Maine Policy Review

Volume 17
Issue 2 *Climate Change and Energy*

2008

Transportation and Climate Change

Jonathan Rubin
University of Maine, jdrfirst@gmail.com

Transportation and Climate Change

by Jonathan Rubin

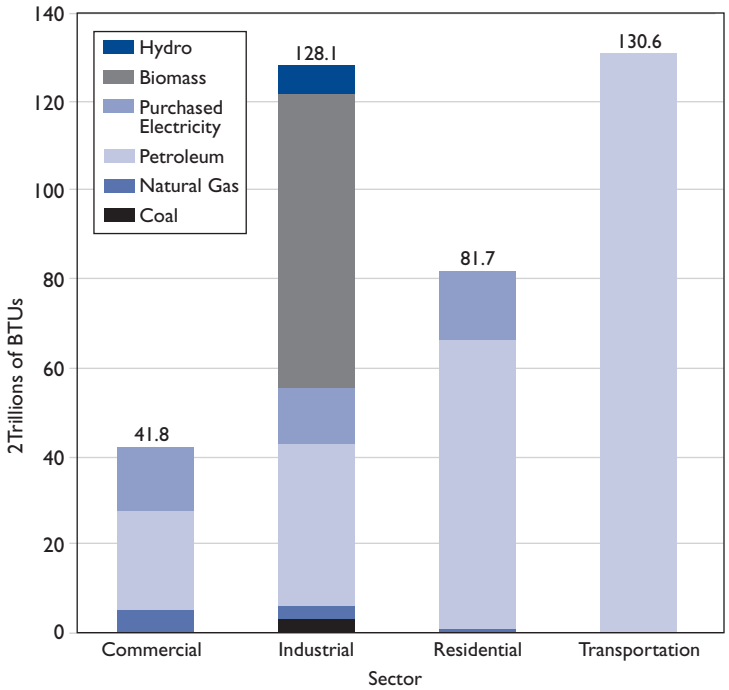
Transportation for personal mobility and freight is a key component of economic and social well-being for Maine as well as the rest of the world. Transportation activity is also responsible for many pressing problems, including accidents and fatalities, degradation of local and regional air quality, land use change, congestion, oil dependency and greenhouse gas (GHG) emissions. There are two ways of thinking about transportation and climate change: how the current and future transportation systems affect the climate system and how climate change is likely to affect the various modes of our transportation system. These dual impacts call for activities both to mitigate emissions and to adapt our transportation system to the changing climate. The mitigation of GHG emissions can provide synergies and produce co-benefits with non-climate transportation impacts including air quality, congestion and oil dependency (Kahn Ribeiro et al. 2007).

GREENHOUSE GAS EMISSIONS

Maine has shown regional and national leadership to reduce its GHG emissions. In 2003, the Maine Legislature enacted Public Law 2003, Chapter 237, An Act to Provide Leadership in Addressing the Threat of Climate Change. This law required the Department of Environmental Protection (DEP) to develop and submit a climate action plan (CAP) for Maine with the goal of reducing GHG emissions to 10 percent below 1990 levels by 2020 and "In the long term, reduction sufficient to eliminate any dangerous threat to the climate. To accomplish this goal, reduction to 75 percent to 80 percent below 2003 levels may be required" (38 MRSA §574-579). (For further discussion of Maine's Climate Action Plan, see Littell, Westerman and Burson, this issue.)

Maine has no fossil fuel reserves; it imports all of its petroleum and natural gas used for heating, transportation, and electricity generation. In 2005, fossil fuels (coal, petroleum products, and natural gas) accounted for nearly three-quarters of all energy use in Maine. The residential sector is heavily reliant on petroleum products for energy, and the transportation sector up until recently has been solely reliant on petroleum. (Some ethanol is beginning to be mixed with gasoline distributed in Maine, and there is some use of biodiesel in heating and transportation.) Only the industrial sector uses a significant amount of renewable energy in the form of hydroelectricity and biomass (Figure 1).

FIGURE 1: **Maine Energy Use by Sector, 2005**



Source: Colgan, Merrill and Rubin (2008)

Transportation Greenhouse Gas Emissions

Transportation GHG emissions are largely (94 percent U.S. data) composed of carbon dioxide (CO_2) from combustion, but also include non-CO_2 emissions of methane and nitrous oxide emissions from combustion and hydrofluorocarbon (HFC) emissions from the use of refrigerants for mobile source air-conditioning units. In terms of global emissions, the transportation sector is responsible for 23 percent of world energy-related GHG emissions, with about three-quarters coming from road vehicles (Kahn Ribeiro et al. 2007). According to the Energy Information Administration's Web site, the comparable figure for the U.S. is 28 percent, reflecting the larger role of carbon-based fuels in our economy compared to the world as a whole (www.eia.doe.gov/oiaf/1605/ggrpt/). In Maine, the transportation sector accounts for roughly 40 percent of GHG emissions (MDEP 2008: 8). Transportation also has an indirect impact on climate change via induced land use change in settlement patterns, housing and business location (Rubin 2006).

