access to stations (such as by improving bicycle parking facilities) can also make it easier for commuters to access rail stations while leaving their cars behind.

Put the Brakes on Exurban Development and Encourage Urban Revitalization

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 Connecticut's efforts to reduce global warming emissions from transportation. By contrast, Connecticut's urban areas – while they face an array of troubles – represent an opportunity for future growth with far less impact on the climate.

Slowing exurban sprawl and revitalizing urban areas require that state resources be channeled toward promoting sustainable growth. State dollars 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 adopt other tools – such as the priority funding areas proposal put forward in the state's Climate Change Action Plan – that promote smart growth.

Encourage Live-Near-Work and Telecommuting

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.

In addition, commuters who live near their place of work are more likely to walk or bicycle to work, producing no global warming emissions from their commutes. These non-motorized commutes are only possible, however, when workplaces and residences are in close proximity and where pedestrian and bicycling infrastructure (such as sidewalks, bicycle lanes and safe crossing points) exists.

Telecommuting also holds promise to reduce the number and length of commuting trips made. Employers should be encouraged to develop telecommuting alternatives for their employees.

Clean Vehicles

Even if Connecticut immediately and fully acts on all off the above policy solutions, a significant number of Connecticut commutes will continue to be made in automobiles. Therefore, the state should take a series of immediate and long-term actions to reduce global warming emissions from cars, SUVs, and light trucks. Connecticut should implement strong vehicle global warming emissions standards and other measures to encourage the purchase of vehicles that produce less carbon dioxide per mile. Financial incentives, such as the state's current tax break for the purchase of hybrid vehicles and proposed incentives for purchase of vehicles with low global warming emissions (paid for by fees on vehicles with high global warming emissions), can play an important role in putting cleaner vehicles on the state's roads.

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. Connecticut 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 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 Connecticut 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 Connecticut 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 commuter rail service in Connecticut, average emission factors for the entire Metro-North rail system (including portions in New York State) were used, as Connecticut-specific figures were not available. For other transit modes in which Connecticut transit agencies did not report energy use data, New England averages were used, calculated ac-

cording 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.

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 Commuter (lb/yr)	Per-Commuter Rank	Total CO_2 Emissions (metric tons)	Total Emissions Rank
Andover town	87%	5,078	43	3,451	140
Ansonia town	86%	3,712	125	14,470	64
Ashford town	84%	5,935	10	5,233	127
Avon town	89%	3,612	132	12,379	76
Barkhamsted town	87%	5,478	21	4,208	135
Beacon Falls town	90%	5,112	40	5,809	124
Berlin town	91%	3,489	137	14,416	65
Bethany town	84%	4,111	98	4,260	134
Bethel town	85%	4,056	109	17,258	49
Bethlehem town	82%	4,966	46	3,713	138
Bloomfield town	82%	2,897	159	10,922	84
Bolton town	88%	4,096	101	4,822	130
Bozrah town	81%	4,063	106	1,949	155
Branford town	88%	3,891	114	26,683	33
Bridgeport town	66%	3,218	149	79,814	3
Bridgewater town	76%	4,320	78	1,594	165
Bristol town	86%	3,566	135	48,953	8
Brookfield town	84%	5,240	35	18,173	48
Brooklyn town	85%	4,466	71	5,847	123
Burlington town	87%	4,117	96	7,776	108
Canaan town	81%	4,260	84	995	168
Canterbury town	88%	5,728	15	5,871	122
Canton town	86%	3,895	113	7,959	104
Chaplin town	87%	5,261	32	2,427	152
Cheshire town	88%	4,868	52	27,867	32
Chester town	84%	4,435	73	3,568	139
Clinton town	85%	5,388	26	16,285	55
Colchester town	86%	6,832	2	22,530	38
Colebrook town	82%	5,807	14	1,829	161
Columbia town	85%	5,306	29	5,656	126
Cornwall town	67%	5,213	36	1,552	166
Coventry town	88%	5,576	19	14,624	61
Cromwell town	88%	3,677	129	10,865	86
Danbury town	76%	4,063	107	71,229	4
Darien town	59%	2,454	166	8,766	97
Deep River town	86%	4,475	70	4,068	136
Derby town	85%	3,597	134	9,647	93
Durham town	87%	4,395	74	6,373	116
East Granby town	92%	4,528	67	4,806	131
East Haddam town	85%	5,970	8	11,045	83
East Hampton town	76%	4,501	69	13,238	72
East Hartford town	77%	2,893	160	29,740	29
East Haven town	84%	3,132	152	19,572	45
East Lyme town	88%	4,107	99	14,076	69
East Windsor town	87%	3,828	117	8,553	100
Eastford town	78%	5,555	20	1,821	162
Easton town	76%	4,107	100	5,946	120
Ellington town	90%	4,941	48	15,452	60
Enfield town	87%	4,439	72	42,193	12
Essex town	84%	5,457	24	7,193	111
Fairfield town	77%	3,787	119	43,583	11
Farmington town	90%	3,485	138	17,188	50
Franklin town	86%	4,130	95	1,656	164
Glastonbury town	87%	3,713	124	26,658	34

