

Primer on Transportation and Climate Change

Executive Summary



AMERICAN ASSOCIATION OF
STATE HIGHWAY AND
TRANSPORTATION OFFICIALS

AASHTO
THE VOICE OF TRANSPORTATION

Authoritative sources tell us the global climate is becoming warmer. Global warming is caused in large part by human activities. Global warming, if allowed to continue unchecked, will cause severe and lasting impacts. What is the role of transportation in mitigating global climate change and adjusting for its impacts?

Anticipated Impacts Affecting Transportation

Research studies have identified the serious impacts climate change poses for transportation. Increases in very hot days will increase the frequency of wildfires, compromise pavement integrity, and deform rail lines; increased flooding of coastal areas will inundate roads, bridges, and rail lines; increases in Arctic temperatures will cause subsidence of permafrost, disrupting roads, rail lines, and airports. Heavier rainfall in many parts of the country will require redesign and replacement of drainage structures; and more frequent and more severe hurricanes will disrupt service in affected areas and require devoting more resources to evacuations.

Recent Reports Say Climate Change Poses a Big Problem for Transportation

Recent authoritative reports have confirmed the challenges which global climate change will pose for the transportation sector. These studies include the *2007 Report of the Intergovernmental Panel on Climate Change* and TRB's Report 290: *Potential Impacts of Climate Change on U.S. Transportation*, 2008.

Emission of Greenhouse Gases Is Causing Temperatures to Rise

The strategy to stop the continuing rise in temperatures is to slow down the rate of greenhouse gas (GHG) emissions and ultimately stabilize GHG concentrations in the atmosphere.

The goals of climate change policy are to stabilize global average temperatures and prepare for the impacts of climate change.

U.S. Goals for Greenhouse Gas Emission Reduction

To date, the U.S. government has not adopted a specific GHG reduction goal. The U.S. Climate Change Partnership (U.S. CAP)—a broad coalition of industry and environmental groups—has set a goal to reduce U.S. GHG



emissions below 2005 levels by 60–80 percent by 2050. Many states have adopted even more aggressive goals.

Cap-and-Trade or Carbon Tax

Many economists have agreed that the most cost-effective way to reduce GHG emissions is to establish a *carbon price*. Carbon pricing would give businesses and individuals an incentive to use less carbon. Under a cap-and-trade program allowances for emissions would be allocated by the government, possibly through an auction. The price of emitting carbon and other greenhouse gases would be increased to the point a given industry would reduce them directly or by purchasing allowances from others. Imposing a carbon tax would have a similar effect. Cap-and-trade appears to be the solution which stands the best chance of near-term enactment in Congress.

Climate Change and Transportation

It is estimated that approximately 33 percent of GHG emissions in the United States come from transportation. Seventy-two percent of the transportation sector's emissions are generated by road use.

Factors Affecting Road-Related GHG Emissions

There are several factors that affect the GHG emissions from road transportation. These include: 1) fuel economy, 2) the type of fuel used, and 3) the number of vehicle miles traveled. A fourth is traffic operations, including traffic-flow management by transportation agencies and individual driving behavior.

Fuel Economy

In 2007, Congress enacted fuel economy standards that will require that the average of all new vehicles in the light-duty automotive fleet, which includes cars, light trucks, and sports utility vehicles, achieve a standard of

35 miles per gallon by 2020. The fleet average today is approximately 21 mpg, so this will bring about a major change in the vehicles produced and sold by the auto industry.

Alternative Fuels and Hybrid Vehicles

It is hoped that alternative fuels, such as ethanol and biodiesel, will help reduce GHG emissions because they emit less CO₂ for each unit of energy produced. There is also interest in the contribution which hybrids, plug-in electric, and hydrogen-fueled vehicles can make in the future. Alternative fuels represent less than two percent of the fuel supply in 2006, and DOE projects that they will rise to only eight percent by 2030.

- **Gas-Electric Hybrids.** A good example of the potential of hybrid vehicles is the Prius which is rated at 46 mpg in average fuel efficiency, as compared to a standard Toyota vehicle, the Corolla, which is rated at 27 mpg city and 35 mpg highway.
- **Plug-In Electric Hybrids.** Plug-in electric hybrid vehicles are being developed. Many of them are expected to achieve fuel efficiency rates of 100 mpg. According to DOE, their commercial deployment is not expected to occur until around 2015.
- **Biofuels.** Already in use are biofuels like ethanol which is used at concentrations of 10 percent in nearly all fuel mixes, and ethanol 85 percent which has seen more limited deployment. 2007 energy legislation mandated the production of 36 billion gallons of biofuels by 2020. While most current biofuels come from corn, there is great interest in the development of cellulosic ethanol, which is expected to represent a more clear-cut net gain in carbon reduction.
- **Zero-Emission Vehicles, Like Hydrogen.** Also under development are hydrogen fuel-cell powered vehicles which produce zero GHG emissions, from the vehicle itself. (Energy is required to produce the hydrogen fuel supply for the vehicles; if fossil fuels are used to produce the hydrogen, then there will be some GHG emissions associated with the use of hydrogen-powered vehicles.) According to DOE, hydrogen-powered vehicles are unlikely to become widespread by 2030, but they could become more widely used between 2030 and 2050.



Strategies to Reduce Growth in VMT. There is great interest in policies to reduce the growth of highway demand by shifting trips to other modes of travel. AASHTO, for example, supports a policy to double transit ridership by 2030. There is hope that making more trips by biking, walking, and telecommuting could help reduce GHG emissions as well.