…unlike other sectors of the economy, transportation decisions typically involve multiple actors and incentives…

The relatively high impact from transportation in Maine reflects the rural character of the state. Maine ranks 14th in the nation for the largest number of highway miles traveled annually per capita, 14,912 per year, and 89 percent of Maine's work force commutes to work by passenger vehicle (Noblet et al. 2006). Nationally, 96 percent of transportation energy comes from petroleum (Davis and Diegel 2007: Table 2.2).

REDUCING TRANSPORTATION DEMAND AND EMISSIONS

Reducing transportation petroleum demand and GHG emissions in Maine requires increasing the efficiency of vehicles, e.g., miles per gallon (MPG), switching to alternative fuels that have lower GHG emissions per mile, and reducing the demand for transport services through long-term actions such as more compact residential development. Since GHG gas emissions are proportional to the amount of fuel purchased or (in the short run) the number of miles driven, the price of fuel can have a large impact on GHG emissions. By historical standards the price of gasoline has been very low up until quite recently. This low price of fuel has led, in part, to the shift towards a greater share of sport utility vehicles (SUVs) and generally heavier and larger vehicles in Maine and the nation. These vehicle characteristics (vehicle type, weight, and size) all reduce fuel economy. There is a clear upward trend in the total vehicle miles travelled (VMT) on Maine's roads, with a 59 percent increase between 1985 and 2006 and a slight decrease in 2007. How much of the leveling off of VMT growth is due to the rise in fuel prices is unclear. Other factors such as a low growth in state population with a general shift towards southern and coastal parts of Maine are also important. Nonetheless, fuel prices are important.

Public Transportation

One of the ways in which communities and individuals in Maine can reduce their impact on climate change is by increasing the capacity of public transportation and choosing to use more public, and less private, transportation. According to the American Public Transportation Association's Web site, the use of public transportation reduces CO_2 emissions by more than 7.4 million tons per year across the nation (www.apta.com/research/info/online/ben_overview.cfm#ptt). Not only will this lower GHG levels by having fewer cars on the road, it will also help individuals save money in the face of increasing fuel costs.

Overall, Maine has seen a significant rise in public transit use over the last 10 years. According to the Maine Department of Transportation, ridership not including air or rail, was at approximately 3.8 million in 2004 compared to 2.4 million in 1999 just five years earlier. The Downeaster rail service from Portland to Boston, MA, has seen significant increases since its inaugural year, starting at approximately 164,000 riders in 2002 to more than 441,769 at the end of the 2008 fiscal year.[1] Increases in the use of public

transportation can also be credited to the University of Maine's efforts to provide free bus service for all of their students and staff.

LEGISLATION

State of Maine

In 2005 the state of Maine adopted two high-priority recommendations identified in Maine's Climate Action Plan: California GHG emission standards for vehicles and California zero emission vehicle (ZEV) mandates. The actual implementation of the tailpipe standards is subject to the legal challenge of the Environmental Protection Agency's (EPA) denial of California's waiver for the California standards by Maine and other states. The ZEV mandate has recently been substantially changed by the California Environmental Protection Agency's Air Resources Board to give vehicle manufacturers greater flexibility in meeting the production goals by increasing the number of plug-in hybrid and other advanced technology vehicles (www.arb.ca.gov/msprog/zevprog/zevreview/zevreview.htm).

These two high-priority measures illustrate the complexity in designing and implementing policies to reduce transportation energy use. This is because, unlike other sectors of the economy, transportation decisions typically involve multiple actors and incentives: private consumers and businesses that purchase and use vehicles; local, regional, and state decision makers who decide on land use zoning and infrastructure development; and state and national decision makers who make rules on vehicle fuel efficiency and provide funds for transportation infrastructure and research and development.

Federal

Despite the set-back in implementing California GHG tailpipe standards, landmark federal legislation accomplishes similar goals. The Energy Independence and Security Act (EISA) of 2007 increases the Corporate Automotive Fuel Efficiency (CAFE) standards of the U.S. light-duty vehicle fleet from the 2007 (combined) level of about 25 MPG to the maximum feasible average to attain 35 MPG—a 40 percent increase—by 2020. In addition, starting in 2011, the CAFE program will include the large SUVs that were previously exempt from CAFE requirements. These are national requirements that must be met on average. The actual fuel economy of new vehicles purchased in Maine depends on the decisions of Maine consumers and businesses. Public education on the value of purchasing more fuel-efficient cars and trucks can help to ensure that Maine benefits from the greater availability of fuel-efficient vehicles that will be produced by automobile manufacturers.