City or Town	Pct. Drive Alone Commutes	CO_2 Emissions per Commuter (lb/yr)	Per-Commuter Rank	Total CO_2 Emissions (metric tons)	Total Emissions Rank
Goshen town	78%	4,868	51	2,434	151
Granby town	86%	5,260	33	12,254	78
Greenwich town	64%	3,024	155	36,852	22
Griswold town	81%	4,846	55	12,314	77
Groton town	76%	2,521	165	22,983	37
Guilford town	84%	4,767	57	23,693	35
Haddam town	86%	5,320	28	9,442	95
Hamden town	81%	3,363	141	40,807	15
Hampton town	78%	4,927	50	1,865	160
Hartford town	56%	2,194	168	40,164	16
Hartland town	87%	6,846	1	3,090	146
Harwinton town	87%	4,217	88	4,533	132
Hebron town	85%	6,036	6	11,757	80
Kent town	73%	4,060	108	2,205	153
Killingly town	81%	4,544	66	15,562	58
Killingworth town	85%	5,466	23	6,460	114
Lebanon town	83%	5,844	12	8,726	98
Ledyard town	89%	3,172	150	10,202	90
Lisbon town	88%	4,234	86	3,762	137
Litchfield town	84%	4,703	59	7,951	105
Lyme town	76%	4,795	56	1,787	163
Madison town	82%	5,859	11	22,011	39
Manchester town	82%	3,535	136	45,357	9
Mansfield town	59%	3,294	145	14,293	67
Marlborough town	88%	5,293	31	6,244	117
Meriden town	84%	3,686	128	45,040	10
Middlebury town	85%	4,329	77	5,658	125
Middlefield town	91%	3,639	130	3,192	143
Middletown town	84%	4,224	87	41,280	14
Milford town	86%	4,084	104	50,553	7
Monroe town	89%	4,992	45	21,012	41
Montville town	87%	3,767	121	14,400	66
Morris town	79%	4,339	76	1,933	156
Naugatuck town	88%	4,860	53	32,537	25
New Britain town	77%	2,837	162	39,288	18
New Canaan town	64%	3,032	154	10,535	87
New Fairfield town	83%	6,154	5	18,238	47
New Hartford town	87%	4,664	63	6,000	119
New Haven town	56%	2,436	167	52,114	6
New London town	66%	1,849	169	9,878	92
New Milford town	84%	5,472	22	34,471	24
Newington town	88%	2,990	157	20,203	44
Newtown town	86%	5,673	16	29,910	28
Norfolk town	77%	5,338	27	1,873	159
North Branford town	89%	4,001	111	12,659	74
North Canaan town	80%	3,096	153	2,054	154
North Haven town	89%	3,283	147	16,559	54
North Stonington town	83%	3,995	112	4,331	133
Norwalk town	74%	2,984	158	58,482	5
Norwich town	79%	3,733	122	28,874	30
Old Lyme town	86%	5,242	34	7,839	106
Old Saybrook town	86%	4,858	54	9,572	94
Orange town	88%	3,710	126	10,017	91
Oxford town	86%	5,080	41	11,604	81
Plainfield town	83%	5,170	38	16,003	57
Plainville town	86%	3,155	151	12,880	73
Plymouth town	89%	4,068	105	10,207	89
Pomfret town	81%	4,270	82	3,173	144