Potential of Transit and Land Use. Many hope that increased transit usage can result in a net reduction in GHG emissions. What is not clear is to what extent. Research done for the Pew Center for Global Climate Change found that, “reducing emissions via increased use of transit would require momentous efforts as transit accounts for only one percent of passenger-miles traveled in the United States today.” A recent report, published by several smart growth advocacy groups concluded that the combination of aggressive land-use strategies and increased transit ridership could bring about emission reductions in the range of 7 to 10 percent.

Reducing Congestion to Reduce GHG Emissions. Many transportation agencies believe that reducing traffic congestion can make a significant contribution to reducing GHG emissions. They point to the billions of gallons of fuel burned by vehicles stuck in traffic which would no longer take place if congestion could be reduced. Smoothing out traffic so vehicles can travel at speeds which burn fuel at more optimal rates has been documented as reducing emissions. Some researchers support congestion relief as a strategy that would result in net reductions in emissions. Others do not recommend congestion reduction as a desired strategy, because of the fear it could encourage more driving and thus increase VMT.

Department of Energy Projections Show Reduction of Road-Related GHG Emissions Will Be Difficult. With regard to increasing fuel economy, DOE projects that the aver-



Photo courtesy of Michael Rosenthal, New Jersey Transit.

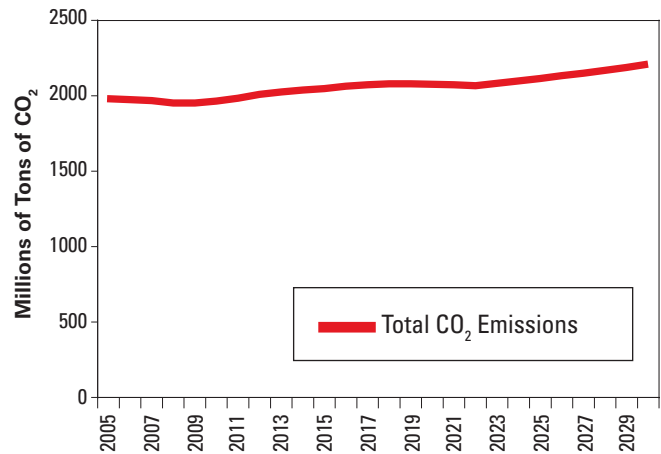
age fuel economy for all light-duty vehicles, new and existing, will rise from 19.9 mpg in 2006 to 27.9 in 2030. DOE shows most of this increase occurring by 2021. From this point onward, DOE assumes that fuel economy will remain unchanged through 2030. DOE makes similarly conservative assessments of the change expected to occur from alternative fuels. Finally, DOE forecasts that VMT will increase by 1.6 percent annually through 2030. (Figure 1)

Others See More Potential for Transportation-Sector GHG Emission Reductions Because High Petroleum Prices Are Expected to Stimulate Technological Innovation and Market Changes. While official forecasts are important to consider, they do not reflect the potential impact of major technological breakthroughs or policy changes.

Scenarios Illustrate GHG Emission Reductions Possible Through Changes in Technology and Policy

AASHTO-sponsored research tested four scenarios to see the GHG emission reductions that could be achieved through significant increases in fuel efficiency and reductions in VMT growth. The most aggressive scenario was for average fuel economy increasing to 100 mpg-ge*, and VMT increasing one percent annually through 2050. *This scenario achieved a decrease in GHG emissions of 68 percent from 2005 levels by 2050.*

Figure 1a. DOE 2030 Forecast Emissions Will Exceed Goals



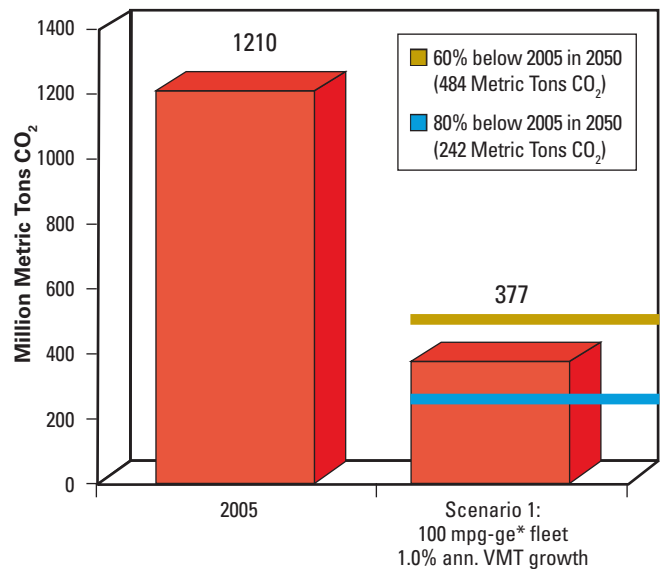
Source: U.S. DOE, Annual Energy Outlook 2008, Revised Early Release (March 2008).

Based on 35 mpg CAFE standard.

The U.S. DOE projects that while fuel efficiency will improve, growth in VMT will outpace those gains. GHG emissions are projected to increase gradually by 2030.

Figure 1b. AASHTO Emissions Scenario Which Achieves Goals

CO₂ Reduction Scenario for 2050 100 mpg, 1% VMT Growth



* Miles per gallon-gasoline equivalent.

With average fuel economy equaling 100 mpg-ge and vehicle miles traveled increasing 1 percent annually CO₂ emissions would be reduced to 377 million metric tons, a decrease of approximately 68 percent, by 2050.

To access the full report, *Primer on Transportation and Climate Change*, visit the AASHTO web site at bookstore.transportation.org
Cover photo courtesy of FIGG, engineer of record for the Natchez Trace Parkway Arches.