The EISA extends and increases the renewable fuel standard (P.L. 109-58 §1501) to require 9.0 billion gallons of renewable transportation fuels in 2008, rising to 36 billion gallons by 2022. This will be approximately 16 percent of all the fuel used by cars and pickup trucks and SUVs, or 11 percent of fuel used by all on-road vehicles including buses and heavy-duty trucks. From 2016 on, all of the increase in renewable fuels must be met with advanced biofuels, defined as cellulosic ethanol and other biofuels derived from feedstocks other than corn starch (such as municipal waste or sugar). There are specific additional requirements that mandate certain quantities of cellulosic biofuels and biomass-based diesel. In addition to these volume requirements, renewable fuels produced from new biorefineries must reduce lifecycle GHG emissions by at least 20 percent relative to gasoline or diesel, depending on which fuel they displace. Advanced biofuels and cellulosic biofuels must reduce GHG emissions by 50 percent and 60 percent, respectively.

Lifecycle GHG emissions can vary depending on a number of different factors including process energy sources (natural gas, coal, corn stover) and land use impacts and attribution of energy and GHG emission to co-products. The EPA reports that the percentage change in GHGs for corn ethanol can range from a 54 percent decrease for a biomass-fired dry mill plant to a four percent increase for a coal-fired wet mill plant. The average GHG emissions decrease of corn ethanol is 21.8 percent compared to gasoline (U.S. EPA 2007). These reductions include methane and nitrous oxide, but do not include induced GHG emissions from direct or indirect induced land use change.

Besides reducing emissions, these biofuel requirements have the potential to help the economy of

Maine. The Forest Bioproducts Research Initiative at the University of Maine is currently involved in helping to develop and commercialize cellulosic biofuels using wood from Maine's forests as a feedstock (www.forestbioproducts.umaine.edu). The success and growth of this industry will depend, in part, on the technology forcing mandates and standards of EISA. The success also depends on Maine vehicle owners' willingness to purchase these new fuels.

ADAPTING TO CLIMATE CHANGE IMPACTS

The transportation sector of each region of the nation will have to find specific ways to adapt to climate change. Maine with its large coast, wide-ranging temperature variation (south to north and coastal to inland), and seasonality will have to find localized solutions. Nonetheless, the Transportation Research Board, which is part of the National Academy of Sciences, has recently come out with a report on the potential impacts of climate change on U.S. transportation and contains recommended actions (TRB 2008a). The report finds that "Climate change will affect transportation primarily through increases in several types of weather and climate extremes….[t]he impacts will vary by mode of transportation and region of the country, but they will be widespread and costly in both human and economic terms and will require significant changes in the planning, design, construction, operation, and maintenance of transportation systems" (TRB 2008b: 1). Some of the specific suggestions include: inventory critical infrastructure such as coastal roads, railways, transit systems, and runways to assess their vulnerability to flooding due to inland storm events and sea level rise and (localized) land subsidence; factor anticipated climate change into investment and land use planning decisions; integrate evacuation and emergency response to extreme weather events into transportation operations; and develop and implement monitoring technologies to give advance warning of infrastructure failures due to water levels, waves and wind.

As critical as our transportation infrastructure is to the safety and welfare of our nation, very few state and region-specific studies have examined the vulnerabilities to climate change. One notable exception is the "Gulf Coast Study," which examined the U.S. central Gulf Coast. This study found that 27 percent of major roads, nine percent of rail lines, and 72 percent of ports are potentially vulnerable to flooding from sea level rise (Department of Transportation 2008). No comparable assessment has been conducted for Maine or New England. While these numbers cannot be used to assess Maine's potential vulnerability, they do give an indication of the potential magnitude of the problems we face. Clearly, it would be prudent for Maine, alone or in conjunction with its New England and Atlantic Province neighbors, to pursue an inventory of the transportation sector's vulnerability to climate change.

Some of the climate impacts will be beneficial for Maine's transportation system. The expected decrease in the length and severity of the winter season will likely reduce the cost of snow and ice control and provide safer travel conditions. Impacts on transportation-oriented recreation including snowmobiling, ATV use, and boating can be expected. The net impact on the economy is not clear. Decreases in expected snow cover will lessen the opportunities for recreational snowmobiling that contributes to Maine's economy. Some of this loss may be offset by increases in the use of ATVs. The actual impact is not known.