City or Town	Pct. Drive Alone Commutes	CO_2 Emissions per Commuter (lb/yr)	Per-Commuter Rank	Total CO_2 Emissions (metric tons)	Total Emissions Rank
Portland town	85%	3,327	143	6,427	115
Preston town	84%	3,298	144	3,208	142
Prospect town	88%	4,365	75	8,502	101
Putnam town	86%	4,144	93	7,676	109
Redding town	74%	4,741	58	8,113	103
Ridgefield town	81%	5,054	44	23,351	36
Rocky Hill town	90%	3,601	133	14,602	62
Roxbury town	69%	4,246	85	1,920	157
Salem town	88%	5,807	13	5,029	128
Salisbury town	66%	4,192	90	3,001	148
Scotland town	85%	5,610	18	1,887	158
Seymour town	89%	4,515	68	15,504	59
Sharon town	70%	5,173	37	2,998	149
Shelton town	87%	4,184	91	37,130	21
Sherman town	78%	6,656	3	4,841	129
Simsbury town	88%	3,831	116	18,710	46
Somers town	85%	4,674	62	8,190	102
South Windsor town	89%	3,703	127	21,004	42
Southbury town	82%	5,080	42	16,960	52
Southington town	89%	4,130	94	38,577	19
Sprague town	82%	4,024	110	2,533	150
Stafford town	84%	5,947	9	14,571	63
Stamford town	70%	3,020	156	80,888	2
Sterling town	78%	4,928	49	3,113	145
Stonington town	84%	3,628	131	13,985	70
Stratford town	85%	3,733	123	39,810	17
Suffield town	89%	4,631	64	12,092	79
Thomaston town	89%	4,095	102	7,036	112
Thompson town	84%	4,700	60	8,673	99
Tolland town	88%	5,628	17	17,038	51
Torrington town	83%	4,149	92	31,885	26
Trumbull town	87%	4,269	83	30,427	27
Union town	86%	6,615	4	860	169
Vernon town	84%	4,276	81	28,594	31
Voluntown town	81%	6,006	7	3,276	141
Wallingford town	88%	4,206	89	41,385	13
Warren town	81%	5,305	30	1,336	167
Washington town	72%	4,282	80	3,076	147
Waterbury town	78%	4,087	103	81,078	1
Waterford town	85%	2,854	161	11,456	82
Watertown town	87%	4,287	79	20,722	43
West Hartford town	84%	2,797	163	35,098	23
West Haven town	80%	3,238	148	37,677	20
Westbrook town	84%	4,583	65	5,937	121
Weston town	65%	3,773	120	7,289	110
Westport town	64%	3,291	146	16,162	56
Wethersfield town	86%	2,639	164	14,257	68
Willington town	83%	5,119	39	6,864	113
Wilton town	71%	3,789	118	12,530	75
Winchester town	80%	4,698	61	10,913	85
Windham town	71%	3,854	115	16,870	53
Windsor Locks town	87%	3,338	142	8,929	96
Windsor town	86%	3,367	140	21,638	40
Wolcott town	90%	4,113	97	13,955	71
Woodbridge town	85%	3,410	139	6,224	118
Woodbury town	86%	4,943	47	10,313	88
Woodstock town	78%	5,422	25	7,825	107

