

**Memorandum for the Record**  
**Transportation Planning and Programming Committee of the**  
**Boston Region Metropolitan Planning Organization (MPO)**

**September 20, 2007 Meeting**

10:00 AM –12:00 PM, State Transportation Building, Conference Room 4, 10 Park Plaza, Boston

David Mohler, Chair, representing Bernard Cohen, Executive Office of Transportation and Public Works (EOTPW)

**Decisions**

The Transportation Planning and Programming Committee voted to take the following actions:

- Approve and release the I-495 Transit Study
- Approve the Regional Pedestrian Plan work program
- Approve the minutes of the August 16 and September 6 meetings
- Add carbon dioxide (CO<sub>2</sub>) to the outputs of the regional transportation model

**Meeting Agenda**

**1. Introductions**

Transportation Planning and Programming Committee members, staff, and members of the public introduced themselves.

**2. Public Comments**

There were none.

**3. Chair's Report** – *David Mohler, EOTPW*

EOTPW has transmitted the MPO's federal fiscal year (FFY) 2008 – 2011 Transportation Improvement Program (TIP) and FFY 2008 Unified Planning Work Program (UPWP) to the Federal Highway Administration (FHWA) and the Federal Transit Administration (FTA). The TIP was also transmitted to the U.S. Environmental Protection Agency (EPA) and the Massachusetts Department of Environmental Protection (DEP). The FFY 2008 – 2011 State Transportation Improvement Program (STIP) will be transmitted to the federal agencies this week.

The Transportation Finance Commission has issued a follow-up report to the initial report that identified the funding shortfall for improving and maintaining the state's transportation infrastructure. The new report offers recommendations for closing that funding gap. Expansion requirements were not addressed.

EOTPW reported on the State Implementation Plan (SIP) at DEP's annual meetings on September 6. The meetings were widely covered by the press. Opposition was voiced about the possible delay of the Green Line Extension project as the state seeks federal funding. The public comment period for the SIP was extended to September 21.

Ben Rasmussen, MPO staff, is leaving CTPS to take a position at the New England office of the International Council for Environmental Initiatives. The Committee sends him its thanks for his contributions and best wishes.

**4. Subcommittee Chairs' Reports – *Barbara Lucas, Metropolitan Area Planning Council (MAPC)***

The Suburban Mobility and Transportation Demand Management (TDM) Subcommittee is working on the Suburban Mobility/TDM program for this coming year.

B. Lucas suggested that a TIP Criteria Subcommittee meeting be held in late October or early November to discuss the handing of the Project Need Forms (PNF) and Project Information Forms (PIF) by the MassHighway District offices.

At the next TIP Criteria Subcommittee meeting, there may be a discussion about the federal requirements regarding transportation projects that disturb wetlands. If, so, Executive Office of Energy and Environmental Affairs (EOEEA) personnel who work in this field might be asked to be available as a resource.

**5. Regional Transportation Advisory Council – *Steve Olanoff, Advisory Council***

The Advisory Council met on September 12. At that meeting, Jared Fijalkowski, MPO staff, gave a presentation on the Bicycle and Pedestrian Improvements in Town Centers Study. Kristina Egan, EOTPW, gave a presentation on the South Coast Rail project and discussed financing of the project. The Council postponed the election of new members to allow more time for the nomination process.

**6. Action Items**

**I-495 Transit Study – *Cathy Buckley Lewis, MPO Staff***

Members received a presentation on the I-495 Transit Study at the September 6 meeting. At this meeting, C. Buckley Lewis provided members with proposed edits to the study that were incorporated to address task force members' comments.

Mary Pratt, Town of Hopkinton, noted that the Town of Milford is not participating in the new MetroWest Regional Transit Authority. She also stated that there should be a regional effort to coordinate senior vans.

A motion to approve the I-495 Transit Study with the proposed changes and release the document was made by Steve Woelfel, MassHighway, and seconded by Jim Gillooly, City of Boston. The motion passed unanimously.

**Regional Pedestrian Plan Work Program – *Barbara Lucas, MAPC***

The Regional Pedestrian Plan work program was discussed at the September 6 meeting and had been distributed prior to that meeting. B. Lucas noted that the contract number will be added to the work program. She also stated that the work program will be coordinated with state pedestrian planning activities and the pedestrian work done by the

MPO for communities in the region. An advisory group will oversee the activities of the work program.

A motion to approve the Regional Pedestrian Plan work program was made by Gordon Feltman, Town of Bedford, and seconded by M. Pratt. The motion passed with B. Lucas abstaining.

**Meeting Minutes – Pam Wolfe, MPO Staff**

A motion to approve the minutes of the August 16 meeting was made by S. Woelfel, and seconded by Ron Morgan, MBTA. The motion passed unanimously.

A motion to approve the minutes of the September 6 meeting was made by S. Woelfel, and seconded by R. Morgan. The motion passed with Thomas Bent, City of Somerville, and Ginger Esty, Town of Framingham, abstaining.

M. Pratt stated that a copy of the September 6 minutes should be sent to Nancy Stevens, the Mayor of the City of Marlborough, who provided public comments at that meeting. B. Lucas asked that the minutes be held and she stated that she had forwarded the minutes to Mayor Stevens for the City's information.

**7. Carbon Dioxide, Climate Change, and the Boston Region MPO – Anne McGahan, MPO Staff**

The draft discussion paper, *Carbon Dioxide, Climate Change, and the Boston Region MPO*, was distributed to members previously. A. McGahan gave a PowerPoint presentation on the paper, which was prepared by B. Rasmussen. (See attached PowerPoint presentation for details.) The presentation highlighted the potential impacts of climate change, provided background and information about potential impacts in the Boston region, and possible next steps for the MPO to consider.

The United States is responsible for approximately one-third of the world's CO<sub>2</sub> emissions. Nationally, the transportation sector is the second largest emitter of CO<sub>2</sub> after the electric power generation sector. In Massachusetts, however, the transportation sector is the largest source of CO<sub>2</sub> emissions. According to the Massachusetts Climate Protection Plan, between 1990 and 1998, vehicle miles traveled (VMT) increased by 13% in the state. The state expects to see a 33% increase in CO<sub>2</sub> emissions from the transportation sector during the period from 1990-2020.

The presentation summarized current policy concerning climate change in the region including: the New England Governors/Eastern Canadian Premiers' (NEG/ECP) climate action plan [which developed short, medium, and long-term greenhouse gas (GHG) emission reduction goals]; the Massachusetts Climate Protection Program (which adopted the targets set by the NEG/ECP); Massachusetts' signing of the Regional Greenhouse Gas Initiative; and the April 2007 ruling that determined that the EPA has the authority to regulate tailpipe emissions from automobiles.

Currently, the MPO funds programs that reduce GHG emissions including transportation alternatives to single occupancy vehicle travel (transit, bicycle/pedestrian projects, carpooling etc.), projects that reduce congestion (such as intersection improvements and HOV lanes), and the use of alternative-fuel vehicles. In the development of the MBTA's 2008 Program for Mass Transportation (PMT) there will be consideration of how the MBTA's emission reduction goals fit with the state's goals.

Possible MPO goals were listed and possible ways that the MPO could further reduce GHG emissions were outlined. (See attached for specific suggestions.) The suggestions include supporting projects and programs that promote the following:

- A more efficient transportation system that supports alternative modes, and reduces congestion and VMT
- Increased use of fuel efficient and cleaner vehicles
- Land uses that reduce VMT

Members discussed the paper and possible MPO actions.

J. Gillooly made an observation about a factor that some scientists believe could make the climate change situation worse than some climate models predict. Some air pollution particulates that enter the atmosphere are deflecting some of the radiation from the sun away from the earth. Improvements in air quality could reduce this "bounce effect," which serves as a radiation shield.

J. Gillooly recommended that the report give more prominence to intelligent transportation systems (ITS) as a means to address congestion problems and reduce emissions in the transportation sector.

M. Pratt noted that federal requirements will be reducing diesel emissions.

S. Olanoff raised the issue of electrifying the railroads to reduce CO<sub>2</sub> emissions. He noted that electrifying the railroads coupled with the use of cleaner fuels for power generation could reduce CO<sub>2</sub> emissions. G. Feltman raised the possibility that the MPO could encourage a change in the power generation of the rail system.

Members discussed whether the paper should be released to the public. G. Feltman advocated for wide distribution of the paper, including through press releases to local newspapers. B. Lucas agreed that the information should be conveyed to the public but she voiced concern about distributing the material in its current form. She noted that the MPO needs more information about the trade-off between different types of projects. Alternative fuels do not always reduce emissions. Also, land use decisions are a factor. The MPO should address the problem through funding the recommendations in the paper, she added. It was noted that MPO staff will be presenting the paper at the upcoming Association of Metropolitan Planning Organizations meeting in Arkansas.

When asked whether staff would be able to provide members with a list of potential Congestion Mitigation and Air Quality Improvement Program (CMAQ) projects for

consideration, A. McGahan explained that members are given a list of potential projects and that estimated CO<sub>2</sub> emissions for projects could be included among the TIP criteria. This information would enable members to determine whether certain projects would provide emission reductions and at what level.

Shirin Karanfiloglu, MassPike, suggested that the MPO discuss ways to address emissions from trucks. D. Mohler noted that EOTPW, EOEEA, and the MassPike are working to address issues associated with idling trucks (i.e. providing rest stops where truckers can plug into electricity rather than keep trucks running).

Mark Breslow, EOEEA, stated that reducing GHG emissions is a priority issue for EOEEA. The agency will be developing estimates for reducing GHG emissions from all sectors of the economy. EOEEA will want to work with the MPO to develop estimates for potential levels of emission reductions from the transportation sector.

A motion to direct MPO staff to add CO<sub>2</sub> to the outputs of the regional transportation model was made by S. Olanoff, and seconded by B. Lucas. The motion passed with M. Pratt abstaining.

During a discussion period about the motion, Karl Quackenbush, MPO staff, explained that by adding this factor to the model, staff will be able to determine the change in emissions that would result from some proposed projects. (The MPO currently does this level of analysis for CMAQ projects or regionally significant projects.)

In response to a member's question about whether the effect of traffic queues on emissions levels can be considered in the model, K. Quackenbush explained that the regional model does not take queues into account explicitly, however, CTPS can use micro-models to consider queues (micro-modeling takes speeds and idling vehicles into consideration). [This pertains to MPO projects. Other projects are evaluated through the MEPA process.]

D. Mohler stated that the MPO should consider the regional levels of CO<sub>2</sub> emissions to determine if the emission levels are trending in the right direction as well as the emissions of individual projects when appropriate.

M. Breslow cautioned that improving traffic flow to reduce emissions can potentially lead to sprawl (which can lead to increases in VMT) and that caution should be taken regarding promoting the use of alternative fuels such as ethanol since it is unclear if that type of fuel reduces emissions.

Further discussion will occur at the TIP Criteria Subcommittee meeting about incorporating CO<sub>2</sub> data into TIP project evaluations.

B. Lucas indicated that MAPC has comments on the paper to discuss with staff. The climate change topic should be added to the next meeting's agenda.

## **8. 2007–2008 HOV Monitoring on I-93 North and the Southeast Expressway – Karl Quackenbush, MPO Staff**

The work program for the 2007–2008 HOV Monitoring on I-93 North and the Southeast Expressway describes the work that CTPS does annually for MassHighway to monitor the travel times on the I-93 HOV lanes. (See attached.) Since 1998, DEP has required MassHighway to monitor travel times to determine if the HOV lanes are causing travel time savings. This \$54,952 State Planning and Research-funded work program is nearly identical to last year's program.

Staff will collect vehicle occupancy counts twice during the year and travel time data four times during the year and determine whether there have been travel time savings on HOV lanes. (Per DEP, the lanes should result in travel time savings of one minute per mile.) Staff will make quarterly reports and an annual report to MassHighway.

Members made several suggestions:

- The assumptions used to determine vehicle occupancy should be revisited and updated if needed.
- Staff could consider getting travel time data from volunteers that have vehicles equipped with GPS. It was noted that MassRIDES already does provide data and that the quality of the data could suffer if volunteers are used.
- Congestion should be measured on non-HOV lanes to determine if HOV lanes are causing more congestion on non-HOV lanes. It was noted that this information is included in the travel time data.
- The data compiled since 1998 should be graphed to determine overall trends. Staff is currently developing a trend analysis.

Members discussed the merits of this work, given the cost. Staff stated that the work is a requirement of the SIP. As noted above, staff was advised to graph the HOV-lane data to determine the overall trends. If the trends are seen to be stable, this information could be provided to DEP and MassHighway could request that DEP re-evaluate the requirement for annually repeating this work. D. Mohler stated that MassHighway would be interested in reducing costs as long as the data does not suffer as a result.

J. Gillooly stated that the City of Boston would be interested in participating in future discussions about using GPS applications for tracking.

Members will vote on the work program at the next meeting.

## **9. Assignments to Transportation Planning and Programming Committee Subcommittees – David Mohler, EOTPW**

Members were asked to provide their preferences for subcommittee membership using the forms distributed at the meeting.

## **10. Members' Items**

J. Gillooly announced that Mayor Menino will be attending a press event at Fan Pier today as part of the City's efforts to advance bicycling as a mode of transportation in

Boston. The City is making a concerted effort to improve roadway bicycling accommodations. MassHighway approved the City's request to modify pavement markings for the Commonwealth Avenue Phase 1 project to include a bicycle lane between Kenmore Square and the BU Bridge. The City will also be looking at improving bicycle accommodations on the American Legion Highway and the Commonwealth Avenue Phase 5 project.

M. Pratt announced that she attended a meeting in Natick on September 19 where Lt. Governor Tim Murray spoke on transportation issues. She stated that she thinks that the Administration's proposal to generate funds by developing casinos would not be the solution to the state's transportation funding problems.

