

Climate Change Initiatives of State Departments of Transportation: Synthesis

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Transportation Synthesis Reports (TSRs) are brief summaries of currently available information on topics of interest to WSDOT staff. Online and print sources may include newspaper and periodical articles, NCHRP and other TRB programs, AASHTO, the research and practices of other state DOTs and related academic and industry research. Internet hyperlinks in the TSRs are active at the time of publication, but host server changes can make them obsolete.

REQUEST FOR REPORT AND SUMMARY:

Katy Taylor, WSDOT Public Transportation Division Director, requested a synthesis report on the role of state departments of transportation in climate change initiatives. A search of available information has revealed a host of measures underway to reduce greenhouse gas (GHG) emissions of the transportation sector. Here is a summary of current initiatives detailed in this report (a state-by-state breakdown follows in the next section):

- incentives to promote the use of low-emissions vehicles, such as carpool-lane access or discounted toll rates;
- stricter emission regulations than those of the federal government (many states have adopted California's strict low-emission vehicle standards);
- enhanced construction methods that incorporate recycled materials, improved energy efficiency, or other green building strategies;
- programs to promote commuting alternatives to driving, such as telecommuting, transit use, or bicycling;
- intermodal truck-to-rail freight-transfer facilities that reduce congestion and emissions by removing trucks from the roadway;
- fuel efficiency programs that aim to reduce idling or improve transportation flow, such as "No Idling" campaigns, truck stop electrification, and intelligent transportation systems;
- public campaigns to improve awareness of transportation alternatives; and
- grants for local smart-growth development.

In addition to the strategies above, DOTs and their states have developed action plans to propose emission-reduction goals and measures. States are also joining in regional partnerships to advance climate change programs, such as the Western Climate Initiative of which Washington is a member.

This report focuses on state initiatives to reduce GHG emissions, initiatives which fall under the umbrella of *mitigation*. Another facet of climate change response is categorized as *adaptation*. Adaptation measures prepare for forecasted changes due to global warming, like increased extreme storm events, higher temperatures, and rising sea levels. At this point, adaptation has

not been addressed as much as mitigation at the level of state DOTs. Links to proposed policies of both areas are found in the later sections of this synthesis.

Key Terms Searched:

Global Warming, Climate Change, Transportation

STATE DOT AND TRANSPORTATION-RELATED INITIATIVES:

Arizona:

Energy Efficient Plate (HOV/Hybrid), Pilot Program

<http://www.azdot.gov/mvd/vehicle/energyefficient.asp>

In February 2007, Arizona began issuing license plates for qualifying low-emission energy-efficient vehicles to travel in high occupancy vehicle lanes. The vehicles must have an average city/highway fuel efficiency of 45 mpg.

California:

Climate Action Program at Caltrans

<http://www.dot.ca.gov/docs/ClimateReport.pdf>

Caltrans and the California Business, Transportation, and Housing Authority have formulated a strategy “to reduce GHG emission from transportation”:

The strategy is twofold:

- a) making transportation system(s) more efficient through operational improvements, application of Intelligent Transportation Systems (ITS), and smart land use thus reducing congestion and lowering the rate of growth in fuel consumption and CO₂ from motor vehicles. In this case, GHG emission reductions are being realized through the Department’s strategic growth plan and congestion relief program with collateral benefit for climate change, and
- b) cleaner, more energy efficient transportation systems and operations which focuses on integrating consideration of energy and GHG emission reduction measures into planning, project development, operations, and maintenance of transportation facilities, fleets, buildings, and equipments. In this case, reducing energy consumption and GHG emissions is the primary reason for implementing this strategy.

If fully funded and implemented, these strategies could result in lowering CO₂ growth by 2.72 MMT in 2010 and 18.67 MMT by 2020. (p. 5)

To improve the efficiency of transportation systems, Caltrans provides grants to support research in improved development practices and has created interagency strategies to improve growth: Regional Blueprint Planning and Local Development/Intergovernmental Review (p. 8).

To improve energy efficiency and reduce GHG emissions, Caltrans is moving the government fleet towards fuel efficient vehicles, reducing energy use at facilities, and educating the public (p. 13). One measure calls for reducing the amount of cement used in concrete:

The typical Department concrete mix is about 25 percent fly ash, generally with no other cement substitutions. This has produced 25 percent less GHG from cement production statewide. The Department objective is to increase concrete mixes with up to 60 percent fly ash and 50 percent slag, thereby improving GHG emissions saving from the 25 percent currently specified to 50 percent or better [see *Related Links* below]. The Department received the U.S. EPA Award for the use of recycled ash from burned coal in concrete for the construction of the new Bay Bridge. This project will use 450,000 cubic yards of concrete, and based on the new concrete mixed will save 0.75 MMT of CO₂ in the construction process. (p. 14)

Caltrans also seeks to “accelerate improvement in California’s freight sector through better freight transport management, efficiency gains (shorter routes, better loading, etc.), reduced truck idling (fuel cell auxiliary systems, overnight idling, electrification of truck parking), technology improvements, and alternative fueled heavy-duty vehicles” (p. 14).

Economic benefits are also assessed (p. 15).

Zero Emission Bus Regulation

<http://www.arb.ca.gov/regact/bus04/fro2.pdf>

As described on page 28, item (c), the California Air Resources Board requires that urban transit agencies with more than 200 vehicles must, in the future, make 15 percent of their new purchases and leasings zero-emissions vehicles. [The most recent updates can be found at <http://www.hydrogenhighway.ca.gov/update/winter06.pdf>. Diesel-path agencies must follow purchasing regulations in 2011, alternative-fuel-path agencies in 2012.]