Appendix C: Emissions and Commuting Data by Town of Work

City or Town	Pct. Drive Alone Commutes	CO_2 Emissions per Commuter (lb/yr)	Per-Commuter Rank	Total CO_2 Emissions (metric tons)	Total Emissions Rank
Andover town	63%	1,329	166	148	166
Ansonia town	82%	2,295	145	3,917	94
Ashford town	72%	2,373	140	545	151
Avon town	85%	3,719	43	15,077	54
Barkhamsted town	74%	2,501	135	676	147
Beacon Falls town	71%	2,608	131	942	138
Berlin town	88%	4,206	21	28,780	30
Bethany town	76%	2,901	112	2,077	117
Bethel town	83%	3,114	90	10,290	68
Bethlehem town	62%	1,898	161	388	157
Bloomfield town	85%	4,655	8	37,415	22
Bolton town	74%	2,327	142	1,194	133
Bozrah town	82%	3,746	40	1,200	132
Branford town	85%	3,443	67	20,547	43
Bridgeport town	77%	3,307	78	68,671	7
Bridgewater town	57%	2,679	126	280	160
Bristol town	85%	3,068	94	31,001	27
Brookfield town	81%	3,678	45	12,530	61
Brooklyn town	85%	2,625	129	1,598	128
Burlington town	72%	2,020	155	863	139
Canaan town	80%	2,764	122	725	146
Canterbury town	81%	3,547	57	1,677	124
Canton town	78%	2,783	120	3,308	96
Chaplin town	82%	2,382	138	265	161
Cheshire town	85%	3,838	35	23,114	36
Chester town	83%	2,967	103	2,131	114
Clinton town	82%	3,428	70	7,012	77
Colchester town	81%	3,780	38	5,804	79
Colebrook town	69%	2,243	148	214	163
Columbia town	73%	2,376	139	670	148
Cornwall town	60%	2,632	128	526	153
Coventry town	74%	2,396	137	1,474	129
Cromwell town	82%	3,253	81	7,866	72
Danbury town	83%	4,368	18	89,908	4
Darien town	76%	3,324	76	13,144	57
Deep River town	80%	2,559	133	971	137
Derby town	83%	2,613	130	5,100	83
Durham town	76%	2,850	118	2,423	107
East Granby town	86%	4,640	9	5,374	80
East Haddam town	77%	2,742	125	1,726	123
East Hampton town	74%	2,783	121	2,511	105
East Hartford town	84%	4,493	13	54,440	11
East Haven town	76%	2,458	136	7,178	75
East Lyme town	86%	3,738	42	7,833	73
East Windsor town	85%	4,070	26	11,322	64
Eastford town	68%	3,564	55	1,061	135
Easton town	58%	1,812	163	733	144
Ellington town	85%	2,761	123	3,017	99
Enfield town	86%	3,773	39	28,976	29
Essex town	84%	3,030	99	3,705	95
Fairfield town	79%	3,448	65	39,805	19
Farmington town	89%	4,406	15	43,864	16
Franklin town	73%	3,502	59	2,020	120
Glastonbury town	84%	4,118	23	27,198	32
Goshen town	61%	2,282	146	544	152
Granby town	76%	2,881	116	2,370	110

City or Town	Pct. Drive Alone Commutes	CO_2 Emissions per Commuter (lb/yr)	Per-Commuter Rank	Total CO_2 Emissions (metric tons)	Total Emissions Rank
Greenwich town	76%	4,566	11	73,406	6
Griswold town	76%	2,652	127	2,260	111
Groton town	80%	3,927	32	59,398	9
Guilford town	80%	3,590	54	12,681	60
Haddam town	79%	3,271	80	2,572	103
Hamden town	77%	3,062	95	27,909	31
Hampton town	61%	1,994	158	313	158
Hartford town	79%	4,597	10	220,145	1
Hartland town	37%	592	169	26	169
Harwinton town	68%	1,989	159	511	154
Hebron town	75%	2,959	105	2,042	118
Kent town	81%	3,471	62	2,027	119
Killingly town	84%	3,464	64	10,586	65
Killingworth town	60%	2,161	150	742	143
Lebanon town	64%	2,060	154	809	140
Ledyard town	76%	5,047	1	29,723	28
Lisbon town	76%	1,541	164	403	155
Litchfield town	81%	3,445	66	5,355	81
Lyme town	50%	1,085	167	123	168
Madison town	78%	3,347	75	7,463	74
Manchester town	83%	3,652	47	46,250	15
Mansfield town	65%	3,172	86	18,331	49
Marlborough town	84%	2,878	117	1,459	130
Meriden town	84%	3,652	48	38,979	21
Middlebury town	87%	3,437	68	5,068	84
Middlefield town	84%	2,308	144	1,023	136
Middletown town	84%	4,769	4	64,861	8
Milford town	84%	3,920	33	52,035	13
Monroe town	85%	3,738	41	11,929	62
Montville town	83%	4,540	12	19,191	47
Morris town	62%	1,896	162	289	159
Naugatuck town	84%	2,547	134	8,579	70
New Britain town	82%	3,197	84	35,943	23
New Canaan town	77%	3,277	79	10,539	66
New Fairfield town	67%	1,981	160	1,616	127
New Hartford town	81%	3,002	100	2,107	116
New Haven town	73%	3,315	77	112,457	3
New London town	78%	2,992	101	22,390	40
New Milford town	82%	3,700	44	16,329	50
Newington town	84%	3,549	56	25,343	35
Newtown town	78%	4,049	27	16,287	51
Norfolk town	66%	3,436	69	1,092	134
North Branford town	83%	2,966	104	5,002	85
North Canaan town	82%	4,421	14	4,055	90
North Haven town	87%	3,928	31	34,906	24
North Stonington town	81%	3,414	72	2,126	115
Norwalk town	79%	4,390	16	87,747	5
Norwich town	85%	3,801	36	31,047	26
Old Lyme town	81%	3,464	63	3,298	97
Old Saybrook town	86%	3,945	30	9,468	69
Orange town	80%	3,081	92	11,358	63
Oxford town	77%	2,882	115	2,555	104
Plainfield town	81%	3,173	85	7,024	76
Plainville town	83%	2,888	114	10,488	67
Plymouth town	79%	2,179	149	2,229	112
Pomfret town	75%	3,485	60	2,407	108