CONCLUSION

Motorized transportation provides us with tremendous economic benefits and personal freedom. At the same time this system is responsible for, or contributes to, many pressing problems including oil dependency and GHG emissions. Advances in technology such as more fuel-efficient vehicles can help reduce GHG emissions. Advances in emission systems have already made large improvements in air quality. However, technology alone will not eliminate the unintended impacts from transportation. Hybrid power systems can be used to increase acceleration rather than improve fuel economy. Increases in vehicle miles traveled can erode gains from cleaner vehicles and exacerbate congestion and land use impacts. Individuals need to demand that local, state and national governments work to set in place a stronger regulatory framework to address these problems.

At the same time, individuals need to take personal responsibility for their own choices and behaviors. Choosing to live distant from work to gain a larger house, lower taxes, or a better view is common. Choosing large, loud, or high-performance vehicles imposes avoidable costs on others. The problem is that when everyone makes the same choices we collectively lose. Individually and collectively we need to learn how to use less private motorized transportation.

ENDNOTE

1. Northern New England Passenger Authority, "Performance Report," June 2008 – FY08 Summary Report.

REFERENCES

Colgan, Charles S., Samuel Merrill and Jonathan Rubin. 2008. Energy Efficiency, Business Competitiveness, and Untapped Economic Potential in Maine. Maine Center for Business and Economic Research, Portland.

Davis, Stacy C. and Susan W. Diegel. 2007. Transportation Energy Data Book, 26 ed. Center for Transportation Analysis, Oak Ridge National Laboratory, Oak Ridge, TN.

Department of Transportation. 2008. Impacts of Climate Variability and Change on Transportation Systems and Infrastructure: Gulf Coast Study, Phase I. Report by the U.S. Climate Change Science Program and the Subcommittee on Global Change Research. Department or Transportation, Washington, DC. http://www.climatescience.gov/Library/sap/sap4-7/final-report/

Kahn Ribeiro, Suzana, Shigeki Kobayashi, Michel Beuthe, Jorge Gasca, David Greene, David S. Lee, Yasunori Muromachi, Peter J. Newton, Steven Plotkin, Daniel Sperling, Ron Wit, Peter J. Zhou. 2007. Chapter 5: Transport and Its Infrastructure. Climate Change 2007: Mitigation of Climate Change. Working Group III Contribution to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press.

Littell, David P., Gary S. Westerman and Malcolm C. Burson. 2008. "Confronting Global Warming: Maine's Multi-Sector Initiatives, 2003–2008." Maine Policy Review 17(2): 52–65.

Maine Department of Environmental Protection (MDEP). 2008. Second Biennial Report on Progress toward Greenhouse Gas Reduction Goals: Report to the Joint Standing Committee on Natural Resources. MDEP, Augusta.

Noblet, Caroline L., Gregory M. Gould, Jonathan Rubin, Daniel Innis and Charles Morris. 2006. Sustainable Transportation Funding for Maine's Future. Prepared for the Maine Department of Transportation. Margaret Chase Smith Policy Center and College of Business, Public Policy and Health, University of Maine. http://mcspolicycenter.umaine.edu/files/pdf/SustainableTransportationFunding01-06.pdf [Accessed January 9, 2009]

Rubin, Jonathan. 2006. Transportation and Land-Use Change. Economics of Rural Land-Use Change, ed. Kathleen. P. Bell, Kevin J. Boyle and Jonathan Rubin. Ashgate Press, Farnham, UK.

Transportation Research Board. 2008a. Potential Impacts of Climate Change on U.S. Transportation. Special Report 290. Transportation Research Board, Washington, DC.

Transportation Research Board. 2008b. Potential Impacts of Climate Change on U.S. Transportation. Report in Brief. Transportation Research Board, Washington, DC. http://onlinepubs.trb.org/onlinepubs/sr/sr290summary.pdf [Accessed January 10, 2009]

U.S. Environmental Protection Agency (EPA). 2007. Greenhouse Gas Impacts of Expanded Renewable and Alternative Fuels Use. EPA420-F-07-035. Office of Transportation and Air Quality, EPA, Washington, DC. http://www.epa.gov/OMS/renewablefuels/420f07035.pdf [Accessed January 10, 2009]

Jonathan Rubin is professor in the Margaret Chase Smith Policy Center and School of Economics, University of Maine. He specializes in the economics of energy, light-duty transportation, greenhouse gas emissions, and alternative fuels. He has published numerous articles in international, national and regional economic journals, and is the chair of the Committee on Transportation Energy, U.S. Transportation Research Board of the National Academies.