Low-Emission Vehicle Program

<http://www.arb.ca.gov/msprog/levprog/levprog.htm>

Details of California’s original emission-reduction program.

California Puts on the Brakes

Planning, March 2007

Millard-Ball, Adam

http://www.stanford.edu/~adammb/Publications/Millard-Ball_2007_California_Puts_on_the_Brakes.pdf

Some results of Caltrans’ Climate Action Program:

New tailpipe standards for cars and light trucks are a centerpiece of [California’s] transportation efforts. Regulations drawn up by the state Air Resources Board in the wake of legislation drafted by former state assembly member Fran Pavley require a 30 percent reduction in greenhouse gas tailpipe emissions by 2016 . . .

But the regulations are currently in limbo thanks to a legal challenge by the auto industry. Car makers claim that the tailpipe regulations are a surrogate for fuel economy standards, which may be set only by the federal government. (p. 1)

A “clean car discount” or “feebate” program would give consumers incentives to buy more fuel-efficient cars, under legislation introduced by state assembly member Ira Ruskin. Cleaner cars such as the Honda Insight would attract a rebate of up to \$2,500, while a similar surcharge would be levied on SUVs and trucks such as Toyota’s Land Cruiser.

The program, which would be self-financing, would apply only to new cars bought in California from 2010 on. What’s more, the rebate and fee schedule would be recalibrated every couple of years, giving manufacturers a constant incentive to improve efficiency. (p. 2)

Related Links:

- **Potential for Reduced Greenhouse Gas Emissions in Texas Through the Use of High Volume Fly Ash**
Cindy Estakhri and Saleel D. Mohidekar, Texas Transportation Institute Report No. 167709-1, March 2004
<http://swutc.tamu.edu/publications/technicalreports/167709-1.pdf>
From Abstract: Researchers estimated production of concrete in Texas and determined that if 60 percent of the portland cement used in Texas concrete production were replaced with fly

ash, carbon dioxide emissions could potentially be reduced by 6.6 million tons annually by the year 2015.

- **EPA Refuses California's Stricter Limits on Emissions**
Elizabeth Shogren, NPR, December 20, 2007
<http://www.npr.org/templates/story/story.php?storyId=17452633>
The U.S. EPA rejects California's waiver to implement stricter auto emissions standards. Agency administrator Steve Johnson cited that the state "does not meet the compelling and extraordinary conditions needed to grant a waiver." Johnson believes a national approach to regulation is preferable to varied state policies. The California Air Resources Board is prepared to challenge the decision. The auto industry backs the EPA and the idea of a national standard.
- **Governor Schwarzenegger Announces Lawsuit against U.S. EPA for Failing to Act on California's Tailpipe Emissions Request, November 2007**
<http://gov.ca.gov/index.php?/press-release/8047/>
- **3 Branches, 0 Consensus**
Lora A. Lucero, *Planning* 73(8): p. 38, Aug/Sep 2007
This is a summary of California's attempt to enact stricter emissions standards than the federal government's. The new standards [referred to elsewhere as the Clean Car or Pavley standards] are an integral state strategy for reducing GHGs, and have been adopted or considered by 13 other states, including Washington. U.S. EPA has failed to grant California a waiver to implement the measures. [For an update see links above.]

Connecticut:

Implementing Connecticut's Climate Change Action Plan: 2006 Progress Report

January 2007

http://www.ctclimatechange.com/documents/SectorSummaries2006Progress_000.pdf

See Section III.A (p. 2) for actions taken in the transportation and land use sector in 2006. The department of transportation has advanced telecommuting with the program Telecommute Connecticut (<http://www.telecommutect.com/homeplate/home.php>). As part of this initiative, operated through brokerage companies, "173 employers are participating with a total of 4,091 telecommuters" (p. 3).

The department has also promoted bicycling through improved bike facilities on public transit routes and a Bike to Work program:

Over 300 individuals participated in 2005 resulting in over 171,000 pounds of GHG emissions. The Bike to Work program encourages workers in the greater Hartford area to leave their cars at home at least one day per month and commute by bicycle. (p. 4)

Delaware:

Delaware Climate Change Action Plan

Center for Energy and Environmental Policy, University of Delaware, January 2000

<http://ceep.udel.edu/publications/globalenvironments/reports/deccap/fullreport.pdf>

This proposed climate change strategy, which begins on page 85 of the pdf, focuses on three categories of cost-effective emissions reduction (improved fuel economy, alternative fuels, and reduction of vehicle miles traveled) at three levels of commitment (full implementation, major commitment, and modest commitment).

Maine:

Intermodal Freight Initiatives: Case Studies: Maine

(from Part II, Sect. 2.5, of the CCAP Transportations Emission Guidebook)

http://www.ccap.org/safe/guidebook/guide_complete.html

Under MaineDOT's Integrated Freight Plan, public and private funds were obtained to establish a truck-to-rail intermodal freight facility in Waterville. This facility, combined with another in Auburn, has reduced the flow of long-haul trucks into the state, reducing congestion and improving air quality.

PUC and MDOT Launch Traffic Signal Replacement Program

February 2003

<http://www.maine.gov/mdot/mlrc/traffic-issues/documents/prtrafficsignals.pdf>

MaineDOT's Municipal Traffic Signal Replacement Program provides grants to cities and towns to update traffic signals from incandescent lighting to energy efficient LED-based signals. In addition to the energy savings, the lights have a ten times longer life span, reducing maintenance costs. Over the life of the bulb three dollars will be saved for every dollar spent.