B. Lucas provided an update on the Regional Bike Parking Program. The program is generating more and more interest. Over 20% of the region's municipalities have subscribed to the program. MAPC has requested a one-year extension of the program from EOTPW so that municipalities could have time to submit their reimbursement forms.

G. Feltman announced that the Three Apple Storytelling Festival will be held in Bedford on September 28.

D. Mohler stated that in October the Committee will be presented with a work program for CTPS's modeling work on the Green Line Extension project.

### **11. Adjourn**

A motion to adjourn was made by G. Feltman, and seconded by J. Gillooly. The motion passed unanimously.

**Transportation Planning and Programming Committee Meeting Attendance  
Thursday, September 20, 2007, 10:00 AM**

**Member Agencies**

EOTPW  
City of Boston  
  
City of Newton  
City of Salem  
City of Somerville  
MassHighway  
MAPC  
  
MassPike  
MBTA  
Advisory Council  
Town of Bedford  
Town of Framingham  
Town of Hopkinton

**Representatives and Alternates**

David Mohler, Chair  
Jim Gillooly  
Thomas Kadzis  
David Koses  
Carey Duques  
Thomas Bent  
Steve Woelfel  
Barbara Lucas  
Jim Gallagher  
Shirin Karanfiloglu  
Ron Morgan  
Steve Olanoff  
Gordon Feltman  
Ginger Esty  
Mary Pratt

**MPO Staff/CTPS**

John Hersey  
Maureen Kelly  
Cathy Buckley Lewis  
Anne McGahan  
Hayes Morrison  
Karl Quackenbush  
Arnie Soolman  
Pam Wolfe

**Other Attendees**

Anna Biton, MAPC  
Marc Breslow, EOEEA  
Wig Zamore, Mystic View Task Force/Somerville  
Transportation Equity Partnership

# Carbon Dioxide, Climate Change, and the Boston Region MPO



Anne McGahan

Boston Region MPO Staff

September 20, 2007

# Presentation Overview

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- Climate change and its local impacts
- Current regional and state policies
- Current MPO programs that reduce GHG emissions
- Staff recommendations for further GHG emission reductions

# Climate Change

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- Unstable weather patterns caused by increases in temperature
- Increase in temperature caused by higher atmospheric concentrations of CO<sub>2</sub>, methane, nitrous oxides and other heat trapping gases
- Results – sea level rise, climate instability

# National Trends

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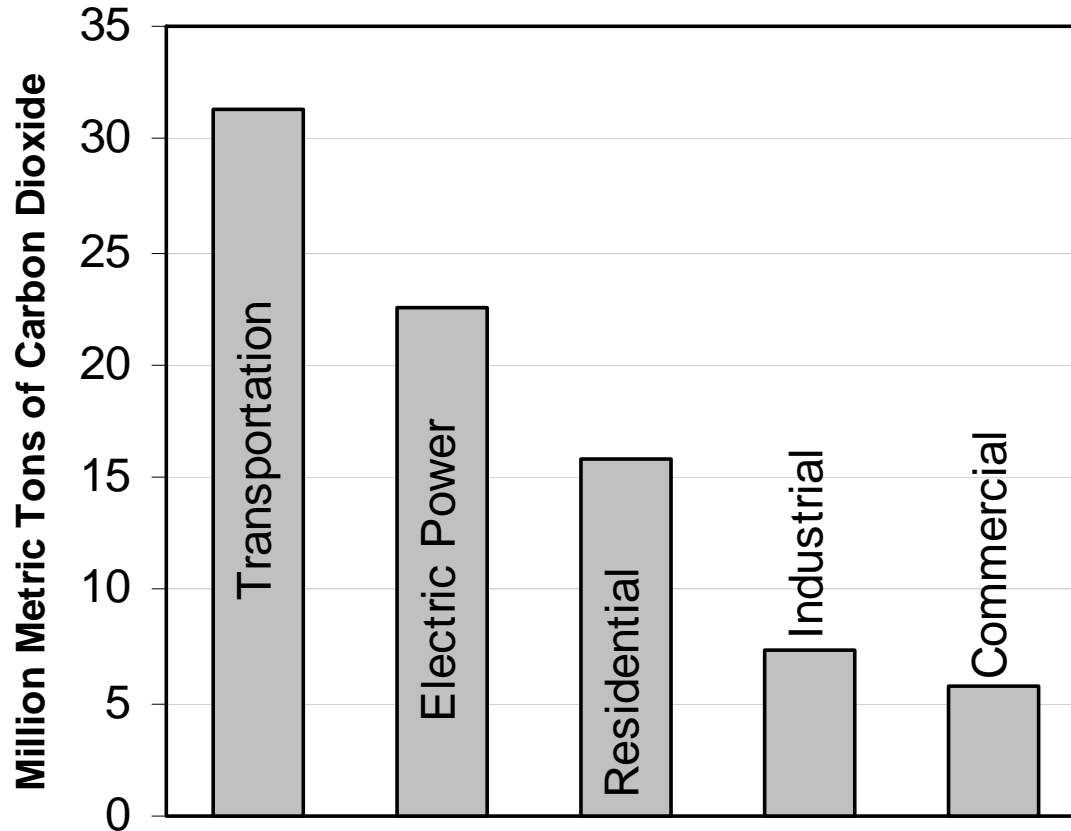


- United States responsible for 36% of the world's CO<sub>2</sub> emissions
- In US, CO<sub>2</sub> rose 20% between 1990 and 2005
- Transportation is the second largest emitter in US behind electric power generators

# State Trends



## MA CO<sub>2</sub> Emissions by Sector (2003)

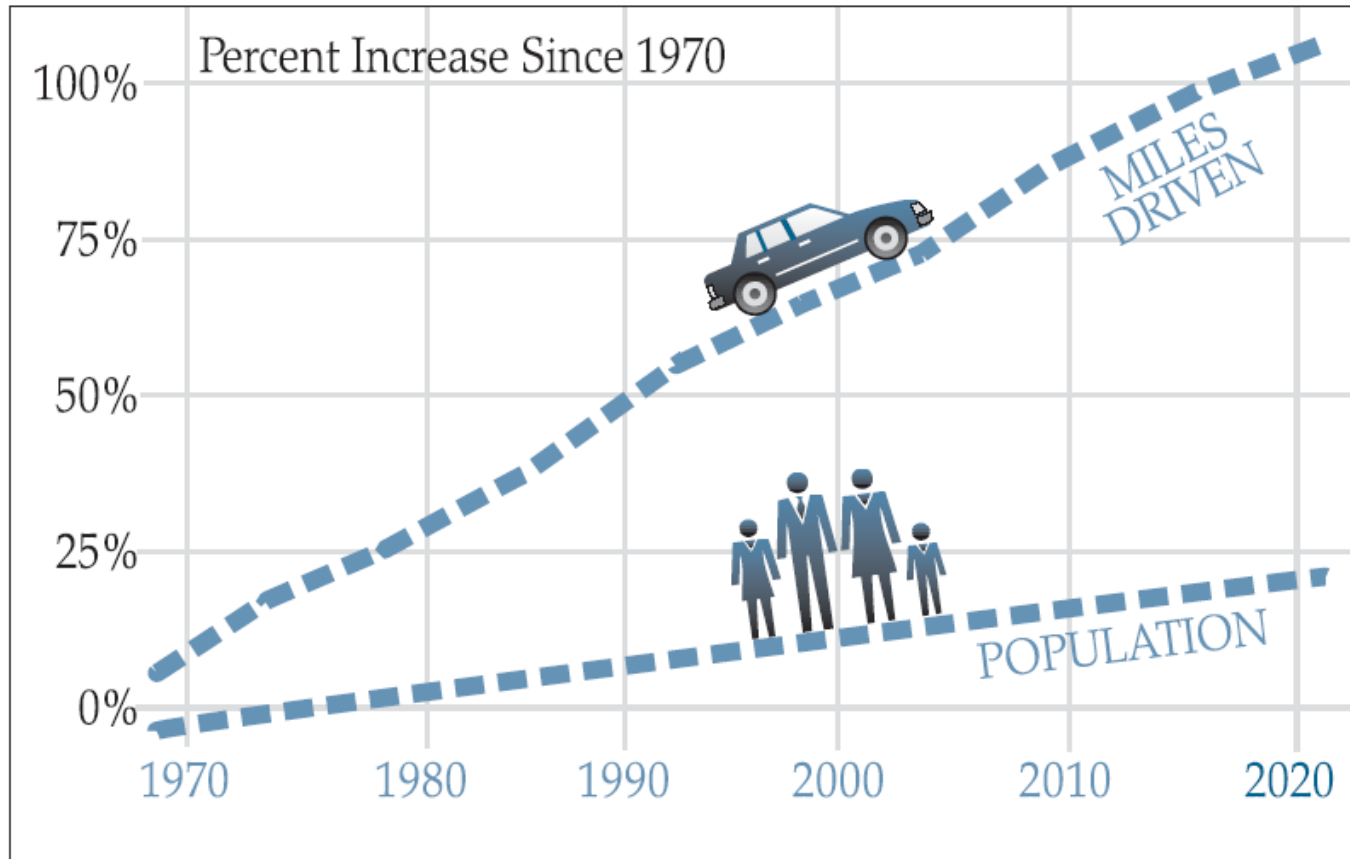


Source: U.S. Environmental Protection Agency, "Energy CO<sub>2</sub> Emissions by State."

# State Trends (cont.)



## Miles Driven and Population Growth in MA



Source: MA Climate Action Plan (2004)

# Regional Impacts

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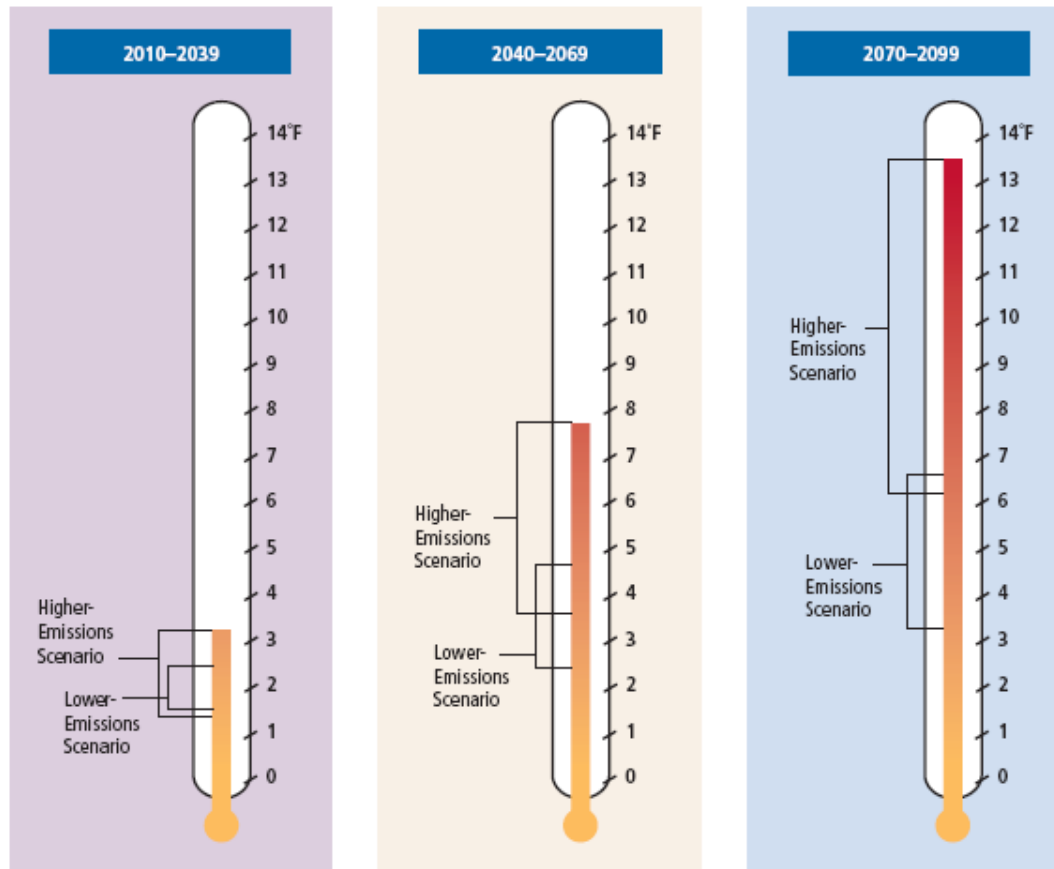


- Historically sea level has risen 11 inches along the Massachusetts coast in last century
- Over the same period:
  - precipitation increased 16.8%
  - temperatures increased 1.7°F