City or Town	Pct. Drive Alone Commutes	CO_2 Emissions per Commuter (lb/yr)	Per-Commuter Rank	Total CO_2 Emissions (metric tons)	Total Emissions Rank
Portland town	84%	2,943	107	3,926	93
Preston town	60%	2,141	151	783	141
Prospect town	79%	2,072	153	1,630	126
Putnam town	86%	3,241	82	8,426	71
Redding town	57%	2,334	141	1,634	125
Ridgefield town	81%	4,379	17	21,664	42
Rocky Hill town	87%	4,760	5	26,444	33
Roxbury town	52%	1,035	168	181	164
Salem town	80%	2,918	111	763	142
Salisbury town	69%	2,937	108	2,141	113
Scotland town	64%	1,520	165	135	167
Seymour town	81%	2,813	119	5,147	82
Sharon town	75%	4,091	25	2,760	101
Shelton town	85%	4,026	28	39,781	20
Sherman town	68%	2,929	110	726	145
Simsbury town	84%	4,099	24	20,310	44
Somers town	79%	3,631	49	3,136	98
South Windsor town	86%	3,953	29	19,458	46
Southbury town	85%	4,722	7	19,585	45
Southington town	85%	3,232	83	22,338	41
Sprague town	83%	2,252	147	552	150
Stafford town	81%	3,407	73	4,707	88
Stamford town	77%	4,787	3	171,617	2
Sterling town	62%	2,014	156	394	156
Stonington town	84%	3,678	46	13,642	56
Stratford town	83%	3,793	37	41,099	18
Suffield town	84%	3,627	50	5,820	78
Thomaston town	87%	3,043	96	4,044	91
Thompson town	78%	2,988	102	1,983	121
Tolland town	85%	3,348	74	4,922	87
Torrington town	83%	3,147	88	22,974	37
Trumbull town	82%	3,599	53	26,020	34
Union town	80%	3,148	87	179	165
Vernon town	84%	3,043	97	12,763	59
Voluntown town	77%	2,321	143	253	162
Wallingford town	87%	4,261	20	48,149	14
Warren town	79%	3,624	51	558	149
Washington town	74%	3,087	91	2,475	106
Waterbury town	81%	3,127	89	56,639	10
Waterford town	86%	3,849	34	18,539	48
Watertown town	82%	2,954	106	12,986	58
West Hartford town	82%	3,605	52	43,231	17
West Haven town	78%	3,081	93	22,880	38
Westbrook town	87%	3,481	61	4,470	89
Weston town	54%	2,101	152	1,810	122
Westport town	80%	4,131	22	33,432	25
Wethersfield town	84%	3,420	71	14,354	55
Willington town	72%	2,751	124	1,419	131
Wilton town	80%	4,747	6	22,526	39
Winchester town	79%	2,899	113	3,932	92
Windham town	80%	3,518	58	16,167	52
Windsor Locks town	86%	4,321	19	15,740	53
Windsor town	88%	4,889	2	52,142	12
Wolcott town	80%	1,999	157	2,790	100
Woodbridge town	79%	3,031	98	4,925	86
Woodbury town	77%	2,597	132	2,744	102
Woodstock town	74%	2,935	109	2,374	109

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. See note 1.

3. Comparison of data from New England Climate Coalition, *Getting on Track: New England's Rising Global Warming Emissions and How to Reverse the Trend*, February 2005, with ranking from Greg Marland, Tom Boden, Bob Andres, Oak Ridge National Laboratory, Carbon Dioxide Information Analysis Center, *National Fossil Fuel CO_2 Emissions*, downloaded from cdiac.esd.ornl.gov/trends/emis/top2000.tot, 17 February 2005.

4. Governor's Steering Committee on Climate Change, *Connecticut Climate Change Action Plan 2005,* 15 February 2005; The Connecticut Energy Advisory Board, *Energy Plan for Connecticut,* January 2005.

5. See note 1.

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

7. 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.

8. U.S. Environmental Protection Agency, *AirData* database, Tier emission reports for Connecticut, downloaded from www.epa.gov/air/data/reports.html, 1 June 2005. Data are for 1999.