New Park-and-Ride Signs Discourage Vehicle Idling

December 2007

<http://www.maine.gov/mdot/mainedot-news-release/parknridedec142007.php>

MaineDOT and the Maine Turnpike Authority are encouraging motorists to reduce vehicle idling at park-and-ride facilities by posting "No Idling" signs. The program is modeled on a similar program to reduce idling at state ferry service terminals.

Maryland:

Advanced Technology Vehicle Program

http://dnrweb.dnr.state.md.us/bay/res_protect/c2k/c2k_form.asp?rn1=4&rn2=3&rn3=4

MDOT's Advanced Technology Vehicle program (ATV) provides financial incentives to qualifying public and private fleets to replace existing high mileage/high fuel-use vehicles with advanced technology vehicles or heavy-duty engines certified to Low Emission Vehicle standards or lower. The primary goal was to reduce emissions of nitrogen oxides from vehicles in counties surrounding Washington, D.C., and Baltimore. The program applies to light and heavy duty vehicles consuming 3000 gallons of fuel or driven at least 45,000 miles per year. ATV identifies appropriate vehicles by emission standards, fuel type, manufacturer, availability, and cost. In helping to provide new fleets to local school districts, transit agencies, and cab and shipping companies, ATV has reduced nitrogen-oxides emissions 75 percent above goals.

Minnesota:

The dilemma in combating climate change

Conrad deFiebre, Twin Cities Daily Planet, October 22, 2007

<http://www.tcdailyplanet.net/node/7629>

The transportation and land use subcommittee of the Minnesota Climate Change Advisory Group proposes to reduce total road travel to 1990 levels by 2025. Such changes would be accomplished through smart growth development favoring alternative travel modes and improved transit service.

New York:

Clean Pass Program

<https://www.nysdot.gov/portal/page/portal/programs/clean-pass>

In March 2006, New York's Clean Pass Program allowed motorists whose estimated USEPA fuel economy rating averaged at least 45 miles per gallon and met certain USEPA strict emissions standards to use the 40-mile Long Island Expressway High Occupancy Vehicle lanes, regardless of the number of occupants in the vehicle. It is predicted that "the program will result in an estimated reduction of 6,000 tons of greenhouse gas emissions and savings in excess of 500,000 gallons of gasoline."

The Clean Pass Program is allowed by the federal transportation bill, Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU), which enabled states to allow low-emission and energy-efficient vehicles to use HOV facilities regardless of occupancy.

Green Pass Discount Plan

<http://www.nysthruway.gov/ezpass/greentag.html>

New York Thruway users are offered a 10 percent discount on tolls if they drive ultra low emission vehicles.

Advanced Travel Center Electrification

<http://www.pewclimate.org/states.cfm?ID=37>

In addition to programs in Georgia, Tennessee, and Arkansas, the New York State Energy Research and Development Authority has begun a demonstration program to install up to 44 Advanced Travel Center Electrification units. These systems provide electrical services to trucks at rest stops to eliminate idling.

It is estimated that this technology saves 6, 424 gallons of diesel fuel per parking space each year. Each parking space equipped with the technology results in a net reduction of 47.5 tons of CO₂ and 0.37 tons of NO_x per year. New York's 44-unit pilot project, therefore, will save over 282, 000 gallons of fuel, 2000 tons of CO₂, and 16 tons of NO_x per year.

This article addresses costs and feasibility.

Estimating Transportation-Related Greenhouse Gas Emissions and Energy Use in New York State

ICF Consulting, for USDOT Center for Climate Change and Environmental Forecasting, March 2005

<http://climate.dot.gov/papers.html>

This report explores transportation-related GHG emissions and energy use in New York state, within the context of the State Energy Plan (NY SEP). Historical and projected state-wide energy use and anthropogenic CO₂ emissions are quantified and compared to the goals of the NY SEP. Recommendations are gathered from metropolitan planning organizations on how to include estimates of energy use and GHG emissions in their plans. Historical and projected CO₂ emissions and energy consumption are estimated by metro region and by mode, as possible. Potential CO₂ and energy impacts of a variety of policies aimed at reducing transportation CO₂ emissions are investigated (p. 1).

Based on the preliminary analyses conducted under Task 3, four of the six mitigation strategies appear to offer of the most promise for reducing energy use and CO₂ emissions at a relatively low cost per ton of CO₂ reduced. These strategies are: feebates, freight modal shift, commuter benefits, and truck stop electrification. Under the project scenarios investigated for these four strategies, New York State's energy use in 2020 would be reduced

by up to 51 trillion Btu, and its CO₂ emissions would be reduced by up to 3.6 million metric tons of CO₂ compared to the baseline; these values correspond to a 3 percent reduction in New York State's transportation-related energy use and transportation-related CO₂ emissions in 2020. In context to the New York State Energy Plan, this reduction would represent about 9 percent of the statewide reduction target for that year.

Two other strategies (CNG bus use and alternative fuels for airport equipment) were investigated; while implementation of these strategies would reduce energy use and CO₂ emissions as well, the results of this analysis indicate that savings in energy use and emissions would be much smaller relative to their cost of implementation. These strategies would each reduce energy use by less than 0.1 trillion Btu and emissions by less than 0.1 million metric tons of CO₂. (p. 4) [More detailed information on the six mitigation strategies begins on page 22.]