# Regional Impacts (cont.)



## Changes in Regional Average Summer Temperature

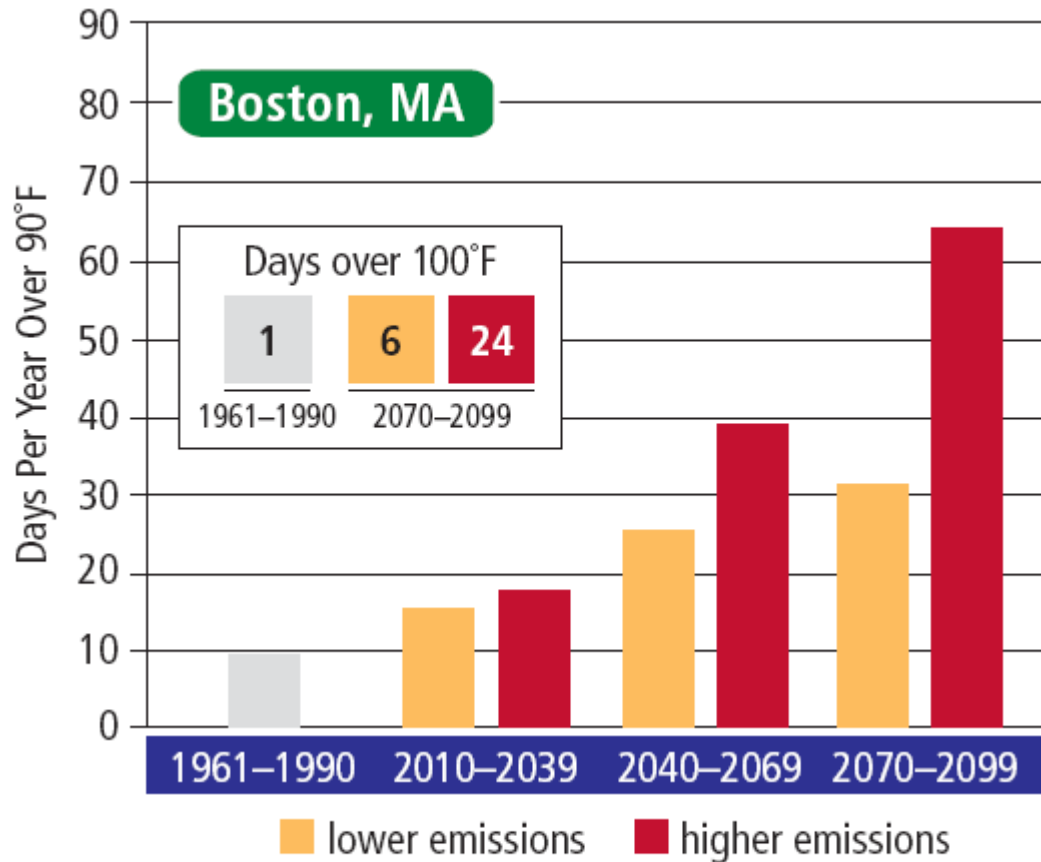


Source: Union of Concerned Scientists, "Confronting Climate Change in the U.S. Northeast" (2007)

# Regional Impacts (cont.)



## Increases in Extreme Heat

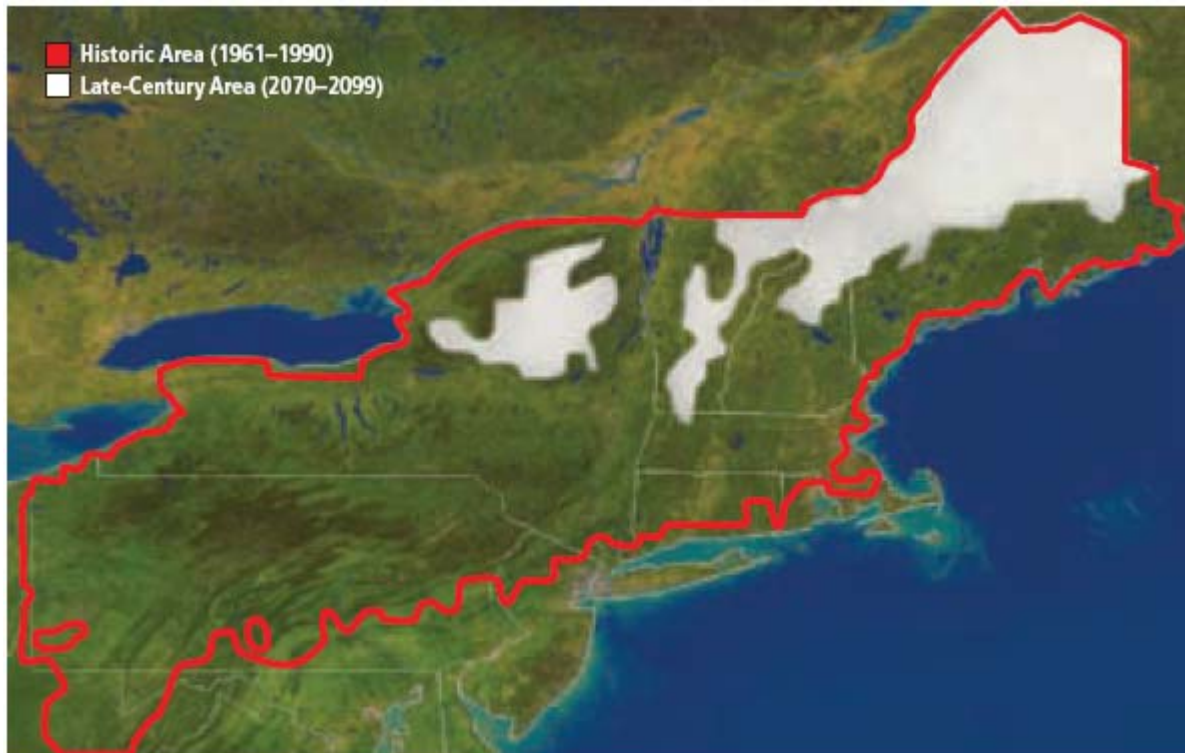


Source: Union of Concerned Scientists, "Confronting Climate Change in the U.S. Northeast" (2007)

# Regional Impacts (cont.)



## The Changing Face of Winter

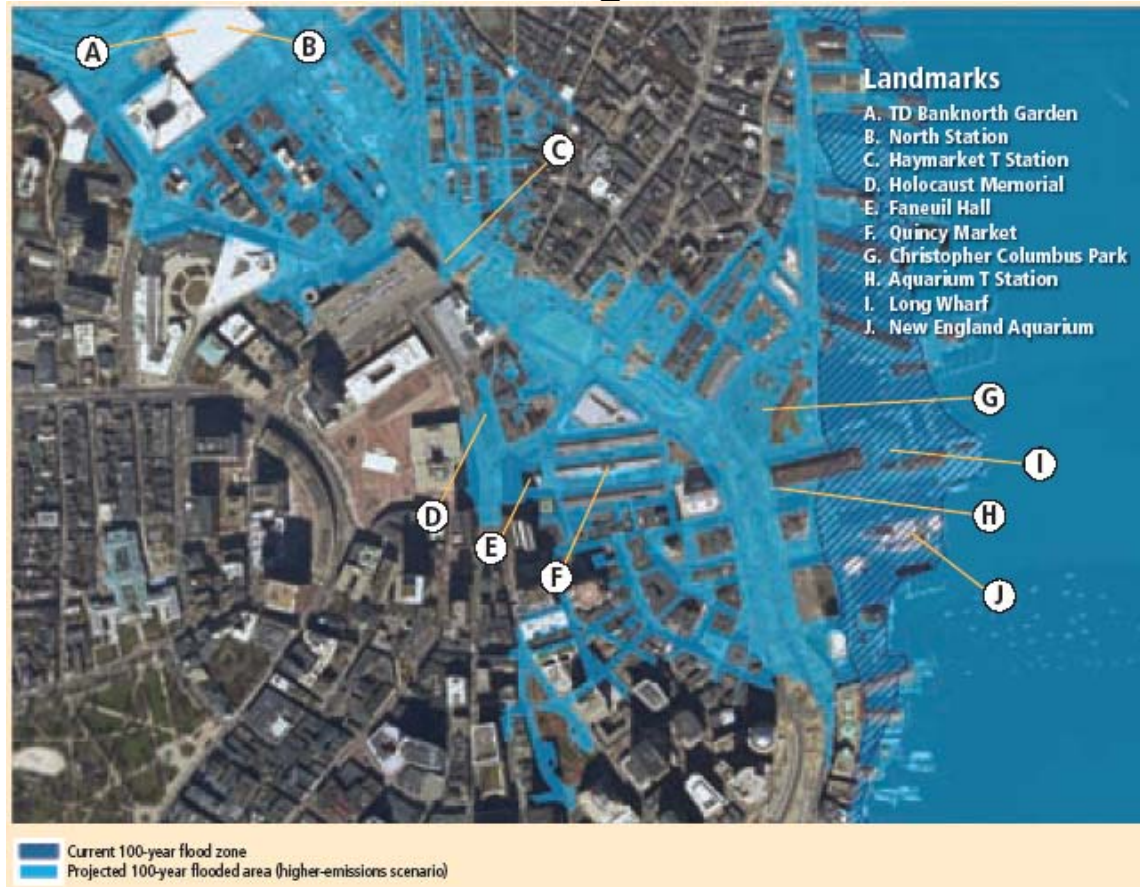


Source: Union of Concerned Scientists, "Confronting Climate Change in the U.S. Northeast" (2007)

# Regional Impacts (cont.)



## Future 100-Year Flood (Higher-Emissions Scenario)



Source: Union of Concerned Scientists, "Confronting Climate Change in the U.S. Northeast" (2007)

# Policy Context of the Issue

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- Regional, state, and local interest
  - New England Governors/Eastern Canadian Premiers Climate Change Action Plan 2001
    - Short, medium, and long-term GHG reduction goals
  - Regional Greenhouse Gas Initiative
    - Creates regional CO2 cap-and-trade program for electricity production sector
    - Includes mid-Atlantic states as well as NE states

# Policy Context (cont.)

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- *Massachusetts v. EPA*
- Executive Order 484: Leading by Example – Clean Energy and Efficient Buildings
- MEPA review process alterations
- Over 15 members, including Boston, in the Cities for Climate Protection Campaign → Climate Action Plans

# Current MPO Programs

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- Three ways the MPO and its partners currently reduce GHG emissions
  1. Alternative Modes - the MPO funds projects that provide people with transportation options other than SOVs (transit, bicycling, walking, and carpooling)
  2. Reduction of VMT & Congestion - MPO investments include the reconstruction of intersections and HOV lanes
  3. Alternative fuels

# Current Programs (cont.)

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- Alternative Modes - Transit
  - MBTA's 2003 long-range capital planning document, the PMT, contains information for each project's projected:
    - Percentage reduction in CO<sub>2</sub> emissions on weekdays regionwide
    - Ratio between the capital cost of the project and the anticipated reduction in CO<sub>2</sub> emissions on weekdays regionwide
  - 2008 PMT will consider how the MBTA's CO<sub>2</sub> emissions reduction goals fit into state and other CO<sub>2</sub> emissions reduction goals

# Current Programs (cont.)

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- Alternative Modes - Bicycle/Pedestrian
  - Over \$23.7 million of the funding in the MPO's FFY 2007-2009 TIP is programmed for bicycle and pedestrian projects using CMAQ funds
  - MA is one of three states that requires state agencies to accommodate bicycles and pedestrians into the design and construction of every project (Reflected in MassHighway's *Development & Design Guide* (2006))

# Goals MPO Could Pursue

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- Staff brainstormed on short, medium, and long-term actions that the MPO could take
  - On its own or with partners
- Actions are categorized by goal:
  - Create a more efficient transportation system through supporting alternative modes and reducing congestion and VMT
  - Use more fuel-efficient and cleaner vehicles
  - Make investments that support land uses that will reduce VMT

# Goal: A more efficient transportation system

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- *Short-Term* – Model CO<sub>2</sub> emissions with the region's transportation model
  - Provide estimates for Build and No Build alternatives and other MPO investments
- *Short-Term* – Enhance transportation planning and decision-making criteria
  - Add CO<sub>2</sub> emissions as criteria in transportation decisions
  - Use Plan and TIP criteria to support GHG-reducing programs and projects
- *Short- to Long-Term* – Fund pedestrian and bicycling programs and facilities

# Goal: A more efficient transportation system (cont.)

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- *Short-Term* – Implement minor/simple pedestrian, bicycle, and congestion-relieving intersection improvements recommended in MPO studies
- *Mid-Term* – Continue to support transit agencies in their efforts to increase parking and capacity at train stations to encourage greater use of public transit
- *Mid- to Long-Term* – Favor transit investments near commercial or residential development

# Goal: A more efficient transportation system (cont.)

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- Possible MPO Interest/Partnership Opportunities:
  - *Short- to Long-Term* – Maintain and upgrade public transit service and improve the efficiency of transit vehicle operations
  - *Mid- to Long-Term* – Support the expansion of ride-sharing and carpool programs and HOV lanes in the region to promote efficient travel

# Goal: More fuel-efficient and cleaner vehicles

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- *Short- to Long-Term* – Continue to fund transit vehicle retrofits and the purchasing of cleaner motor vehicles and train engines in public transit fleets
- *Short- to Long-Term* – Upgrade bridges to lift weight restrictions for freight and accelerate the double-stacked bridge program

# Goal: More fuel-efficient and cleaner vehicles (cont.)

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- Possible MPO Interest/Partnership Opportunities:
  - *Short- to Long-Term* – Support the acquisition of clean and fuel-efficient vehicles for public fleets
  - *Short- to Long-Term* – Promote the use of cleaner diesel equipment on state-funded construction projects
  - *Short- to Mid-Term* – Support initiatives to eliminate unnecessary idling

# Goal: Investments that support land uses

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- Possible MPO Interest/Partnership Opportunities:
  - *Short- to Long-Term* – Support the sustainable redevelopment of urban areas that enables residents to live near their work or live near transit
  - *Short- to Long-Term* – Continue to support compact development and discourage sprawl

# Questions/Comments

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**DRAFT**

# **Carbon Dioxide, Climate Change, and the Boston Region MPO**

## **A Discussion Paper**

Boston Region MPO Staff

Prepared by Ben Rasmussen



August 2007

*Reviewers:*  
*Cathy Lewis*  
*Anne McGahan*  
*Scott Peterson*  
*Karl Quakenbush*  
*Pam Wolfe*

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## **Carbon Dioxide, Climate Change, and the Boston Region MPO**

August 2007

### **INTRODUCTION**

Climate change will likely have significant impacts on the Boston region. If climate trends continue as projected, the climate and weather patterns in Boston at the end of this century will look more like those now found in Richmond, Virginia, or Atlanta, Georgia.<sup>1</sup> More severe weather events, a rise in sea level coupled with storm-induced flooding, and warmer temperatures would impact the region's infrastructure, economy, human health, and natural resources.

