A Multipronged Approach to Curbing Gasoline Use

The key to curbing America’s ever-growing appetite for petroleum is not just fuel-efficient vehicles or high gasoline taxes or huge surcharges on gas-guzzling models. It is all of those measures and more, carefully combined into a set of self-reinforcing policies that affects everyone who makes, buys, or uses vehicles and their associated fuels.

This multidimensional approach to tackling the US petroleum consumption problem was outlined by Professor John B. Heywood and graduate student Anup P. Bandivadekar at a March 18 lunchtime seminar hosted by the Laboratory for Energy and the Environment (LFEE).

The United States consumes almost a quarter of the world’s petroleum, and current projections suggest that by 2025 it will use 40% more petroleum than it does now (see the table below). About 70% of that petroleum will be imported, and almost three-quarters of it will be used for transportation.

Such tremendous growth in petroleum use has serious environmental implications, Professor Heywood noted. In addition, it sets the stage for possible petroleum system shocks that could disrupt the transportation system on which the US economy and lifestyle depend.

“We’ve had one or two such shocks, but they were isolated and our economy recovered. What happens if they come more frequently?” Professor Heywood said.

Developing better engine and vehicle technologies and fuels could cut petroleum use and make our transportation system more robust, he said. A recent comprehensive assessment by Professor Heywood, Dr. Malcolm A. Weiss, and others at MIT concluded that even “evolutionary” improvements in “mainstream” gasoline and diesel technologies could yield a 35% reduction in fuel consumption in new vehicles in 20 years—and at moderate cost (see references 2 and 3 in the References section).

But better technology alone may not help. Indeed, over the past 20 years, vehicle efficiency increased by 30%, but any potential fuel savings disappeared because people bought bigger, heavier vehicles and drove them farther and faster.

According to Mr. Bandivadekar, gains will come only when we tackle all aspects of the problem simultaneously. “A simple way to think about it is that petroleum use and greenhouse emissions depend on how fuel-efficient our vehicles are, how much we drive, and how carbon-intensive our fuel is. We need to target all those pieces of the puzzle,” he said.

As an illustration, Mr. Bandivadekar and Professor Heywood looked at the impacts on fuel consumption of increasing fuel efficiency, of reducing vehicle-kilometers traveled, and then of making both of those changes simultaneously. Using a spreadsheet-based model and data from the automotive industry and other sources, they examined four possible scenarios. Those scenarios and the analytical results are presented in the figure on the next page.

The curves in the figure show that tackling two pieces of Mr. Bandivadekar’s puzzle—vehicle efficiency and distance traveled—can substantially reduce fuel use by 2035. But those results also demonstrate the difficulty of reducing transportation fuel use significantly in the near future. Climate-change targets are often defined in terms of 1990 levels of consumption. Even with all the changes assumed in the most-aggressive scenario, the estimated consumption in 2035 does not return to 1990 levels—and the researchers believe that the estimates they used in their analysis were optimistic.

What are the best ways to spur the needed changes? To answer that question, the researchers examined all the available policy options—economic incentives such as taxes and subsidies, regulatory actions such as emissions standards and fuel requirements, and public investment, for example, in alternative-fuel development. For each option they
The researchers' final warning: don’t wait to take action. A few years’ delay now will mean a significantly higher level of petroleum use in 20 or 30 years—and a significantly greater problem to be solved by hydrogen fuel cells or whatever technology we come up with for the long term.

“We need to find ways to change attitudes as well as technologies. It’s not clear we’ll win, but we’d better try,” Professor Heywood said.

John B. Heywood is the Sun Jae Professor of Mechanical Engineering and director of the Sloan Automotive Laboratory. Anup P. Bandivadekar is a PhD candidate in MIT’s Engineering Systems Division. Malcolm A. Weiss is a visiting engineer in the LFEE. This research was supported by the Alliance for Global Sustainability (AGS) and the MIT/AGS Consortium on Environmental Challenges. Further information can be found in reference 1. Information on the comprehensive assessment of vehicle and fuel technologies can be found in references 2 and 3.

References

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United States Petroleum Use

- **No change** – assumes that fuel consumption remains steady at 2008 levels. (Gains from any fuel-efficiency improvements are offset by losses due to higher performance or added vehicle weight or amenities.) Car sales grow at the same rate as population, and each car goes 0.5% farther each year.
- **Baseline** – adds the evolutionary improvements in technology identified in the comprehensive assessment (references 2 and 3). About half of the efficiency improvements translate into reductions in fuel consumption.
- **Baseline + hybrids** – assumes the previous scenario with the gradual addition of gasoline-electric hybrid vehicles into the fleet. By 2035, half of all the new vehicles sold are hybrids.
- **Composite** – adds to the mix a slowing in the growth of both vehicles sold and vehicle-kilometers traveled (VKT). In this scenario, car sales grow only half as fast as population grows, and the distance traveled by each car remains constant at 2008 levels.

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*1990 Fuel Use: 391 Billion Liters*