Related Links:

- **Recommendations to Governor Pataki for Reducing New York State Greenhouse Gas Emissions**
Center for Clean Air Policy, April 2003
http://www.ccap.org/pdf/04-2003_NYGHG_Recommendations.pdf
See page 170 of the pdf for transportation-related recommendations to reduce GHG emissions, including those noted above.
- **New York State Energy Plan, Section 2.4 "Energy and Transportation"**
June 2002
<http://www.nyserda.org/sep/sepsection2-4.pdf>
This report enumerates many of New York's initiatives and proposals to reduce transportation energy use and emissions, e.g.:
 - use Intelligent Transportation Systems to reduce congestion at borders and tolls (p. 9 and 22 of pdf),
 - relieve congestion and reduce vehicle use during commuting through accident response, coordinated traffic signals, increased public transport, and grants to promote employer incentives for alternative transport (p. 10 of pdf),
 - reconstruct state highways to enhance rural main streets (p. 14 of pdf),
 - and offer public transportation fare discounts and incentives (p. 18 of pdf).
- **New York State's Transportation Master Plan for 2030**
NYSDOT, Summer 2006
<https://www.nysdot.gov/portal/page/portal/main/transportation-plan/repository/masterplan-111406.pdf>
Two more NYSDOT initiatives not already noted in this TSR (p. 76 of pdf):
 - utilization of clean fuels and equipment and green building practices in reconstruction of Rte. 9A in New York City, serves as a model for building practice;
 - use of "ozone action days" encourages alternative transportation methods to reduce emissions during periods of poor air quality (for more on this initiative see the following item).
- **The effects of ozone action day public advisories on train ridership in Chicago**
Eric Welch, Xiaohua Gu, and Lisa Kramer
Transportation Research Part D: Transport and Environment 10(6): 445-458, November 2005
This paper analyzes public transit ridership in Chicago on ozone action days (OADs) from April 2002 to November 2003. An OAD is a public advisory by the government when high ozone pollution levels are forecasted. The warnings in part advise drivers to reduce pollution by reducing vehicle miles traveled (VMT) or finding alternative routes to work, such as transit. The authors found that increases in public train ridership were significant enough to show that OADs had influenced behavior, even in light of what was determined to be an ill-guided media campaign. Ridership increase on OADs during commuter hours amounted to a reduction of 0.03-0.13 percent of hourly VMT.

Oregon:

About Drive Less, Save More

http://www.oregon.gov/ODOT/PT/PROGRAMS/TRANS_OPTIONS/about_dism.shtml

Oregon DOT and other groups established a website, <http://www.DriveLessSaveMore.com>, "to increase public awareness about transportation choices to reduce single person car trips."

Oregon Transportation and Growth Management Program, Biennial Report 2005-2007

<http://www.oregon.gov/LCD/TGM/docs/biennialreport0507.pdf>

A partnership of the departments of transportation and land conservation and development, the Oregon Transportation and Growth Management Program (TGM) encourages smart growth and reducing reliance on automobiles by providing grants and technical assistance to local communities to achieve three objectives: more transportation alternatives (in addition to driving), economically vibrant, livable communities, and sound future plans (p. 6 of pdf). Projects are guided by four objectives: coordinating transportation and land use, improving connectivity of routes, enhancing transportation efficiency, and preserving and enhancing existing transportation resources (p. 7 of pdf). The section "2005-2007 Biennium Highlights" (p. 12 of pdf) describes several recent TGM projects.

Green Light Weigh Station Preclearance

<http://www.oregon.gov/ODOT/MCT/GREEN.shtml>

This intelligent transportation system (ITS) allows safe and legal trucks to bypass weigh stations by use of in-road scales and transponders. The transponders notify the weigh station of a truck's identification and are free to qualifying trucking companies. This project was implemented with a \$20 million federal grant. Eliminating stops at weigh stations reduces operating costs, emissions, congestion, and the financial burden of providing full weigh-station service to an increasing number of vehicles. This site roughly estimates that "Green Light saves one metric ton of health impact pollutants for every 112,000 trucks that are precleared."

Tennessee:

Speed Limits Reduced in Shelby County to Improve Air Quality

<http://www.state.tn.us/environment/news/release/2005/Mar/speedlimit.php>

In 2005, the Tenn. Dept. of Transportation (TDOT) reduced the maximum speed limit for trucks on certain highways from 65 to 55 mph. This measure was taken to reduce nitrogen-oxide emissions in two counties, one of which was at a marginal attainment status with the EPA standard for ozone. The TDOT commissioner, Gerald Nicely, cites a Federal Highway Administration study which "shows that reducing truck speed limits by 10 miles per hour can reduce the nitrogen oxide emission factor by approximately 18% or more per truck."

Vermont:

Vermont's Public Transportation Policy Plan

February 2007

http://www.aot.state.vt.us/publictrans/Documents/Final%20Report%20formatted_02_05.pdf

From page 47 of the pdf:

Vermont, unlike almost all other eastern states, has maintained its air quality "attainment" status under the federal Clean Air Act (CAA). Maintaining "attainment" is important for economic, health and environmental reasons. The state's CAA status is due in part to the state's adoption of California's Low Emission Vehicle (LEV) program [see above section on

California initiatives]. LEV requires more stringent vehicle emissions standards to address pollutants regulated under the CAA and will in the future, pending successful litigation, include provisions to address CO₂, a green house gas . . .