Greenhouse gases (GHG) contribute to climate change, and 84% of the United States' GHG emissions are composed of carbon dioxide (CO<sub>2</sub>), a common emission from motor vehicles and the burning of fossil fuels.<sup>2</sup> In Massachusetts, transportation sources emit more CO<sub>2</sub> than any other sources.

Transportation planning policies and decision-making can affect a reduction in the transportation sector's CO<sub>2</sub> emissions. To have a significant effect, however, some important considerations and trade-offs must be faced. Improving mobility for alternative mode users, particularly transit, may result in reduced mobility for motorists. For example, shifts in investments to increase transit mode split may reduce funding for highway projects.

The purpose of this document is threefold. Part I provides the Boston Region Metropolitan Planning Organization with an overview of climate change and its local impacts. Part II provides a summary of the MPO's plans and programs that are already resulting in the reduction of GHG emissions. Part III provides specific potential "next step" actions to deliberately continue existing programs or start additional GHG-reducing initiatives.

### **Current Policy Context**

To better understand the current political context surrounding climate change, this section outlines current policies in the region that are relevant to climate change and CO<sub>2</sub> emissions. In August 2001, the Conference of New England Governors and Eastern Canadian Premiers (NEG/ECP) adopted the first and only regional action plan in North America for addressing climate change. This agreement, known as the Climate Change Action Plan 2001, reflected the conviction of the NEG/ECP that climate change is a significant environmental concern that will have a major impact on the region's environment and economy. In 2004, the Massachusetts Climate Protection Plan adopted the same targets as the Climate Change Action Plan 2001.

With the Climate Change Action Plan, the NEG/ECP, and subsequently the Commonwealth, made a commitment to take steps to address climate change by setting specific GHG emission reduction targets for the region and the Commonwealth:

- Short-term: Reduce GHG emissions to 1990 levels by the year 2010.

- Medium-term: Reduce GHG emissions 10% below 1990 levels by the year 2020.
- Long-term: Reduce GHG emissions sufficiently to eliminate any dangerous threat to the climate; current science suggests this will require reductions as much as 75–85% below current levels.

In line with these targets, Governor Deval Patrick signed the Regional Greenhouse Gas Initiative (RGGI) in January 2007, committing Massachusetts to a multi-state effort to reduce emissions of CO<sub>2</sub> and address global climate change. States participating in RGGI are developing a regional strategy for controlling emissions, including a market-based, multi-state cap-and-trade program<sup>3</sup> that will require electric power generators to reduce their emissions of CO<sub>2</sub>.

On April 2, 2007, the Supreme Court ruled in “Massachusetts v. Environmental Protection Agency” that the Environmental Protection Agency (EPA) has the authority to regulate heat-trapping gases in automobile emissions. The decision increases the likelihood that the EPA will approve Massachusetts’s and 11 other states’ programs to limit tailpipe emissions, beginning with the 2009 model year.

On April 12, 2007, Mayor Menino enacted an executive order that requires Boston city government to cut GHG emissions to 80 percent below 1990 levels by the year 2050. As a first step, the city government must cut emissions by seven percent below 1990 levels by 2012.

Six days later, Governor Patrick signed an executive order that directs agencies to cut energy use 20 percent below 2002 levels by 2012 and 35 percent by 2020. It also requires them to cut their GHG emissions to 25 percent below 2002 levels over the next five years, to 40 percent by 2020, and to 80 percent by 2050.

Most recently, Governor Patrick changed Massachusetts environmental policy so that private developers planning projects large enough to warrant a state environmental review are required to estimate GHG emissions for these projects and reduce the emissions with measures such as energy-efficient lighting, alternative fuels, or commuter shuttles. This policy change takes impacts such as emissions from smokestacks and heating with fossil fuels into consideration, as well as the effect of thousands of workers driving to a new development.

## **PART I: OVERVIEW OF CLIMATE CHANGE**

Climate change refers to unstable weather patterns caused by increases in the average global temperature. There is a consensus among climate scientists that these changes result from atmospheric concentrations of CO<sub>2</sub>, methane (CH<sub>4</sub>), nitrous oxide (N<sub>2</sub>O), and other heat-trapping gases. These GHGs form a blanket of pollution that stays in the atmosphere.

Increasing concentrations of GHGs are causing a rise in average global temperatures. Greenhouse gases warm the earth’s atmosphere and are so-called because they simulate the effect of a greenhouse, trapping heat within the atmosphere and contributing to an increase in the earth’s temperature. GHGs may be the fundamental cause of sea level rise and climate instability

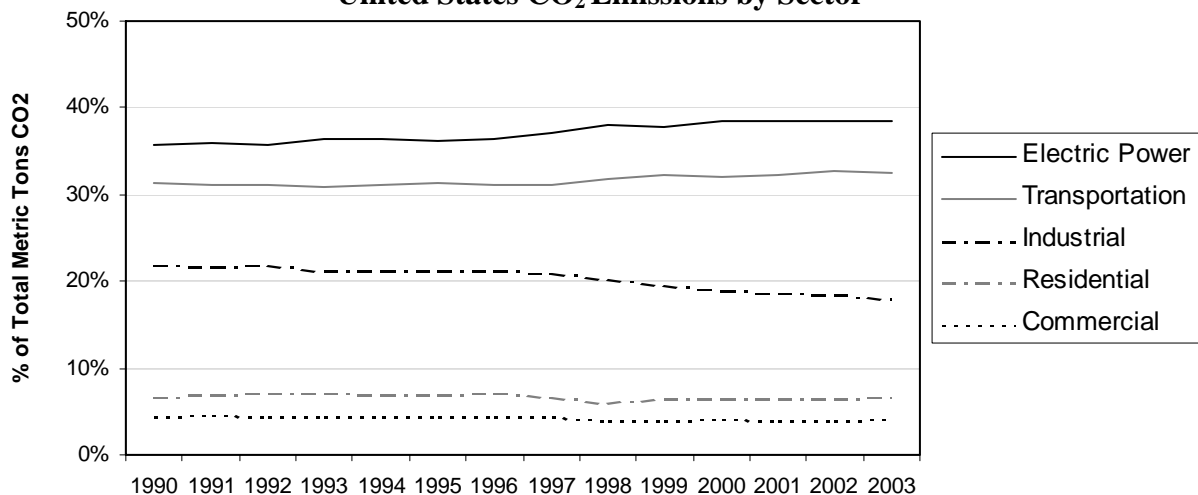
characterized by severe weather events such as storms, droughts, floods, and heat waves. Appendix A contains information on global climate change trends and impacts.

**National, Regional, and State Trends and Impacts**

**Trends**

The United States is responsible for more than one-third (36%) of the world’s CO<sub>2</sub> emissions – more than any other country.<sup>4</sup> In the United States, CO<sub>2</sub> emissions rose 20.4% percent between 1990 and 2005.<sup>5, 6</sup> As a sector, transportation is the second largest CO<sub>2</sub> emitter in the United States (Figure 1).

**FIGURE 1  
United States CO<sub>2</sub> Emissions by Sector<sup>7</sup>**



Emissions per capita in Massachusetts are lower than the national average, with the state emitting 1.9% of the total CO<sub>2</sub> emitted in the U.S. while housing 2.4% of the population, but it is still a comparatively large amount of the world’s GHG emissions. Massachusetts’ emissions are likely lower than other states per capita due to relatively cleaner energy sources and to there being a high proportion of people living in the inner core area in and around Boston, where population densities are high, work and other destinations are close by, and transit alternatives are available. Overall, Massachusetts ranks 25<sup>th</sup> in total state CO<sub>2</sub> emissions.

**FIGURE 2**  
**Massachusetts CO<sub>2</sub> Emissions by Sector (2003)<sup>8</sup>**

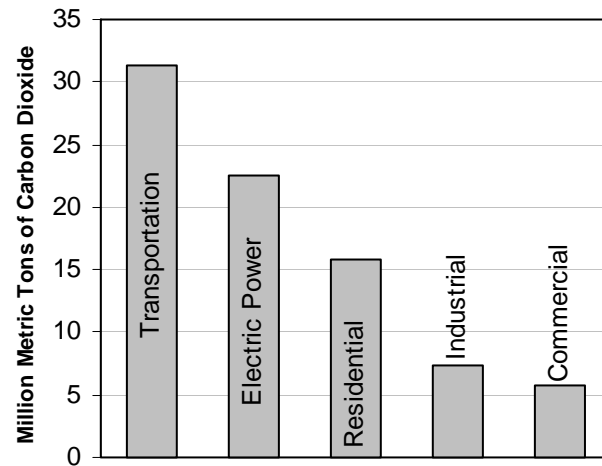
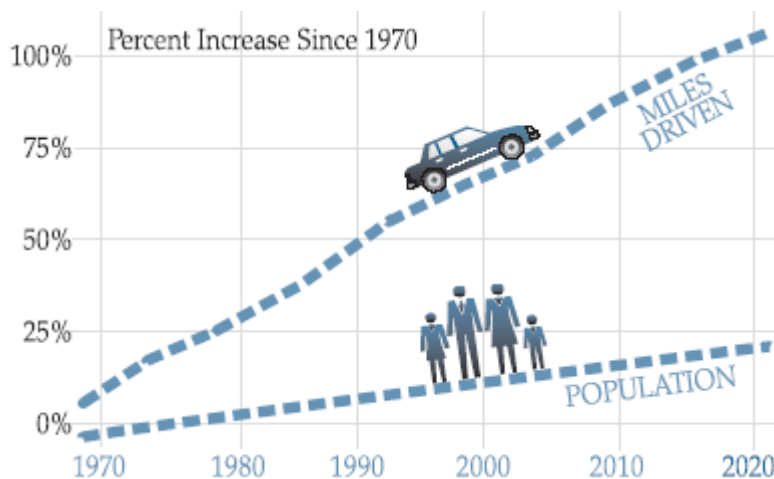


Figure 2 shows that CO<sub>2</sub> emissions are higher for the transportation sector than for any other sector in Massachusetts. Between 1990 and 1998, annual vehicle miles traveled (VMT) in Massachusetts rose 13%, from 45 billion miles to 51 billion miles. Figure 3 shows how VMT is outpacing population growth in the Commonwealth.

**FIGURE 3**  
**Miles Driven and Population Growth in Massachusetts<sup>9</sup>**



Massachusetts anticipates a 33% overall increase in CO<sub>2</sub> from the transportation sector between 1990 and 2020.<sup>10</sup> This is due in part to increasing VMT, but is even more attributable to increasing sales of less efficient vehicles, which include light trucks and sport utility vehicles.<sup>11</sup> Additionally, diesel fuel, the predominant fuel for freight, is a major source of GHG emissions in Massachusetts. National projections in 2004 showed diesel fuel consumption growing 14% from 1997 to 2010, which represents an increase of more than 40% above 1990 levels.<sup>12</sup> Although modest efficiency gains in all forms of freight transportation are expected over the next decade, they will be offset by increased freight travel as more goods are produced and consumed for a growing national population. Vehicle miles traveled by heavy-duty trucks are expected to

increase by nearly 24% from 1998 to 2010, according to projections from the U.S. Energy Information Administration.<sup>13</sup>

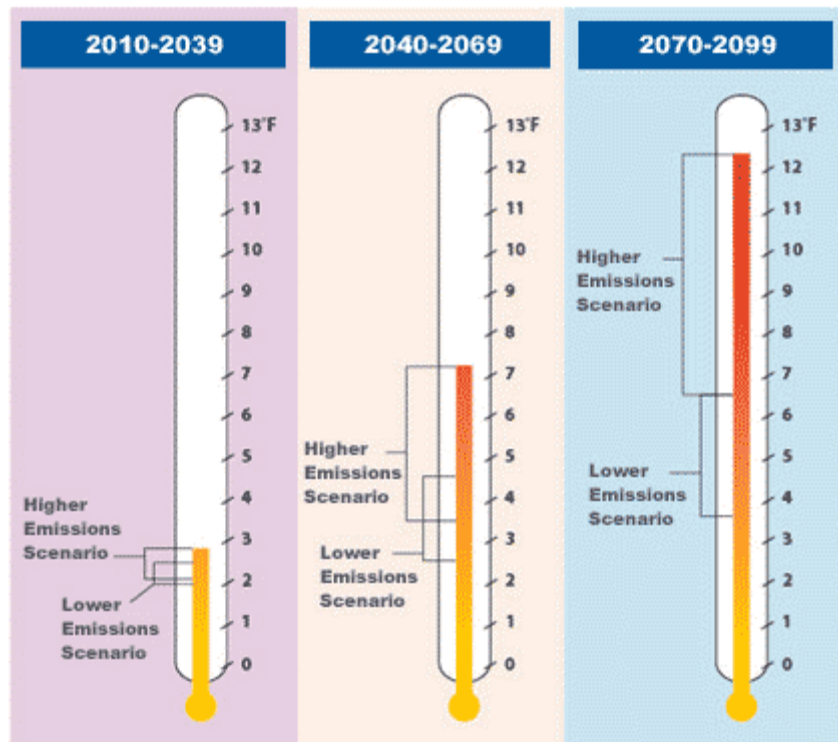
**Impacts**

Historically, sea level rose 11” along the coast of Massachusetts in the last century.<sup>14</sup> Over the same time period, precipitation increased 16.8% and temperatures increased 1.7°F in coastal areas of New England.<sup>15</sup> For parts of New England, wintertime warming has been nearly three times the summertime warming.<sup>16</sup>