9. See Connecticut Fund for the Environment, *The Drive for Cleaner Air in Connecticut: The Benefits of Adopting the California Low-Emission Vehicle Standard for Cars and Light Duty Trucks*, September 2003.

10. Data from Texas Transportation Institute, *The 2004 Urban Mobility Study*, downloaded from mobility.tamu.edu/ums/congestion_data/east_map.stm, 17 February 2005.

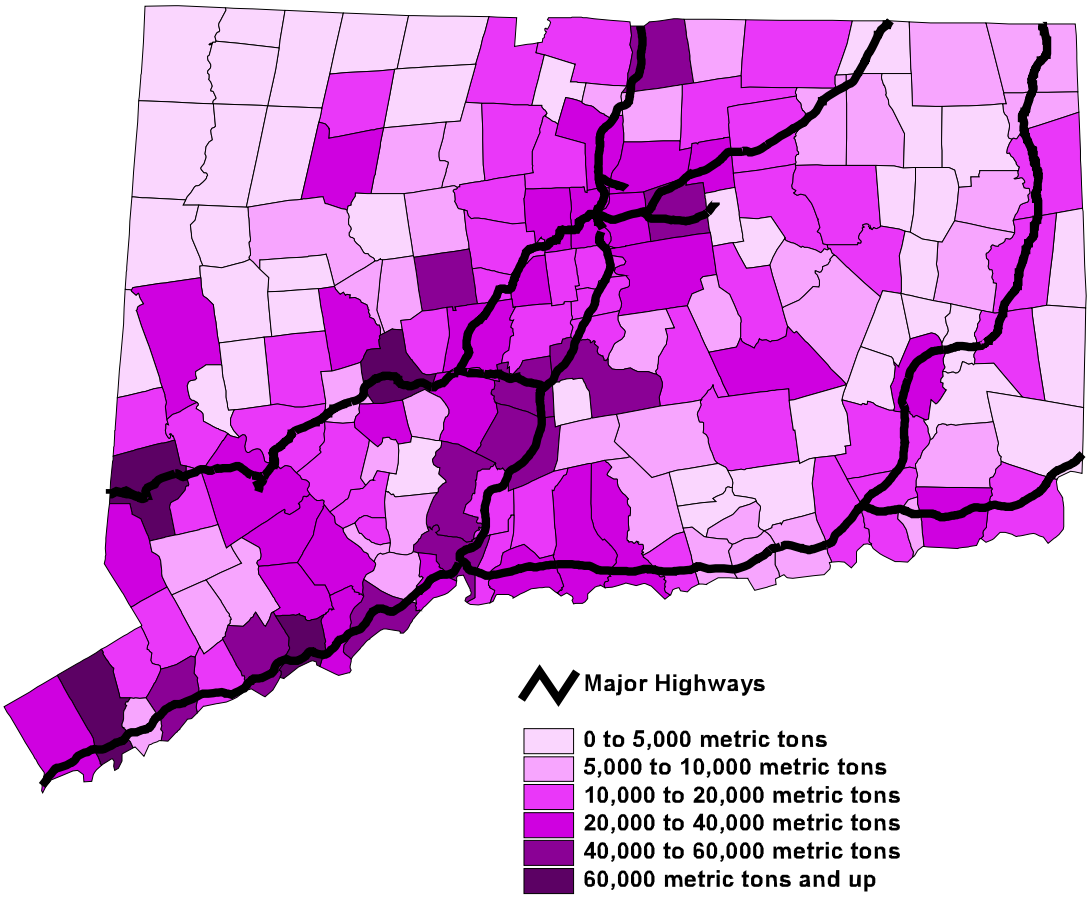
11. Federal Highway Administration, *Highway Statistics,* "State Funding for Highways-Summary-2003," November 2004.

12. For a discussion of generated traffic and its impacts, see Todd Litman, Victoria Transport Policy Institute, *Generated Traffic and Induced Travel: Implications for Transport Planning*, 10 May 2005.