In 2006 the Legislature passed Bill S.259 (Act 168) which mandates the creation of a comprehensive climate action plan; establishes state goals regarding greenhouse gas reductions—the greenhouse gas emission reduction targets outlined in the [New England Governors/Eastern Canadian Premiers global warming] agreement; and also requires state agencies to consider greenhouse gas emissions during decision making, including transportation projects and planning processes.

Vermont's energy policy (from p. 55 of the pdf):

- VTrans will work with providers to enhance and expand public transportation services. Adding new services and improving the efficiency and convenience of existing ones could help attract and retain additional public transportation ridership.
- Address energy conservation and include climate change considerations and criteria in state and regional transportation plans and policies (S.259, part (c)).
- VTrans will promote use of low emissions technologies by public transportation providers.
- VTrans will work with the Governor, Legislature, and other state agencies to evaluate an energy tax credit program for businesses. This program could allow businesses to partner with public transportation providers on projects that reduce vehicle miles traveled per capita and greenhouse gas emissions. In other states, the public transportation provider earns the tax credits as a non-taxable entity and passes them on to the business for cash payment at the end of the project. This provides a mechanism for private funding of public transportation.

Second Biennial Report of the Climate Neutral Working Group

April 2007

<http://www.anr.state.vt.us/air/Planning/docs/CNWG%202nd%20%20Biennial%20Report%204-2007.pdf>

Current VTrans climate change measures are listed on page 9 of the pdf:

- rigorous regular maintenance improves fuel economy and reduces particulate emissions;
- biodiesel blends are being used for fuel at fleet garages; and
- petroleum diesel for fleet is ultra low sulfur, reducing particulate emissions.

Other measures being implemented in accord with the state energy policy are noted on page 15 of the pdf:

- upgrading garages with efficient lighting,
- prevention of unnecessary idling of fleet vehicles,
- installation of meters to track fuel use, and
- promoting efficient use of building heating and electrical systems.

Virginia:

VDOT Receives 2007 “Green” Leadership Award

<http://www.virginiadot.org/news/newsrelease.asp?ID=CO-0786>

From the November 2007 news release:

The Virginia Department of Transportation (VDOT) received the 2007 Green Leadership Award in the government category Wednesday from the James River Green Building Council (JRGC) for its design and construction of the new Interstate 64 West Safety Rest Area in New Kent County . . .

Opened in April 2007, the 9,000 square foot safety rest area not only has traveler amenities such as restroom facilities, vending and information kiosks, but it also has environmentally friendly features, such as:

- A system to collect more than 250,000 gallons rainwater from the roof annually that is used for flushing the restroom facilities
- A storm-water bio-retention facility to control and filter runoff from the parking lots
- A 32-well geothermal system that uses the constant temperature 400 feet below the surface of the earth to reduce the need for supplemental heating and air conditioning
- Energy efficient lighting to provide maximum visibility with minimal energy consumption that makes the new facility approximately 75 percent more efficient in energy consumption than its predecessor
- A terrazzo floor made from recycled mirrors and glass, rather than traditional granite or marble

Over time, these energy-savings efforts will result in a significant operational cost savings for the commonwealth.

This interstate facility is one of three recent safety rest area reconstruction projects in the commonwealth . . .

All three reconstruction projects are designed to meet the United States Green Building Council's Leadership in Energy and Environmental Design standards.

Related Link:

- **VDOT Safety Rest Area and Information Center (I-64 Westbound, New Kent County)**
<http://www.virginiadot.org/travel/resources/NKSRAWB-LEEDbrochure.pdf>

This brochure notes additional energy-saving and emission-reducing benefits of the rest area:

- preserving the previous concrete structure of the parking area,
- diverting 1100 tons of building waste from the landfill,
- efficient climate control and lighting,
- low-VOC adhesives, sealants, carpets, and paints reduce toxic emissions, and
- use of local building materials reduces transportation energy use and emissions.

The ground source heating is predicted to save 36.7 tons of CO₂ emissions over 30 years.

Regional Initiatives:

Western Climate Initiative

<http://www.westernclimateinitiative.org/Index.cfm>

Washington, Arizona, California, New Mexico, Oregon, British Columbia, and Manitoba are collaborating to develop regional goals and strategies to fight climate change and to design a market-based mechanism to reduce GHGs. Currently, regional goals are set to reduce GHG emissions to 15% below 2005 levels in 2020.

[Midwestern] Governors Sign Energy Security and Climate Stewardship Platform and Greenhouse Gas Accord

<http://www.midwesterngovernors.org/govenergynov.htm>

This press release notes the goals of this newly formed group. Transportation-related goals focus on increasing production and distribution of alternative fuels.

Regional Greenhouse Gas Initiative

<http://www.rggi.org/>

This is an initiative of northeast and mid-Atlantic states. The group is currently developing an emissions reduction strategy, which will incorporate a cap-and-trade program with a market-based emissions trading system. Energy sector reductions are emphasized.

New England Governors and Eastern Canadian Premiers: Climate Change Action Plan

August 2001

<http://www.negc.org/documents/NEG-ECP%20CCAP.PDF>

This plan calls for reduction of regional GHG emissions to 1990 levels by 2010 and to 10 percent less than 1990 levels by 2020. Transportation-related recommendations are listed on page 20 of the pdf.