*Temperature Increases*

The Union of Concerned Scientists recently developed two GHG emissions scenarios and examined their impacts on temperature increases for the Northeast (which includes New England, New York, New Jersey, and Pennsylvania) and Massachusetts. The higher emissions scenario represents a continued heavy reliance on fossil fuels, causing heat-trapping emissions to rise significantly over the century. The lower-emissions scenario represents a shift away from fossil fuels in favor of clean energy technologies, causing heat-trapping emissions to decline by mid-century. Both scenarios assume a world with high economic growth and a global population that peaks mid-century and then declines. Based on these scenarios, temperatures in New England could increase on average by 3.5° F to 12° F by 2100 (Figure 4).<sup>17</sup>

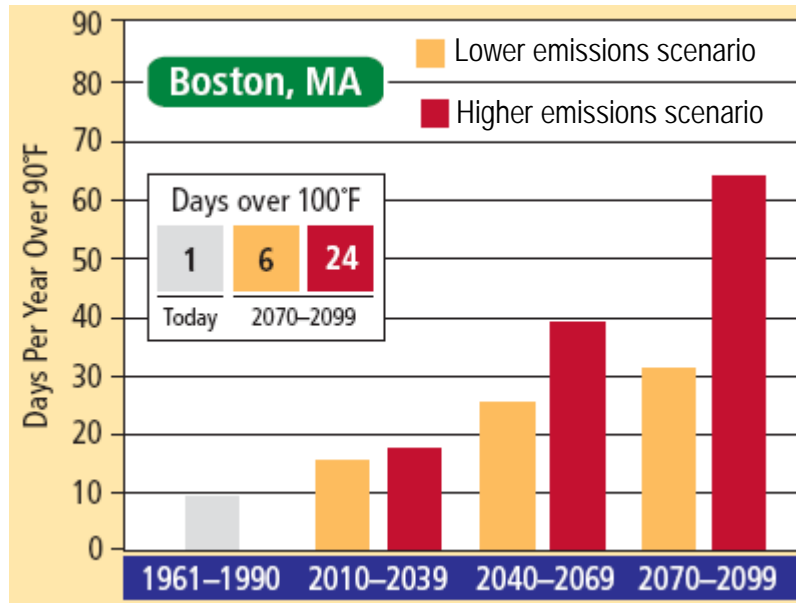
**FIGURE 4:**  
**Changes in Average Annual Temperature in New England<sup>18</sup>**



Under these scenarios, this study determined that Boston, which previously experienced an average of 10 days per year with temperatures exceeding 90°F, would have up to 63 such days by 2100 with 24 days over 100°F (Figure 5).<sup>19</sup> Such increases in extremely hot days may result in an appreciable increase in high-energy consumption days and the need for requisite peaking units, which are ancillary electricity-producing facilities.<sup>20</sup>

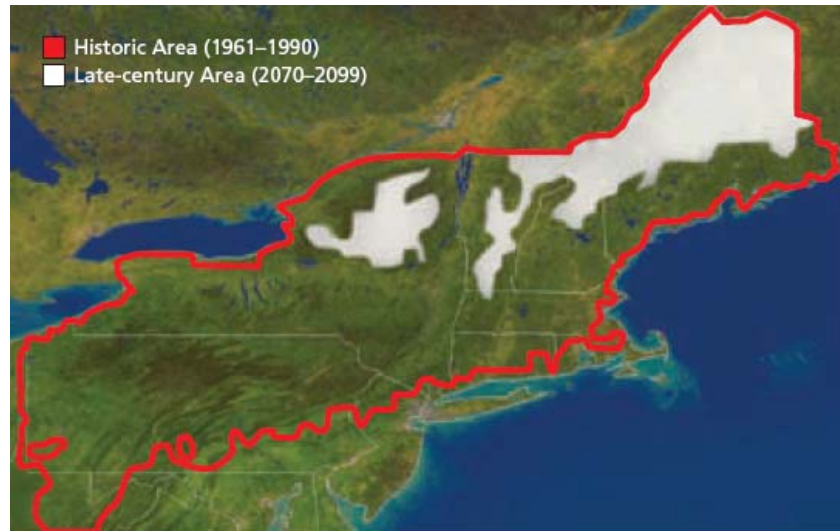
Hotter weather with more frequent and severe heat waves also pose multiple health risks that include a rise in heat-related illness, more frequent periods of harmful outdoor air quality, and the spread of certain diseases.<sup>21</sup> Those most at risk from high and continuous heat include the elderly, young children, and people who already suffer from certain illnesses, particularly heart disease.<sup>22</sup> In Boston, elevated heat-stress mortality rates occur in certain lower-income and immigrant neighborhoods, suggesting that these communities are more socially vulnerable to heat than others.<sup>23</sup>

**FIGURE 5:  
Extreme Heat in Boston<sup>24</sup>**



Higher temperatures and a changing climate translate into less snow for the Northeast. Figure 6 shows that far less of the Northeast will experience a typical snow season toward the end of the century under the higher emissions scenario. The red line in the map shows the area of the northeastern United States that had at least a dusting of snow on the ground for at least 30 days in the average year. The white area shows the projected retreat of this snow cover by the end of this century.

**FIGURE 6**  
**The Changing Face of Winter<sup>25</sup>**



### *Air Quality*

Hotter summers could set the stage for an increase in the number of days that fail to meet federal air-quality standards.<sup>26</sup> In the absence of more stringent controls on ozone-forming pollutants, the number of days with poor air quality is projected to quadruple in Boston under the higher-emissions scenario.<sup>27</sup> Such days could increase by half under the lower-emissions scenario.<sup>28</sup> Deteriorating air quality would exacerbate the risk of respiratory, cardiovascular, and other ailments in Massachusetts, which already has the highest rate of adult asthma in the United States.<sup>29</sup> In Boston, eight-hour maximum ground-level ozone concentrations are projected to increase 13 to 21 percent under the higher-emissions scenario and zero to five percent under the lower-emissions scenario.<sup>30</sup>

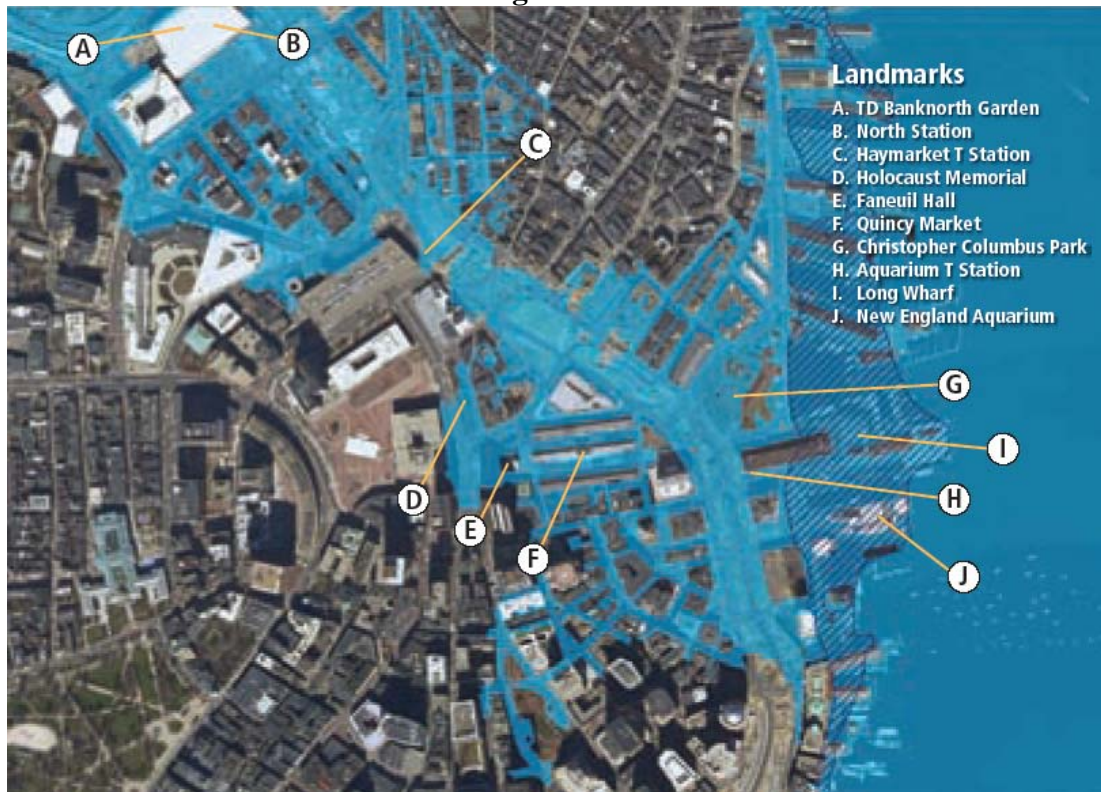
### *Sea Level Rise and Flooding*

Massachusetts and all coastal states will lose beachfront in the coming years as climate change causes rising sea levels and stronger coastal storms.<sup>31</sup> By the end of the century, sea levels are expected to rise four to 21 inches under the lower-emissions scenario and eight to 33 inches under the higher-emissions scenario, with the potential for additional increases due to more rapid melting of major polar ice sheets.<sup>32</sup> Regardless of scenario, Boston can expect a coastal flood equivalent to today's 100-year flood every two to four years on average by mid-century and almost annually by the end of the century.<sup>33</sup>

As today's 100-year maximum flood height of 9.7 feet becomes a more common occurrence in Boston, the new 100-year maximum flood height is projected to rise to more than 12 feet under the higher-emissions scenario by the end of this century.<sup>34</sup> This means that many more existing buildings and properties as well as associated transportation and other infrastructure will be at risk of flooding. Figure 7 shows the current Federal Emergency Management Agency 100-year flood zone (hatched darker blue) as well as the extent of the projected 100-year flood zone in 2100 (lighter blue) under the higher-emissions scenario for the waterfront/Government Center

area of Boston.<sup>35</sup> Under this scenario, important Boston landmarks (such as Faneuil Hall) and transportation infrastructure currently not at great risk of flooding could witness repeated flooding in the future unless they are protected from such events beforehand.<sup>36</sup> Flood elevations under the lower-emissions scenario are roughly half a foot lower than the flooding depicted in this figure (but are still two feet higher than the current 100-year flood).<sup>37</sup>

**FIGURE 7**  
**Potential Flooding in Downtown Boston<sup>38</sup>**



The Commonwealth has a very high risk of coastal and river flooding because of its long coastline, numerous rivers and streams, and concentrated development in combination with high exposure to heavy rainstorms, hurricanes, and nor'easters. One study estimates that property damage and emergency services due to rises in sea level over the next 100 years could range from \$20 billion to \$94 billion if there are no adaptive responses except rebuilding after floods.<sup>39</sup> For more information on the impact of sea level rise and flooding in the Boston region, please see Appendix B.

### *Transportation Impacts*

The principal way in which climate change will affect the transportation system is through extreme climate events, in particular events that produce significant flooding or snowfall. Sea level rise impacts will become evident during extreme events when storm tides will be higher, increasing the frequency and severity of coastal flooding. In economic terms, the impacts of extreme weather events on the transportation system are of two types.

The first is the damage inflicted upon infrastructure, such as flood damage to road, rail, and bridges. According to the Union of Concerned Scientists report, “In 1996, heavy rains raised the level of Boston’s Muddy River, flooding a tunnel entrance to the ‘T,’ the city’s subway system. The damage from this flooding closed a busy subway line for several weeks and cost... roughly \$75 million. While the main reason for this damage and disruption is simple—the tunnel entrance was not flood-proof—it also underscores the broader vulnerability of Boston’s transportation infrastructure: its subway system—the country’s oldest—was not built with certain conditions in mind, including significantly higher sea levels and storm surges.”<sup>40</sup>

The second is the economic cost of interruptions in the operation of the transportation systems, which prevent, for example, employees from going to work, shoppers from getting to stores, and goods from being delivered. One study estimates that traffic delay due to flood events over the course of the 21st century in the Boston region may increase by about 80% and lost trips over the same period may increase by 82% over delay and lost trips that would be expected in the absence of climate change.<sup>41</sup>

### *Social, Economic, and Natural Impacts*

New England and Massachusetts may be affected by climate change in several other ways. These impacts are attributable, at least in part, to temperature increases and sea level rise. All of these impacts have economic implications since important Massachusetts industries such as tourism and agriculture rely on the state’s climate and natural resources.<sup>42</sup> These impacts include more frequent and damaging weather events, water shortages, and adverse changes in the state’s ecosystems, native species, and commercial fish stocks.<sup>43</sup>

## **PART II: CURRENT MPO POLICY AND ACTION**

As stated in JOURNEY TO 2030, the MPO’s current long-range transportation plan, the MPO will continue to support projects and programs to reduce emissions of CO<sub>2</sub> in the region. Several of the policies and visions that the MPO created to guide the development of JOURNEY TO 2030 and to steer decision-making for transportation in the region may lead to MPO actions that may reduce GHG emissions over time. Primarily, these policies can be found under the Environment, Land Use and Economic Development, and Mobility topics in the plan. A few of the policies under the System Preservation, Modernization, and Efficiency; Safety and Security; and Public Participation topics may also lead to ways the MPO can reduce GHG emissions in the region. Appendix C lists the policies that may lead to a reduction of GHG emissions over time.

There are three basic ways the MPO and its partners currently work to reduce GHG emissions. First, the MPO funds projects that provide people with transportation options other than single-occupancy vehicles (SOVs) to travel to work, school, and other destinations. Alternative modes to SOVs include transit, bicycling, walking, and carpooling. Second, MPO investments, such as the reconstruction of intersections, reduce VMT and roadway congestion, therefore cutting back emissions. Third, the MPO funds the use of alternative fuels, which release less GHG emissions than traditional fossil fuels. This third method is discussed within the context of the other two methods as described below.