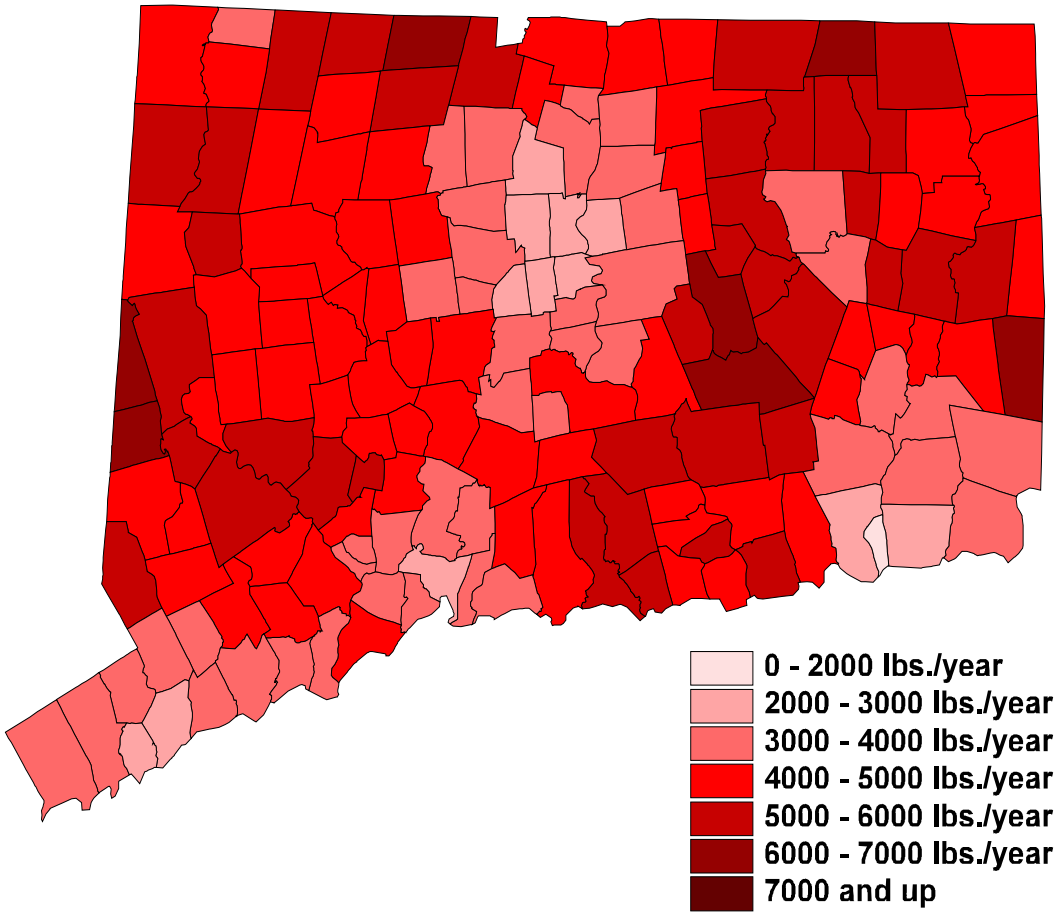
13. This figure includes emissions from residents of Connecticut commuting to workplaces in other states. See "Methodology" for more details.

14. Governor's Steering Committee on Climate Change, *Connecticut Climate Change Action Plan*, January 2005.

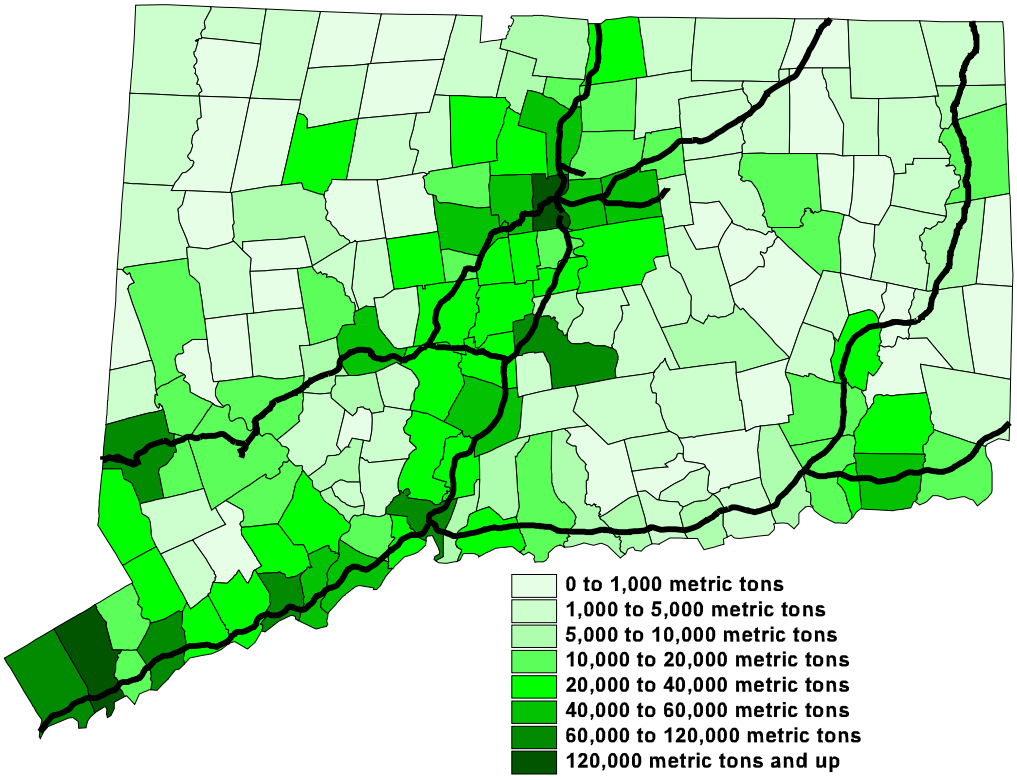
Total Carbon Dioxide Emissions from Commuting by Place of Residence