BACKGROUND:

Transportation and Global Warming: Defining the Connection and the Solution

CTC & Associates LLC and WisDOT Research & Library Unit, July 2007

<http://www.dot.wisconsin.gov/library/research/docs/tsrs/tsrglobalwarming.pdf>

This transportation synthesis report provides background on transportation's contribution to global warming and a state-by-state list of DOT and local government initiatives. [Most state initiatives were researched for this report; local initiatives generally were not.] Research articles on CO₂ emission reduction strategies are cited or included for the following subjects:

- reducing GHG emissions through land-use development (The Kyoto Protocol and Sustainable Cities: Potential Use of Clean-Development Mechanism in Structuring Cities for Carbon-Efficient Transportation, *Transportation Research Record No. 1983*, 2006);
- using byproducts such as fly and bottom ash for embankment construction (p. 15 of the pdf);
- developing policies to target behavioral differences of diesel and hybrid car buyers (p. 35 of the pdf);
- implementing an emission permit trading program (p. 50 of the pdf); and
- measuring emissions reductions of roundabouts (p. 66 of the pdf).

Bush Signs Bill Boosting Fuel Standards

H. Josef Hebert, Associated Press, December 19, 2007

<http://ap.google.com/article/ALeqM5jvZgGKHW7h7XbaTX4VD0h-HI58NwD8TKJRFG0>

President Bush signs into law an energy bill which calls for increasing auto fuel efficiency to an industry-wide standard of 35 miles per gallon by 2020. Additionally the bill calls for a sixfold increase in ethanol use by 2022, to 36 billion gallons a year, of which 21 billion gallons will come from feedstock other than corn, such as prairie grass or wood chips.

Study looks at transportation's effects on global warming

By Doyle Rice, *USA Today*, January 2008

http://www.usatoday.com/weather/climate/globalwarming/2008-01-08-transportation-co2_N.htm

This article reports of a recent study on transportation sector GHG emissions by the Center for International Climate and Environmental Research in Oslo:

Fifteen percent of the manmade carbon dioxide (CO₂) in the Earth's atmosphere comes from cars, trucks, airplanes, trains, and ships. This is the first study to specifically measure the impact of transportation on global greenhouse gas emissions . . .

Within the transport sector, road transportation (cars, buses and trucks) contribute the most greenhouse gases, which includes CO₂, ozone, methane, and others.

And while the transport sector is responsible for a growing share of global emissions, many of the gases emitted by transportation aren't covered by regulations from the Kyoto Protocol. The study [led by Jan Fuglestedt] was published in the *Proceedings of the National Academy of Sciences*.

[From sidebar] current trends show atmospheric CO₂ concentration would double by the end of the century.

International Energy Annual: 2005

http://www.trb.org/news/blurb_detail.asp?id=8316

Abstract: The U.S. Department of Energy's Energy Information Administration has released its annual report of international energy statistics. The report presents an overview of key international energy trends for production, consumption, imports, and exports of primary energy commodities in more than 220 countries, dependencies, and areas of special sovereignty. Also included are estimates of carbon dioxide emissions from the consumption and flaring of fossil fuels. Other data included are population data, as well as prices for crude oil in selected countries.

MITIGATION:

Roadmap for Climate Protection: Reducing Greenhouse Gas Emissions in Puget Sound

The Puget Sound Clean Air Agency Climate Protection Advisory Committee, December 2004

<http://www.pscleanair.org/programs/climate/rptfin.pdf>

The Climate Protection Advisory Committee was formed to develop climate protection strategies for the Puget Sound region, particularly Snohomish, King, Kitsap, and Pierce counties. Chapter 6 (p. 44 of pdf) focuses on two high priority transportation sector strategies, the reduction of GHG emissions of new vehicles and the reduction of vehicle miles traveled (VMT). Key actions for reducing GHG emissions of new vehicles are as follows: urging the federal government to improve fuel economy and adopting California motor-vehicle standards. Key actions for reducing VMT are as follows: establishing a VMT reduction goal; implementing land-use, transit, and demand-side strategies; and incorporating climate change considerations into land-use and transportation planning (p. 49 of pdf; see Table 4, p. 51 of pdf, for specific strategies).

Appendix K (p. 175 of the pdf) includes other detailed climate protection strategies for the transportation sector, along with technical information. Additional strategies, those not deemed "key actions" as above, can be found on page 220 of the pdf, and educational strategies, on page 221 of the pdf.

Intergovernmental Panel on Climate Change Fourth Assessment Report

<http://www.ipcc.ch/>

This international organization offers resource links to information on climate change and adaptation and mitigation strategies.

- **Climate Change 2007: Mitigation, Working Group III Report**

<http://www.ipcc.ch/pdf/assessment-report/ar4/wg3/ar4-wg3-chapter5.pdf>

This chapter covers mitigation policies for the transportation sector. Section 5.3.1, p. 336, details mitigation strategies for road travel. GHG emissions can be reduced with four basic measures: reducing loads, increasing fuel efficiency, changing to a less carbon-intensive fuel, and reducing non-CO₂ emissions.

Section 5.5 of this report describes mitigation policies for transportation agencies (p. 366).

Literature suggests that in general, single policies or initiatives tend to have a rather modest effect on the motorization process. The key to restraining motorization is to cluster a number of initiatives and policies, including improved transit service, improved facilities for NMT (Non-motorized transport) and market and regulatory instruments to restrain car ownership and use (Sperling and Salon, 2002). (p. 366)

Center for Clean Air Policy Transportation Emissions Guidebook

http://www.ccap.org/safe/guidebook/guide_complete.html

This interactive website provides an index to two categories of mitigation policies: (1) land use, transit, and travel demand management, and (2) vehicle technology and fuels. The site provides briefs for each policy, which include an overview, emissions-reduction potential, implementation strategies, case studies, and links to resources. There is also an emissions-reduction calculator and a policy comparison matrix.