## **Alternative Modes**

### **Transit**

One American person using mass transit for an entire year, instead of driving to work, can keep an average of over 5,000 pounds of CO<sub>2</sub> from being discharged into the air, and one full, 40-foot bus takes 58 cars off the road.<sup>44</sup> A 10 percent nationwide increase in transit ridership would save 135 million gallons of gasoline a year and prevent 2.7 billion pounds of CO<sub>2</sub> being added to the atmosphere (one gallon of gasoline creates 20 pounds of CO<sub>2</sub>).<sup>45, 46</sup>

The Massachusetts Bay Transportation Authority (MBTA) is a significant part of the region's transportation system, both by providing people with an alternative to SOVs and by running buses, subways, trains, and maintenance and operations vehicles throughout the region. The Massachusetts Bay Transportation Authority's (MBTA) 2003 long-range capital planning document, the Program for Mass Transportation (PMT), contained information for each project's projected percentage reduction in CO<sub>2</sub> emissions on weekdays regionwide and on the ratio between the capital cost of the project and the anticipated reduction in CO<sub>2</sub> emissions on weekdays regionwide. The 2008 PMT will consider how the MBTA's CO<sub>2</sub> emissions reduction goals fit into state and other CO<sub>2</sub> emissions reduction goals.

In line with the PMT and JOURNEY TO 2030, the MPO allocates millions of dollars of funding to transit projects annually. This funding is used to maintain, improve, and expand the existing transit system. Near-term transit upgrade projects include the Blue Line modernization, Fairmount Line improvements, the redevelopment of Ashmont Station, station accessibility improvements, and the procurement of new buses. Despite these expenditures, many un-met transit needs still persist in the region.

The MPO also allocates Congestion Mitigation and Air Quality (CMAQ) and transit funds for cleaner transit vehicles. In recent and coming years, these projects include: undertaking bus diesel retrofit programs, purchasing hybrid locomotive switches, monitoring and controlling bus emissions, and procuring emission control diesel buses.

### **Bicycle and Pedestrian Projects**

Non-motorized (bicycle and pedestrian) transportation produces no emissions. According to the Regional Bicycle Plan, 66% of our trips, by any mode of transportation, are less than five miles; 68% of us live within two miles of a transit station; and 31% of us live within one mile of a shared-use path.<sup>47</sup> Despite these relatively short distances, bicycling remains a marginal transportation choice for work and errands, comprising less than 1% of trips in our region.<sup>48</sup> The Metropolitan Area Planning Council conducted a survey on bicycle issues in the region that identified reasons more people do not bicycle to work, to shop, or to visit friends. The survey found that approximately 45% of respondents would bicycle more often if the route were safer for bicycling.<sup>49</sup>

The MPO allocates funding for bicycle and pedestrian projects in the region to make the use of these modes of transportation safer, more attractive, and more viable as a mode choice. Over \$23.7 million of the funding in the MPO's Federal Fiscal Years 2007-2009 Transportation Improvement Program (TIP) is programmed for bicycle and pedestrian projects using CMAQ funds. These projects mainly include multi-use paved paths. Recent projects include the Peabody Bikeway, the Upper Charles Trail in Milford, and a portion of the reconstruction of Somerville Avenue in Somerville. The MPO also funds a bicycle parking program and conducts studies and workshops to improve bicycling and walking conditions throughout the region in an effort to get more people to use these modes for traveling to work and running errands.

Massachusetts is one of three states that requires state agencies to accommodate bicycles and pedestrians into the design and construction of every project. This requirement is reflected in the Massachusetts Highway Department's *Project Development & Design Guide* (2006). The design guide provides for the accommodation of pedestrians and bicyclists in line with Chapter 87 of the Acts of 1996. By integrating these guidelines into their design, new roadway projects will accommodate both bicyclists and pedestrians.

## **Reduction of VMT and Roadway Congestion**

### **Congestion Mitigation and Air Quality Improvement Program**

The MPO programs funds for projects that help improve air quality and reduce traffic congestion as part of its CMAQ program. Projects eligible for funding under this program include public transportation improvements, traffic flow improvements (usually through intersections and interchanges), travel demand management, bicycle and pedestrian projects, alternative fuel projects, inspection and maintenance programs, intermodal freight transportation, public education and outreach, idle reduction technology, and intelligent transportation systems. Recent projects using CMAQ funds include the signalization and improvements on Route 28 in Reading, the bus diesel retrofit program, the suburban mobility program, and the region's bicycle parking program. In recent years, the MPO's target for spending CMAQ funds has been approximately \$13 million a year.

### **Freight Projects**

Freight transportation accounts for 6.3% of total CO<sub>2</sub> emissions in the United States.<sup>50</sup> Much of New England's freight is transported by truck, contributing to CO<sub>2</sub> emissions and congestion in the region. Among other reasons, the perishability and short-haul distances of many of the commodities transported in the region necessitates truck freight transportation. The MPO helps to decrease truck CO<sub>2</sub> emissions and improve freight mobility by funding projects that rehabilitate weight-restricted bridges and reduce congestion. For example, weight-restricted bridges in the region require detours of truck traffic that could take up to one and a half hours, thereby increasing traffic and CO<sub>2</sub> emissions.

Moving a larger percentage of freight by rail has the potential to reduce GHG emissions since trains are three times more fuel-efficient than trucks on a ton per mile basis. According to the American Society of Mechanical Engineers, if 10% of intercity freight now moving by highway

were shifted to rail, 2.5 million fewer tons of CO<sub>2</sub> would be emitted into the air annually nationwide.<sup>51</sup> An increase in the movement of rail freight via more frequent service in the Boston region would have to be coordinated with passenger rail operations so as not to diminish passenger service that may use the same tracks. Additional infrastructure would also be necessary to accommodate more frequent rail freight in the region.

One way of increasing the movement of rail freight without increasing the frequency of trains in the region is to double-stack rail cars. Double stack rail cars, which have two containers stacked on one another, move freight more efficiently than single stack cars. Since one rail car can carry as much as 3.5 truckloads, one double stack car can carry approximately seven truckloads. Since many bridges over rails in the Boston region are too low to accommodate double-stack rail cars – there are approximately 56 railroad bridges in the region with a vertical clearance of less than 21 feet, which is the threshold for double stack cars – it is Massachusetts policy that new bridges over rail lines, and bridges over rail lines that are scheduled for reconstruction, are built with a vertical clearance of 21 feet in order to accommodate double-stack rail cars.

### **PART III: FUTURE MPO ACTIVITIES**

Because transportation is a significant source of CO<sub>2</sub> emissions in Massachusetts, slowing the growth of emissions in the transportation sector is important. While the MPO and its partners should continue the work that reduces CO<sub>2</sub> emissions as described above, there are several additional actions that can be taken to reduce GHG emissions in the region within the purview of the MPO. Some actions can be taken exclusively by the MPO, and other actions can be led or carried out by the MPO in partnership with other agencies and organizations.

While these actions can effect a reduction in the transportation sector's CO<sub>2</sub> emissions, some important considerations and trade-offs must be faced to have a significant effect. Improving mobility for alternative mode users, particularly transit, may result in reduced mobility for motorists. For example, shifts in investments to increase transit mode split may reduce funding for highway projects. These kinds of decisions over time could impact our current lifestyle through prohibiting or discouraging the continuance of our current travel behavior.

#### **Other MPO Actions**

Other MPOs are becoming increasingly involved in climate change issues and reducing CO<sub>2</sub> emissions. Since 2002, the New York State Department of Transportation has required that New York MPOs include estimates of energy use and GHG-related emissions in their TIPs and transportation plans with an analysis showing no-build versus build conditions.

The Board of Directors of the Metropolitan Washington Council of Governments in Washington, DC, recently adopted a regional initiative designed to address global climate change by controlling harmful emissions locally. The Board created a new Climate Change Steering Committee to make recommendations for reducing the region's GHG emissions. In addition to establishing a reduction goal for the region, the committee will consider several other action items, including:

- Measuring local GHG emissions and their impact on the region;
- Preparing a catalogue of activities currently underway in local jurisdictions;
- Identifying best practices for local governments; and
- Recommending climate change policy and potential advocacy positions on federal, state, and local climate change proposals.

During the update to its regional plan, the Puget Sound Regional Council (PSRC) in Seattle, Washington, received numerous comments urging the updated plan to address climate change. To integrate climate change into its planning process, PSRC drafted several goals and policies under its environment policy area that called for decreasing per-capita CO<sub>2</sub> emissions and energy use, increasing alternatives to driving alone, and preparing for climate change impacts. PSRC also models CO<sub>2</sub> emissions to compare alternative development scenarios as part of its long-range transportation planning process.

## **Goals**

Lowering the transportation sector's GHG emissions in the Boston region requires:

- Creating a more efficient transportation system through supporting alternative modes and reducing congestion and VMT,
- Using more fuel-efficient and cleaner vehicles, and
- Making investments that support land uses that will reduce VMT.

Ways to achieve these goals are listed below.

Consistent with its policies, the MPO can adopt these goals and take steps to lead them. The MPO can add these goals to the list of policies under the Environment topic to integrate them into the MPO's current planning process.

The possible actions below are based on actions and ideas from the Massachusetts Climate Protection Plan, other MPOs, MPO staff, and other sources. Each possible action is broadly categorized as something that can be accomplished in the short-term, mid-term, long-term, or a combination thereof.

### **A Transportation System that Emits Less GHG Emissions**

If desired, the Boston Region MPO can create a transportation system that curtails the anticipated growth of GHG emissions and reduces current emissions. Spending decisions would be based on reducing transportation-related CO<sub>2</sub> emissions in the region by encouraging people to travel in more climate friendly ways, such as taking transit, ride-sharing, bicycling, and walking; alleviating congestion; and ultimately reducing VMT. To attain this goal, the MPO can take some of or all of the following actions.

Possible MPO Actions:

- *Short-Term* – Model CO<sub>2</sub> emissions with the region’s transportation model. With the appropriate programming, the region’s transportation model can provide the MPO with information on the CO<sub>2</sub> emissions of existing and/or future transportation networks. This information can be reported alongside other emissions that MPO staff routinely models and compared to see the relative benefits of some investments.
- *Short-Term* – Enhance transportation planning and decision-making criteria.
  - Add CO<sub>2</sub> emissions as criteria in transportation decisions. By adopting criteria that estimates a project’s CO<sub>2</sub> emissions for Plan and TIP projects, the MPO can be informed on what projects’ CO<sub>2</sub> emissions will be and can make decisions accordingly.
  - Use Plan and TIP criteria to support GHG-reducing programs and projects. Give greater emphasis to Plan and TIP criteria and projects that support sustainable land use and transit-oriented development; that promote transit, ridesharing, and TDM coordination; and that include bicycle and pedestrian improvements that will generate significant use of these modes.
- *Short- to Long-Term* – Fund pedestrian and bicycling programs and facilities that are likely to result in auto trips being replaced by non-motorized trips. Planning and infrastructure investments can improve and increase non-motorized transportation.
- *Short-Term* – Create a CMAQ-funded program in the TIP to implement minor and simple pedestrian, bicycle, and congestion-relieving intersection improvements recommended in MPO studies.
- *Short- to Mid-Term* – Conduct an inventory of successful transportation-related climate change-curbing activities that agencies and municipalities in the region are undertaking. Develop best practices for agencies and municipalities in the region based on this inventory and relevant national best practices.
- *Mid-Term* – Continue to support transit agencies in their efforts to increase parking at train stations to encourage greater use of public transit. Increased parking spaces at crowded train stations would encourage more people to drive to transit, thereby shortening their overall auto trip. These studies would also consider train capacity since trains would need to have enough available capacity to accommodate any additional riders.
- *Mid- to Long-Term* – Favor transit investments near commercial or residential development. Providing transit stations near commercial or residential development can increase transit mode share and reduce VMT.

Possible MPO Interest/Partnership Opportunities:

- *Short- to Long-Term* – Maintain and upgrade public transit service and improve the efficiency of transit vehicle operations. Funding projects that improve facilities and services and that enhance the capacity of the region’s transit system can increase the number of transit riders and decrease the number of cars on the region’s roads.
- *Mid- to Long-Term* – Support the expansion of ride-sharing and carpool programs and high-occupancy vehicle (HOV) lanes in the region to promote efficient travel. More visibility and encouragement to use existing ride-share lots, and the creation of more ride-share lots, can lead to more carpooling in the region. More HOV lanes in the region would provide an additional incentive for people to carpool.

**Promote Fuel-Efficiency and Cleaner Vehicles**Possible MPO Actions:

- *Short- to Long-Term* – Continue to fund transit vehicle retrofits and the purchasing of cleaner motor vehicles and train engines in public transit fleets. Cleaner transit by purchasing more efficient vehicles can curb global warming emissions by 10 to 15 percent compared with conventional buses.<sup>52</sup> Cleaner train engine technology can also help to reduce diesel soot and particulates.<sup>53</sup>
- *Short- to Long-Term* – Upgrade bridges to lift weight restrictions for freight and accelerate the double-stacked bridge program. There are two rail bridges in the region that are limited to 263,000 pounds per train carload, which limits the movement of freight within and across the region. Weight-restricted roadway bridges could also be upgraded to prevent long detours. In addition to these upgrades, increasing the clearance of bridges to allow for the passage of double-stacked railcars would create more efficient freight movement in the Boston region.

Possible MPO Interest/Partnership Opportunities:

- *Short- to Long-Term* – Support the acquisition of clean and fuel-efficient vehicles for public fleets. State and regional agencies and municipalities should buy more efficient cars and trucks and increase the use of lower-carbon fuels. By doing this, agencies and municipalities will assemble a cleaner fleet and save money on energy.
- *Short- to Long-Term* – Promote the use of cleaner diesel equipment on state-funded construction projects.
- *Short- to Mid-Term* – Support initiatives to eliminate unnecessary idling. The Massachusetts anti-idling regulation prohibits idling the engine of any motor vehicle while the vehicle is stopped in excess of five minutes (with exceptions for activities such as maintenance and operating auxiliary equipment such as delivery lifts). With technology that is now available, buses can be automatically switched off if left idling for over five minutes.