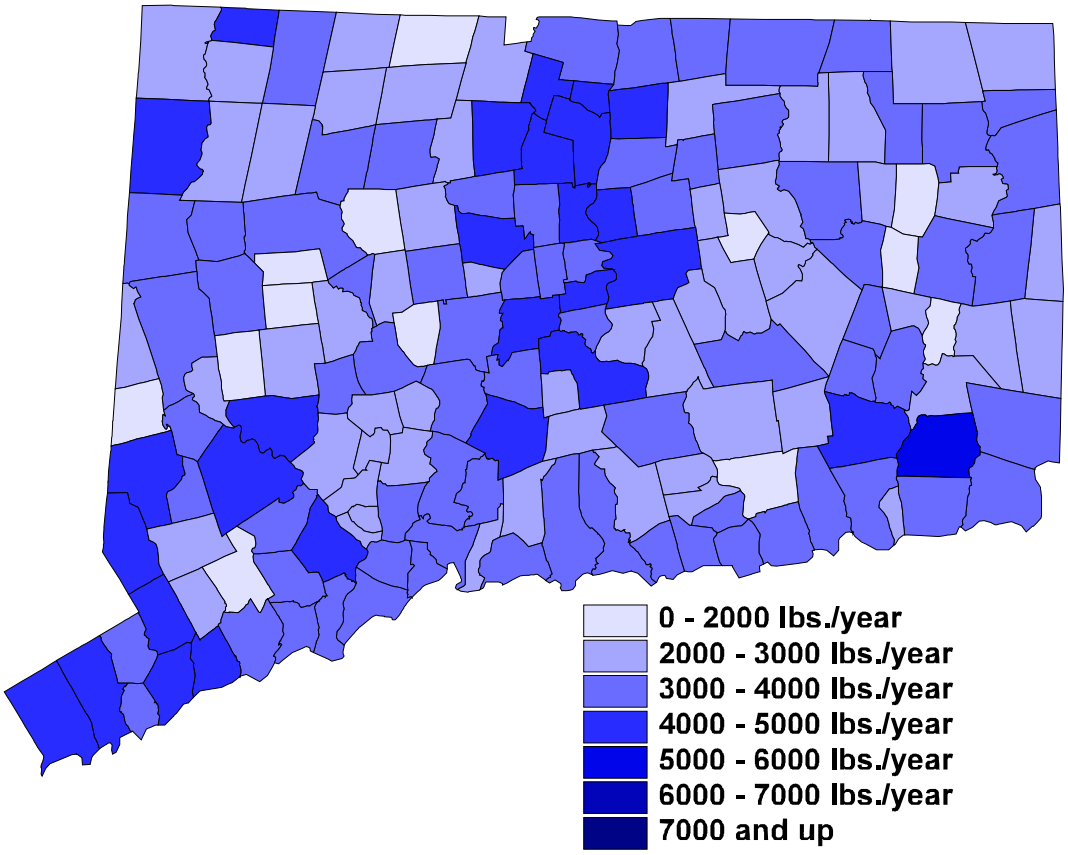
Per-Worker Carbon Dioxide Emissions from Commuting by Place of Residence



Total Carbon Dioxide Emissions from Commuting by Place of Work



Per-Worker Carbon Dioxide Emissions from Commuting 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