Transportation and Climate Get Hitched [Opinion]

Eric de Place, November 2007

http://www.sightline.org/daily_score/archive/2007/11/07/transportation-and-climate-get-hitched#more

Recent voter opposition to an \$18 billion transportation proposal in the Seattle metro region highlights increasing public awareness of climate change. The proposal would have built more than 180 lane miles of highway and 50 miles of light rail. Much of the opposition leading up to election cited that the project would have increased global warming. The author believes the proposition failed in part because it did not provide voters with a comprehensive assessment of climate impacts. He suggests future transportation projects should,

- consider climate impacts, particularly how much greenhouse gas will be contributed by increasing highway capacity;
- focus on small-caliber climate-friendly solutions like ridesharing or improved bus service; and
- improve land use patterns.

Related Link:

- **Transportation forever linked with climate change**
Eric de Place, *Seattle Post-Intelligencer*, November 7, 2007
This is a similar article to the one above.

Less Auto-Dependent Development Is Key to Mitigating Climate Change, Research Team Concludes

Urban Land Institute, September 2007

<http://www.smartgrowthamerica.org/gcindex.html>

This summary of a technical report suggests that current projected growth rates for automobile use will outpace targeted improvements for fuel efficiency and reduced emissions by 2030. The report recommends increasing development that favors compact mixed-use neighborhoods to minimize vehicle miles traveled: "Depending on several factors, from mix of land uses to pedestrian-friendly design, compact development reduces driving from 20 to 40 percent, and more in some instances." One suggestion calls for increased and direct federal funding to metropolitan planning organizations to enhance new urban growth. Links to the full report and an executive summary are provided.

Excerpt: Real estate projections [show] that two-thirds of development expected to be on the ground in 2050 is not yet built, meaning that the potential for change is profound . . . Shifting 60 percent of new growth to compact patterns would save 85 million tons of CO₂ annually by

2030. The savings over that period equate to a 28 percent increase in federal vehicle efficiency standards by 2020 (to 32 mpg), comparable to proposals now being debated in Congress.

U.S. Climate Change Technology Program Strategic Plan

September 2007

<http://www.climatechange.gov/stratplan/final/CCTP-StratPlan-Sep-2006.pdf>

Page 60 of this report provides a list of transportation technology research and development projects funded by the federal government. Major areas of research are as follows:

- light vehicles
- heavy vehicles
- fuel research
- intelligent transportation systems,
- aviation fuel efficiency
- increasing commuter flexibility
- supporting local efforts to deploy alternative fuel vehicles
- providing funds to reduce congestion and improve air quality
- reducing emissions of vehicle air conditioning systems
- reducing freight sector emissions

Page 86 describes using hydrogen power as a fuel source for transportation and other sectors. Page 96 discusses infrastructure readiness for ethanol-blend fuels:

No significant changes to vehicles and refueling infrastructure are needed until E10 ethanol (90 percent gasoline, 10 percent ethanol) in gasoline blends captures 10 percent of gasoline markets. When 85 percent ethanol/gasoline blends (E85) expand, which is expected if ethanol costs come down further, limited refueling infrastructure modifications will be needed. However, refueling technology needed for E-85 is already well developed, and several automobile manufacturers are already selling E-85 vehicles at low or no incremental costs.

Green transit : environmental innovation benefiting all Canadians, 2001, 38 pages

From the Abstract: Recent developments, outlined briefly in this paper, show that Canadians may be ready now more than ever before to entertain serious environmentally sustainable alternatives to today's automobile. Among these sustainable alternatives are advanced fuel technology and improved engine design. Clean diesel, natural gas, electricity, fuel cells and hybrid electric vehicles are examined in turn. The paper goes on to place these advanced in a community-based context. Snapshots of local initiatives, along with the names and contact details of the people who are working to enhance the environment through improved technology and planning, round out the paper.

ADAPTATION:

Preparing for Climate Change: A Guidebook for Local, Regional, and State Governments

Center for Science in the Earth System (Climate Impacts Group), Joint Inst. for the Study of the Atmosphere and Ocean, and Univ. of Wash. for King County, Wash.—September 2007

<http://www.cses.washington.edu/db/pdf/snoveretalgb574.pdf>

This report provides a step-by-step guide to governments for establishing a climate change policy.

Several examples focus on problems facing the transportation sector directly and indirectly. Some possible transportation-related impacts (p. 53 of pdf):

- Fewer travel disruptions and lower maintenance and infrastructure costs associated with snow and ice;
- More travel disruptions associated with landslides, road washouts, and flooding;
- Increased road surface damage from higher temperatures;
- Increased maintenance requirements for roadside and median-strip vegetation;

- Increased brush fires in roadside and median-strip vegetation;
- Need for new or upgraded flood and erosion control structures;
- Reduced effectiveness of sea walls with sea level rise;
- Increased erosion or damage to coastal infrastructure, dunes, beaches, and other natural features due to sea level rise and storm surge;
- Loss of coastal wetlands and other coastal habitats due to sea level rise and erosion; and
- Increased costs for maintenance and expansion of coastal erosion control

More specific analysis of some of the above scenarios is found on page 88 of the pdf, with some sample solutions on page 114 of the pdf.