**Coordinate with Land Use Decisions**

Many GHG-reducing initiatives can be advanced by changes in land use, particularly when coordinated with changes in transportation services. While land use decisions are not made by the MPO, the MPO should continue consulting with municipal, regional, and state agencies to ensure that transportation investments are coordinated with land use changes and plans. Through this process the MPO can make and support investments that promote alternative mode choices in development areas.

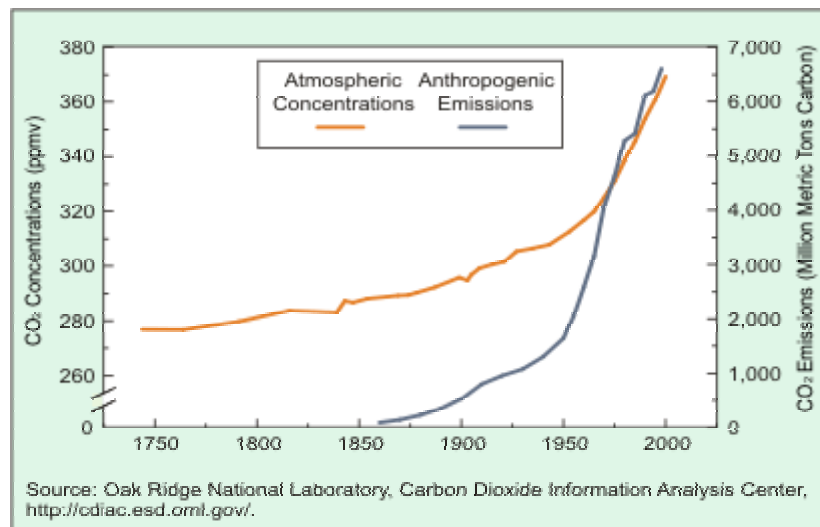
Possible MPO Interest/Partnership Opportunities:

- *Short- to Long-Term* – Support the sustainable redevelopment of urban areas that enables residents to live near their work or live near transit. Providing people with the option to live nearer to their work or closer to public transit reduces the need for long trips to and from work.
- *Short- to Long-Term* – Continue to support compact development and discourage sprawl. Through revised zoning laws, many towns are returning to a more compact, traditional New England style of development that relies less on the automobile and can allow people to complete more of their daily tasks via transit, by bicycle, or on foot. This support can include activities such as funding the design and construction of roadways that control traffic speeds and allow pedestrians to cross safely and prioritizing and funding projects that encourage the redevelopment of existing urban areas instead of funding projects that may encourage new, auto-dependent development in the suburbs.

## Appendix A: International Trends and Impacts

Globally, more CO<sub>2</sub> is emitted than any other GHG. Human contributions to CO<sub>2</sub> began with the industrial revolution when we began burning wood and fossil fuels in engines and generators and have increased sharply over the last half-century. Atmospheric concentrations of CO<sub>2</sub> are the highest they have been in 140,000 years, with concentrations growing from 290 parts per million (ppm) in 1870 to 373 ppm today. Figure 1 shows how this increase corresponds with an increase in human-caused, or anthropogenic, emissions.

**FIGURE 1**  
**Trends in Atmospheric Concentrations and Anthropogenic Emissions of CO<sub>2</sub>**



The third warmest year on record was 2003, following 2002, while 1998 remains the warmest year. The International Panel for Climate Change, a group sponsored by the United Nations and the World Meteorological Organization, representing more than 2,000 leading climate scientists, predicts an average temperature increase of 5 to 9°F by 2100, with a wider range of outcomes possible. To put this number in perspective, only about 9°F separates the world at the beginning of the twenty-first century from the world at the end of the last Ice Age, more than 10,000 years ago.

Current global impacts of climate change include:<sup>54</sup>

- The number of Category 4 and 5 hurricanes has almost doubled in the last 30 years.
- Malaria has spread to higher altitudes in places like the Colombian Andes, 7,000 feet above sea level.
- The flow of ice from glaciers in Greenland has more than doubled over the past decade.
- At least 279 species of plants and animals are already responding to global warming, moving closer to the poles.

Scientists predict more severe global impacts in the future:<sup>55</sup>

- Deaths from global warming will double in 25 years to 300,000 people a year.

- Global sea levels could rise by more than 20 feet with the loss of shelf ice in Greenland and Antarctica, devastating coastal areas and cities worldwide. As much as one-tenth of the world's population (630 million people) live in coastal areas that are within 33 feet of elevation from sea level.
- Heat waves will be more frequent and more intense.
- Droughts and wildfires will occur more often.
- More than a million species worldwide could be driven to extinction by 2050.

**Appendix B: Sea Level Rise and Flooding in the Boston Region**

Sea level rise in the coastal zone will lead to more severe flooding events, and a decrease in the average recurrence interval of design floods such as the current 100-year storm.<sup>56</sup> An increase in mean sea level will add to the base elevation of any storm surge, giving it more power to overtop both natural and constructed protection. A continuation of today's sea level rise rates would give the 10-year storm the intensity of the current 100-year storm before the end of this century and the 100-year storm the intensity of a 500-year storm.<sup>57</sup>

With a worst case scenario of a one-meter (39.4 inches) increase in sea level rise, the expected area at risk to permanent inundation makes up 1.2 percent of the total land area of the Boston region, with some towns expected to experience up to a six percent loss. Specifically, while most municipalities are expected to lose less than one percent of their total land area, the Towns of Nahant and Hull are exceptions: in both municipalities, considerable amounts of residential area would be lost as a result of a rise in sea level of one meter.<sup>58</sup>

Flooding can seriously damage the built environment, paralyze transportation, interrupt energy distribution, and impair wastewater plants, posing threats to the economy of the region and the health of its inhabitants. The areas vulnerable to the most extreme river flood events have a disproportionately high representation of low value houses that are likely to be uninsured.<sup>59</sup> If the frequency of very severe events increases as expected under climate change, households with relatively poor ability to cope will become more vulnerable. Table 1 shows the number of properties and estimated damage climate change could cause in riverside areas. A localized case study found that with increased flood discharges in rivers, bridge foundation scour could become a problem.<sup>60</sup>

**TABLE 1**  
**Properties Damaged by River Flood under Baseline (No Climate Change) and Climate Change Scenarios – Cumulative to 2100, maximum of 3 events per year<sup>61</sup>**

Scenario	Residential		Commercial		Industrial	
	Units	Cost (\$ mil)	Hectares	Cost (\$ mil)	Hectares	Cost (\$ mil)
No climate change	334,979	6,226	8,834	22,741	30,321	1,789
Climate change	604,491	12,121	16,161	41,096	54,795	3,964
<i>Increase</i>	<i>80%</i>	<i>95%</i>	<i>83%</i>	<i>81%</i>	<i>81%</i>	<i>122%</i>

## **Appendix C: Policies that Will Likely Result in the Reduction of Carbon Dioxide Emissions**

### **Environment**

- Give priority to projects that maintain and improve public transportation facilities and services so as to increase public transportation mode share and reduce reliance on automobiles.
- Give priority to projects that reduce congestion or manage transportation demand to improve air quality.
- Promote the use of low-polluting or alternative fuels, efficient engine technology, and other new, viable technologies that protect resources.
- Consider environmental issues during project selection; in particular, air quality and the reduction of pollutants (CO, NO<sub>x</sub>, VOCs, particulates, and CO<sub>2</sub>), the protection of water resources (soil and water contamination, stormwater management, and wetlands impacts), greenfields and open space, and wildlife and ecosystem preservation; and value those projects that reduce negative impacts.
- Consult with environmental and cultural resource agencies and entities on environmental effects, particularly through the existing NEPA/MEPA processes.
- Encourage, through planning and programming, transportation choices that promote a healthy lifestyle such as walking and bicycling.

### **Land Use and Economic Development**

- Make transportation investments where existing or planned development will encourage public transportation use, walking, and bicycling.
- Give priority to projects in areas identified in local and regional plans as being suitable for concentrated development and/or redevelopment, including brownfield redevelopment; support initiatives that increase sustainability.
- Consider both existing development and densities in transportation decision-making and give priority to projects that support them.

### **Mobility**

- Support projects and programs that improve public transportation service by making it faster, more reliable, and more affordable.
- Fund projects that expand the existing transportation system's ability to move people and goods in areas identified in the Boston Region Mobility Management System, the MBTA Program for Mass Transportation, the MPO's Regional Equity Program, and MPO and EOT freight studies, and through public comment. This includes encouraging options that manage demand. Adding highway capacity by building general-purpose lanes should

be considered only when no better solution can be found and should be accompanied by proponent commitments, developed in the environmental review process, to implement transportation demand management (TDM) measures.

- Assist agencies and communities in planning and implementing projects that provide bicycle and pedestrian routes, networks, and facilities.
- Support programs that meet public transportation needs in suburban communities, including improving access to existing public transportation and partnering with others to initiate new intra-suburban services linking important destinations.

### **Safety and Security**

- Support designs and fund projects and programs that address safety problems and enhance safe travel for all system users. This includes designs and projects that encourage motorists, public transportation riders, bicyclists, and pedestrians to share the transportation network safely.

### **System Preservation, Modernization, and Efficiency**

- Make investments that maximize the efficiency, effectiveness, reliability, and flexibility of the existing transportation system.

### **Public Participation**

- Use the MPO's criteria, based on MPO policies, in decision-making and project selection.
- Solicit the input of environmental, cultural resource, community, business, economic development, and other appropriate agencies on MPO activities, to promote the integration of these interests with transportation planning and programming.

## NOTES

<sup>1</sup> New England Regional Assessment Group. *Preparing for a Changing Climate: The Potential Consequences of Climate Variability and Change. New England Regional Overview*, U.S. Global Change Research Program, University of New Hampshire. 2001: 96 pp.

<sup>2</sup> U.S. Department of Energy, Energy Information Administration, “Greenhouse Gases, Climate Change, and Energy.” <http://www.eia.doe.gov/oiaf/1605/ggccebro/chapter1.html>. Date accessed: Apr. 25, 2007.

<sup>3</sup> A cap-and-trade program is a flexible, market-based approach to achieving real emissions reductions at the lowest possible cost. The design of RGGI, like any other cap-and-trade program, includes the following basic components: First, the states determine the emissions sources to be covered by the cap. Second, the states establish the total amount of emissions to be allowed from all of the sources, commonly referred to as the “emissions cap.” Third, each state issues one allowance for each ton of emissions, up to the amount of the cap, and those allowances are distributed to the generators and the market. Lastly, every covered source is required to have enough allowances to cover its emissions at the end of each compliance period. Sources that do not have enough allowances to cover their projected emissions can either reduce their emissions, buy allowances on the market, or generate credits through an emissions offset project. Sources that reduce their emissions and have excess allowances may either bank those allowances or sell them to other sources. Emissions trading guarantees that the most cost-effective reductions are implemented at the plants

<sup>4</sup> Corbin, R. *An Inconvenient Truth in the Classroom*. 2006: 59 pp.

<sup>5</sup> Energy Information Administration, “Emissions of Greenhouse Gases in the United States 2005.” <http://www.eia.doe.gov/oiaf/1605/ggrpt/carbon.html>. Date accessed: Apr. 27, 2007.

<sup>6</sup> This increase is antithetical to the Kyoto Treaty, an international agreement signed by 169 countries, which calls for a 55% global reduction of carbon dioxide based on 1990 levels. As one of the original signatories of the Kyoto treaty in the early 1990s, the United States agreed to reduce emissions by 6% from its 1990 levels. The United States has not ratified the treaty.

<sup>7</sup> U.S. Environmental Protection Agency, “Energy CO2 Emissions by State.” [http://www.epa.gov/climatechange/emissions/state\\_energyco2inv.html](http://www.epa.gov/climatechange/emissions/state_energyco2inv.html). Date accessed: Apr. 27, 2007.

<sup>8</sup> U.S. Environmental Protection Agency, “Energy CO2 Emissions by State.” [http://www.epa.gov/climatechange/emissions/state\\_energyco2inv.html](http://www.epa.gov/climatechange/emissions/state_energyco2inv.html). Date accessed: Apr. 27, 2007.

<sup>9</sup> Office for Commonwealth Development. *Massachusetts Climate Protection Plan*. The Commonwealth of Massachusetts. 2004: 51 pp.

<sup>10</sup> *Ibid.*

<sup>11</sup> *Ibid.*

<sup>12</sup> *Ibid.*

<sup>13</sup> *Ibid.*

<sup>14</sup> *Ibid.*

<sup>15</sup> New England Regional Assessment Group. *Preparing for a Changing Climate: The Potential Consequences of Climate Variability and Change. New England Regional Overview*, U.S. Global Change Research Program, University of New Hampshire. 2001: 96 pp.

<sup>16</sup> *Ibid.*

<sup>17</sup> Union of Concerned Scientists. “Climate Change in the U.S. Northeast: A Report of the Northeast Climate Impacts Assessment.” Oct. 2006; 35 pp.

<sup>18</sup> *Ibid.*

<sup>19</sup> *Ibid.*

<sup>20</sup> Kirshen, P., et al. *Infrastructure Systems, Services and Climate Change: Integrated Impacts and Response Strategies for the Boston Metropolitan Area*, also known as *Climate's Long-term Impacts on Metro Boston (CLIMB)*. Civil and Environmental Engineering Department, Tufts University; School of Public Policy, University of Maryland; Center for Transportation Studies, Boston University; and Metropolitan Area Planning Council. EPA Grant Number: R.827450-01. 2004: 164 pp.

<sup>21</sup> Office for Commonwealth Development. *Massachusetts Climate Protection Plan*. The Commonwealth of Massachusetts. 2004: 51 pp.

<sup>22</sup> Union of Concerned Scientists. “Confronting Climate Change in the U.S. Northeast: Science, Impacts, and Solutions.” July 2007; 146 pp.

<sup>23</sup> *Ibid.*

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- <sup>24</sup> Union of Concerned Scientists. "Climate Change in the U.S. Northeast: A Report of the Northeast Climate Impacts Assessment." Oct. 2006; 35 pp.
- <sup>25</sup> *Ibid.*
- <sup>26</sup> Union of Concerned Scientists. "Confronting Climate Change in the U.S. Northeast: Science, Impacts, and Solutions." July 2007; 146 pp.
- <sup>27</sup> *Ibid.*
- <sup>28</sup> *Ibid.*
- <sup>29</sup> *Ibid.*
- <sup>30</sup> *Ibid.*
- <sup>31</sup> Sea level rise has two components, both related to temperature increases. The first is thermal expansion of seawater as it warms, and the second is an increase in the amount of water in the ocean basins resulting from the addition of fresh water as continental ice sheets and glaciers melt.
- <sup>32</sup> Union of Concerned Scientists. "Climate Change in the U.S. Northeast: A Report of the Northeast Climate Impacts Assessment." Oct. 2006; 35 pp.
- <sup>33</sup> Union of Concerned Scientists. "Confronting Climate Change in the U.S. Northeast: Science, Impacts, and Solutions." July 2007; 146 pp.
- <sup>34</sup> *Ibid.*
- <sup>35</sup> *Ibid.*
- <sup>36</sup> *Ibid.*
- <sup>37</sup> *Ibid.*
- <sup>38</sup> *Ibid.*
- <sup>39</sup> Kirshen, P., et al. *Infrastructure Systems, Services and Climate Change: Integrated Impacts and Response Strategies for the Boston Metropolitan Area*, also known as *Climate's Long-term Impacts on Metro Boston (CLIMB)*. Civil and Environmental Engineering Department, Tufts University; School of Public Policy, University of Maryland; Center for Transportation Studies, Boston University; and Metropolitan Area Planning Council. EPA Grant Number: R.827450-01. 2004: 164 pp.
- <sup>40</sup> Union of Concerned Scientists. "Confronting Climate Change in the U.S. Northeast: Science, Impacts, and Solutions." July 2007; 146 pp.
- <sup>41</sup> Kirshen, P., et al. *Infrastructure Systems, Services and Climate Change: Integrated Impacts and Response Strategies for the Boston Metropolitan Area*, also known as *Climate's Long-term Impacts on Metro Boston (CLIMB)*. Civil and Environmental Engineering Department, Tufts University; School of Public Policy, University of Maryland; Center for Transportation Studies, Boston University; and Metropolitan Area Planning Council. EPA Grant Number: R.827450-01. 2004: 164 pp.
- <sup>42</sup> *Ibid.*
- <sup>43</sup> Office for Commonwealth Development. *Massachusetts Climate Protection Plan*. The Commonwealth of Massachusetts. 2004: 51 pp.
- <sup>44</sup> National Safety Council, "Auto Emissions Fact Sheet." [http://www.nsc.org/ehc/mobile/mse\\_fs.htm](http://www.nsc.org/ehc/mobile/mse_fs.htm). Date accessed: Apr. 16, 2007.
- <sup>45</sup> *Ibid.*
- <sup>46</sup> United States Department of Energy and the U.S. Environmental Protection Agency. "How can a gallon of gasoline produce 20 pounds of carbon dioxide?" <http://www.fueleconomy.gov/feg/co2.shtml>. Accessed Apr. 2007.
- <sup>47</sup> Metropolitan Area Planning Council and the Boston Region MPO. "Regional Bicycle Plan." Mar. 2007: 90 pps.
- <sup>48</sup> *Ibid.*
- <sup>49</sup> *Ibid.*
- <sup>50</sup> Scott, J. and H. Sinnamon. *Smokestacks on Rails: Getting Clean Air Solutions for Locomotives on Track*. Environmental Defense. 2006: 39 pps.
- <sup>51</sup> American Association of State Highway and Transportation Officials. *Transportation – Invest in America: Freight-Rail Bottom Line Report*. 2003: 123 pp.
- <sup>52</sup> Dutzik, T., et al. *Shifting Gears: 20 Tools for Reducing Global Warming Pollution from New England's Transportation System*. MASSPIRG Education Fund, Clean Water Fund, and Massachusetts Climate Action Network. 2006: 61 pp.
- <sup>53</sup> In addition to CO<sub>2</sub> emissions, scientists have recently identified black carbon (soot) as having a large and fast-warming impact on the atmosphere.
- <sup>54</sup> Corbin, R. *An Inconvenient Truth in the Classroom*. 2006: 59 pp.
- <sup>55</sup> *Ibid.*

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<sup>56</sup> A design flood is a hypothetical flood representing a specific likelihood of occurrence.

<sup>57</sup> Kirshen, P., et al. *Infrastructure Systems, Services and Climate Change: Integrated Impacts and Response Strategies for the Boston Metropolitan Area*, also known as *Climate's Long-term Impacts on Metro Boston (CLIMB)*. Civil and Environmental Engineering Department, Tufts University; School of Public Policy, University of Maryland; Center for Transportation Studies, Boston University; and Metropolitan Area Planning Council. EPA Grant Number: R.827450-01. 2004: 164 pp.

<sup>58</sup> *Ibid.*

<sup>59</sup> *Ibid.*

<sup>60</sup> *Ibid.*

<sup>61</sup> *Ibid.*

## MEMORANDUM

**DATE** October 4, 2007  
**TO** Transportation Planning and Programming Committee  
of the Boston Region Metropolitan Planning Organization  
**FROM** Arnold J. Soolman, CTPS Director  
**RE** Work Program for: 2007-2008 HOV Monitoring on I-93 North and the  
Southeast Expressway

### ACTION REQUIRED

Review and approval

### PROPOSED MOTION

That the Transportation Planning and Programming Committee of the Boston Region Metropolitan Planning Organization, upon the recommendation of the Massachusetts Highway Department, vote to approve the work program for 2007-2008 HOV Monitoring on I-93 North and the Southeast Expressway in the form of the draft dated October 4, 2007.

### PROJECT IDENTIFICATION

#### **Unified Planning Work Program Classification**

Regional Planning Studies

#### **CTPS Project Number**

23222

#### **Client**

Massachusetts Highway Department

*Project Supervisor:* Adriel Edwards

#### **CTPS Project Supervisors**

*Principal:* Efi Pagitsas

*Manager:* Seth Asante

#### **Funding**

MHD SPR Highway Planning Contract #39687

## **IMPACT ON MPO WORK**

The MPO staff has sufficient resources to complete this work in a capable and timely manner. By undertaking this work the MPO staff will neither delay the completion of nor reduce the quality of other work in the UPWP.

## **BACKGROUND**

In 1998, the Massachusetts Department of Environmental Protection began requiring monitoring of the Southeast Expressway and I-93 North general-purpose and HOV lanes to determine HOV performance. The requirements are set forth in 310 CMR 7.37, which calls for travel time data collected Monday through Friday seasonally throughout the year. This work scope provides for the continuation of this process and documents the projected tasks, products, scheduling, and costs of HOV monitoring for 2007-2008.

## **OBJECTIVE(S)**

The objectives of this work are:

1. To collect at least 1,000 total travel time runs on the I-93 North and Southeast Expressway HOV lane segments and their associated general-purpose lane segments during the fall of 2007 and the winter, spring, and summer of 2008.
2. To collect AM period vehicle occupancy counts on the I-93 North and Southeast Expressway HOV lane segments and their associated general-purpose lane segments during the fall of 2007 and the spring of 2008.
3. To calculate average speed, travel time, vehicle occupancy, and HOV travel time savings throughout this period.
4. To analyze and document the results in written and graphic format.

## **WORK DESCRIPTION**

The work required to accomplish the study objectives will be carried out in four tasks as described below:

**Task 1 Collect Travel Time Data**

CTPS will collect sample travel time data using stopwatches and Global Positioning System (GPS) satellite receivers in rented automobiles on the I-93 North and Southeast Expressway HOV and general-purpose lanes. The collection hours are between 6:00 and 10:00 AM on I-93 North southbound and the Southeast Expressway northbound and between 3:00 and 7:00 PM on the Southeast Expressway southbound. Data will be collected over the course of four quarters throughout the year, beginning in the fall of 2007. CTPS will also collect travel time data from CTPS and Massachusetts Highway Department employees and MassRIDES vanpoolers, as they become available.

***Products of Task 1***

- Travel time data for the general-purpose and HOV lanes in electronic form and on handwritten field notes.

**Task 2 Process and Analyze Travel Time Data**

CTPS will process the data collected using GPS technology and incorporate it into the geographic information system (GIS) travel time database. CTPS will then combine the GPS data with data collected using the stopwatch method during the same season and analyze it using tables and graphs.

***Products of Task 2***

- Four sets of tables and graphs presenting seasonal estimates of speed, travel time, and HOV travel time savings for I-93 North during the AM period, for the Southeast Expressway during the AM period, and for the Southeast Expressway during the PM period.

**Task 3 Collect Vehicle Occupancy Data**

CTPS will collect vehicle occupancy data on both the I-93 North and Southeast Expressway HOV lanes and their associated general-purpose lanes on a typical weekday during the fall of 2007 and again during the spring of 2008. Data will be collected throughout the four hours of AM HOV operation.

***Products of Task 3***

- Total numbers of vehicles and their occupants, grouped by fifteen-minute intervals, on a typical weekday during the spring and fall for each of the two HOV and seven general-purpose lanes under study.

#### **Task 4 Document Travel Time Savings**

The data collected in Task 1 and analyzed in Task 2 will be used to produce five technical memoranda documenting high-occupancy vehicle (HOV) lane performance. The occupancy data collected in Task 3 will be reported bi-annually and including a calculation of the total vehicles and persons and vehicle occupancy for I-93 North and Southeast Expressway HOV and general-purpose lanes.

##### ***Products of Task 4***

- Four memos documenting the most recent performance of the HOV lanes by seasons (fall, winter, spring, and summer). The spring and fall memos will also include the results of vehicle occupancy counts.
- A fifth memo generated at the end of the project year, documenting the year's performance of the HOV lanes.

#### **ESTIMATED SCHEDULE**

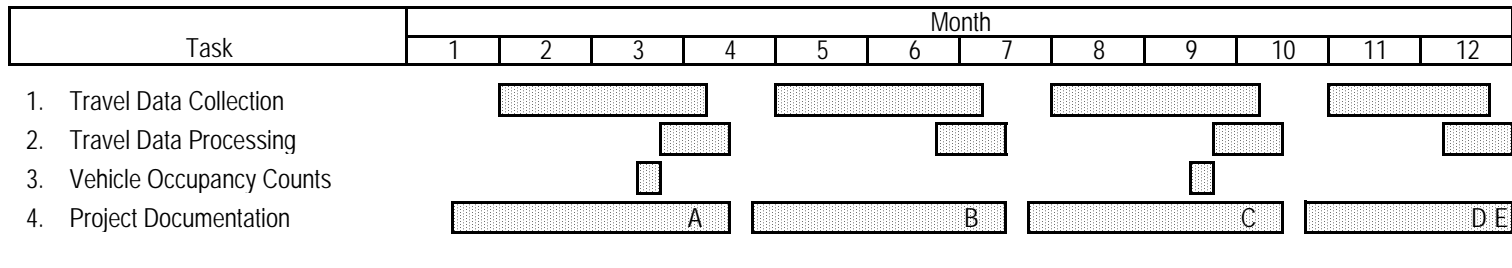
It is estimated that this project would be completed twelve months after the notice to proceed is received. The proposed schedule, by task, is shown in Exhibit 1.

#### **ESTIMATED COST**

The total cost of this project is estimated to be \$54,952. This includes the cost of 35.5 person-weeks of staff time, overhead at the rate of 84.98 percent and travel. A detailed breakdown of estimated costs is presented in Exhibit 2.

AJS/SAA/saa

Exhibit 1  
 ESTIMATED SCHEDULE  
 2007-2008 HOV Monitoring on I-93 North and the Southeast Expressway



Products/Milestones

- A: Memo documenting fall 2007 travel times and vehicle occupancy
- B: Memo documenting winter 2007-2008 travel times
- C: Memo documenting spring 2008 travel times and vehicle occupancy
- D: Memo documenting summer 2008 travel times
- E: Memo documenting annual travel times and vehicle occupancy

Exhibit 2  
 ESTIMATED COST  
 2007-2008 HOV Monitoring on I-93 North and the Southeast Expressway

**Direct Salary and Overhead** **\$49,052**

Task	Person-Weeks					Total	Direct Salary	Overhead (@ 84.98%)	Total Cost
	M-1	P-5	P-1	Temp					
1. Travel Data Collection	0.0	0.5	3.0	16.0		19.5	\$10,701	\$9,094	\$19,795
2. Travel Data Processing	0.5	2.0	3.0	0.0		5.5	\$5,977	\$5,079	\$11,056
3. Vehicle Occupancy Counts	0.0	1.0	1.0	4.5		6.5	\$4,445	\$3,778	\$8,223
4. Project Documentation	1.0	2.0	1.0	0.0		4.0	\$5,394	\$4,584	\$9,978
Total	1.5	5.5	8.0	20.5		35.5	\$26,517	\$22,534	\$49,052

**Other Direct Costs** **\$5,900**

Travel \$5,900

**TOTAL COST** **\$54,952**

*Funding*  
 MHD SPR Highway Planning Contract #39687