Local Warming

Christopher Swope, *Governing*, December 2007

<http://www.governing.com/articles/12warm.htm>

Local governments, especially King County, Washington, but also Homer, Alas., Boston, Chicago, and Miami-Dade County, Florida, are planning for a future in which global warming has altered the landscape. King County is trying to use forecasted conditions for 2050 to build appropriate infrastructure today by “building climate-change risks into all of its long-term planning and policy-development processes. Last month, the county council agreed to a tax inspired by the looming dangers of climate change.” In western Washington, it is predicted that flooding events, such as the one in November 2006 that caused \$34 million worth of damage, will become more frequent.

Excerpts from the article:

Take the concept of the “100-year flood.” That benchmark is deeply ingrained in local planning documents, building codes and the federal flood insurance program. Yet a 100-year flood today may not mean the same thing just 20 or 30 years from now. Scott Shuford, a city planner who has worked in St. Petersburg, Florida, and Asheville, North Carolina, says climate change essentially voids the historical record . . .

Homer, [Alaska,] a coastal town of 5,000, is feeling vulnerable to nature's whims. A recent run of warm, dry summers brought an invasion of spruce bark beetles that ravaged millions of acres of forest. Then this summer, about 75 square miles of the weakened timberland caught fire. Homer also is susceptible to sea-level rise . . . [A] task force is looking at how to scrutinize coastal development more closely, account for wildfire risks, bolster storm-water infrastructure and develop new sources for drinking water . . .

Boston Mayor Tom Menino recently asked for an adaptation plan for the city. He also ordered that any construction or renovation of public facilities include an evaluation of the project's climate-change vulnerabilities and a description of how to manage those risks. A climate-change task force in Chicago has been studying adaptation questions such as what kinds of trees will thrive in a warmer climate and how to handle warm-weather pests such as termites.

Climate Change 2007: Synthesis Report, Summary for Policymakers

http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr_spm.pdf

This report of the international organization, the Intergovernmental Panel on Climate Change, describes broad climate changes predicted to occur from global warming: e.g., increased temperatures, flooding, and sea levels (p. 12). A combination of adaptation and mitigation strategies is recommended to combat climate change (p. 18). Adaptation strategies are noted with corresponding policy frameworks and constraints. Some strategies are the relocation of infrastructure, protection with natural buffers to counteract flooding and high sea levels, and new design standards and planning to cope with warming and drainage (p. 15). Key mitigation technologies for the transportation sector, also listed with corresponding policies and constraints, are more fuel efficient vehicles, hybrid vehicles, cleaner diesel vehicles, biofuels, modal shifts

from road transport to rail and public transport systems, non-motorized transport (cycling and walking), land-use and transport planning, second generation biofuels, higher efficiency aircraft, and advanced electric and hybrid vehicles with more powerful and reliable batteries (p. 18).

The Potential Impacts of Climate Change on Transportation: Workshop Summary and Proceedings, October 2002

<http://climate.dot.gov/workshop1002/index.html>

This website provides links to papers discussed at the USDOT Center for Climate Change and Environmental Forecasting's workshop on forecasted impacts to transportation. Papers cover general impacts to infrastructure, as well as regional case studies.

Vulnerability to Inundation and Climate Change Impacts in California: Coastal Managers' Attitudes and Perceptions

Susanne C. Moser and John Tribbia, *Marine Technology Society Journal* 40(4): 35-44, Winter 2006/2007

From the Abstract: The authors study current inundation related risks, growing coastal problem vulnerability, and climate change risk perception among California's local coastal managers. They discuss the extent to which increasing challenges are considered and addressed by coastal managers. In addition to critical coastal management considerations in California indicated by survey results, there are also coastal management challenges unrelated to inundation. Limited resources and staff time, as well as pressing current issues, limit coastal management in addressing growing risks of sea-level rise, even with moderately good understanding of potential climate change impacts on coastal areas and high awareness of global warming. The authors conclude that in regard to climate change impacts on coastal areas, California is inadequately prepared. They stress the need for state and federal agencies to substantially support local government if future elevation of climate change and other inundation-related risk preparation is to be adequate.

Impacts of flooding and climate change on urban transportation: A systemwide performance assessment of the Boston Metro Area

Pablo Suarez, William Andersonb, Vijay Mahalc, and T.R. Lakshmanan

Transportation Research Part D: Transport and Environment 10(3): 231-244, May 2005

This paper develops a model to determine the impact to the Boston transportation system of extreme river and coastal flood events, events expected to increase with climate change. "Results indicate almost a doubling in delays and lost trips."

Boston Harbor has seen a significant increase in extreme water levels:

While sea level rise appears to be present as a slight trend upwards, a relevant fact is that high water levels associated with extreme events have increased dramatically over the second half of this period [1920 to 2000]. It is estimated that a rise in sea level of 30–90 cm would increase the size of the 100-year floodplain in the US by 10,000–20,000 km².

A storm with significant flooding can be expected to disrupt the transportation system by causing cancellation of trips or extending travel times with detours or congestion. "These disruptions have economic costs because trips have value. This may be expressed in terms of lost work-days, lost sales, or lost production. Traveler's time also has value and, thus, lost time due to circuitous travel or traffic congestion has significant cost."

Road transport sensitivities to weather and climate change in Australia

Bevan D. Rowland, et al., In Proceedings 30th Australasian Transport Research Forum, Melbourne, Australia (2007)

As summarized in the abstract, this paper focuses on how weather influences road safety, particularly in cases of severe or adverse weather, which may be related to climate change. For example, "research indicates a significant increase in crash risk as the duration of time between rainfall events [increases]." In Australia storm intensity and high temperatures are expected to increase as a result of global warming.