Testimony to the United States Senate Committee on Energy and Natural Resources

POLICIES TO INCREASE PASSENGER CAR AND LIGHT TRUCK FUEL ECONOMY

2:30 pm, Tuesday, January 30, 2007
Dirksen Senate Office Building, Room SD-366

by

Dr. David L. Greene
Corporate Fellow
Engineering Science and Technology Division
Oak Ridge National Laboratory

Good afternoon. Thank you for inviting me to discuss the need to formulate effective policies to significantly increase motor vehicle fuel economy. The views I express today will be entirely my own and do not necessarily reflect the views of Oak Ridge National Laboratory or the Department of Energy.

Our transportation system consumes more petroleum than any other country in the world, on average 6,300 gallons of oil per second. It produces more climate changing carbon dioxide emissions than any other country in the world except China. There is good reason to be concerned about the sustainability of conventional petroleum as a source of energy for the world's transportation system. More than one fourth of all the petroleum consumed in all of human history was consumed in the past ten years. Both the International Energy Agency (IEA, 2006) and the ExxonMobil Corporation have predicted that by 2010 conventional oil production outside of OPEC nations will peak or reach a plateau. If we continue on our present path, only OPEC or more carbon intensive unconventional fossil energy sources will be able to supply the world's growing demand for liquid fuels.

Why do we need fuel economy policy?

For too long we have ignored the urgent need to reduce our petroleum dependence, protect the global climate and chart a course toward a sustainable energy system. For the past twenty years we have spent the technology that could have been used to raise fuel economy to instead increase horsepower and vehicle mass. Since 1987 horsepower is up 85% and mass over 25%. In part, this is because consumers value acceleration and speed. But it is also because car buyers undervalue fuel economy. Raising the fuel economy of passenger cars and light trucks will not by itself solve our energy dependence, greenhouse gas emissions and sustainable energy problems. But significantly increasing vehicle efficiency is an essential component of any meaningful strategy to address these important goals.

How do we know that consumers undervalue fuel economy? *Consumers say so.* Consumers' responses to survey questions indicate a willingness to pay for only about 2 years of fuel savings. Half of a random sample of U.S. households was asked how much they were willing to pay for a fuel economy improvement that would save them $400 per year in fuel costs. The other half was asked how much money they would have to save each year in fuel costs to justify a $1,200 increase in the price of a vehicle. The average payback periods implied by consumers' answers to these questions were roughly 2-2.5 years, regardless of which way the question was posed. The published literature on consumer payback periods for fuel economy improvements is almost non-existent. However, such short payback periods are entirely consistent with the larger literature on consumers' preferences for other energy-using durable goods.

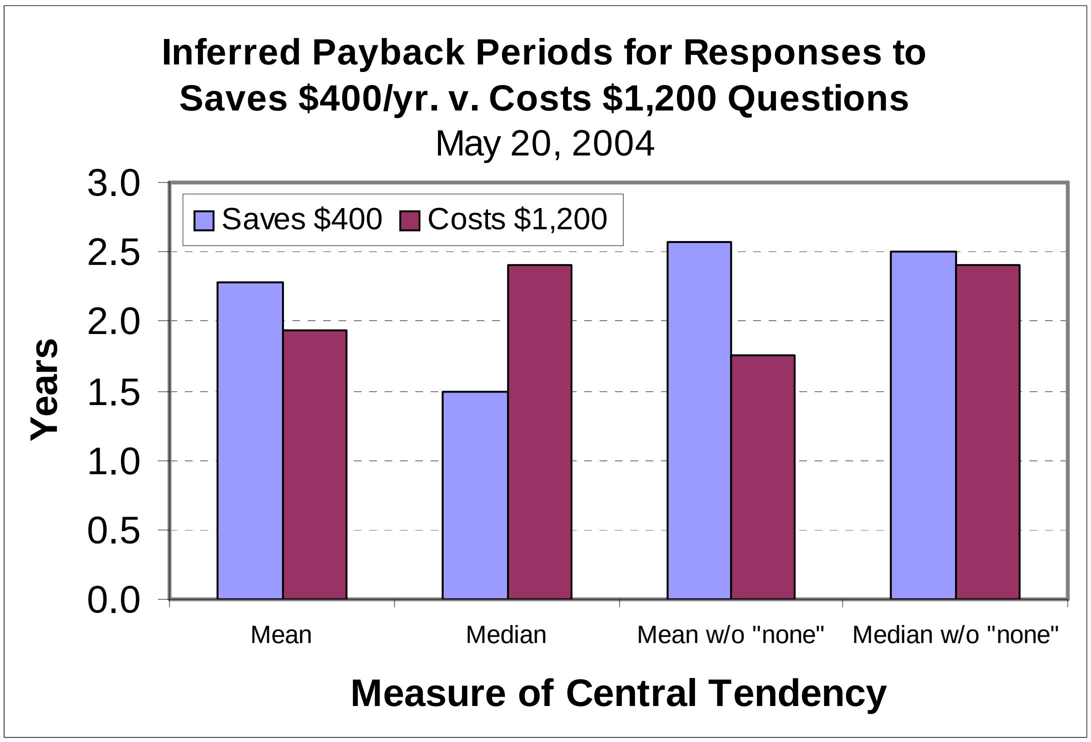

Figure 1. Consumers' Inferred Payback Periods for Fuel Economy Improvements
Source: Opinion Research Corporation, Caravan Survey for the U.S. Department of Energy, May 20, 2004.

Manufacturers say so. Some say that consumers consider only the first 50,000 miles of fuel savings. Other manufacturers have told me they believe payback periods of 2-4 years accurately reflect consumers' willingness to pay. I have yet to find a manufacturer who believes that consumers value the discounted present value of fuel savings over the full lifetime of a vehicle. What manufacturers think consumers are willing to pay is important because it is they who make the decisions about vehicle design and the use of fuel economy technologies.

Scientific research says so. What little scientific research has been done on the subject provides strong evidence that the simple model of an economically optimizing consumer who compares the cost of improved fuel economy to the discounted present value of fuel savings does not apply to consumers' decisions about fuel economy. Detailed interviews of 57 vehicle-owning households in California covering the complete histories of their car-buying decisions found not one that did any comparison of the value of fuel savings versus its cost. The U.C. Davis researchers concluded: "When consumers buy a vehicle, they have neither the motivation nor the basic building blocks of knowledge to make a calculated decision about fuel costs." (Turrentine and Kurani, 2004, p. 2)

It's not that consumers are irrational or uninformed. In fact, there is relatively little net gain (or loss) for consumers from increased fuel economy over a wide range of higher fuel economy levels. The National Research Council (NRC, 2002) Committee's estimates of the cost of increasing the fuel economy of an average passenger car, together with the present value of future fuel savings are plotted in figures 2 and 3 for gasoline prices of $1.50 and $2.00 per gallon (constant 2000 $). The economically rational consumer is concerned with the net value of the fuel economy improvement: the present value of fuel savings minus the increased vehicle price. If the price of gasoline is $2/gallon, as shown in Figure 2, almost $500 in net value can be gained by increasing miles per gallon from 28 to 32. But there is very little difference in net value between 32 and 41 mpg, about $100 or so. Figure 3 shows the same calculations at $1.50 per gallon. There is perhaps a difference of $250 in net value between 28 and 40 miles per gallon. Of course, the consumer doesn't know what the future price of gasoline will be any more than I do.

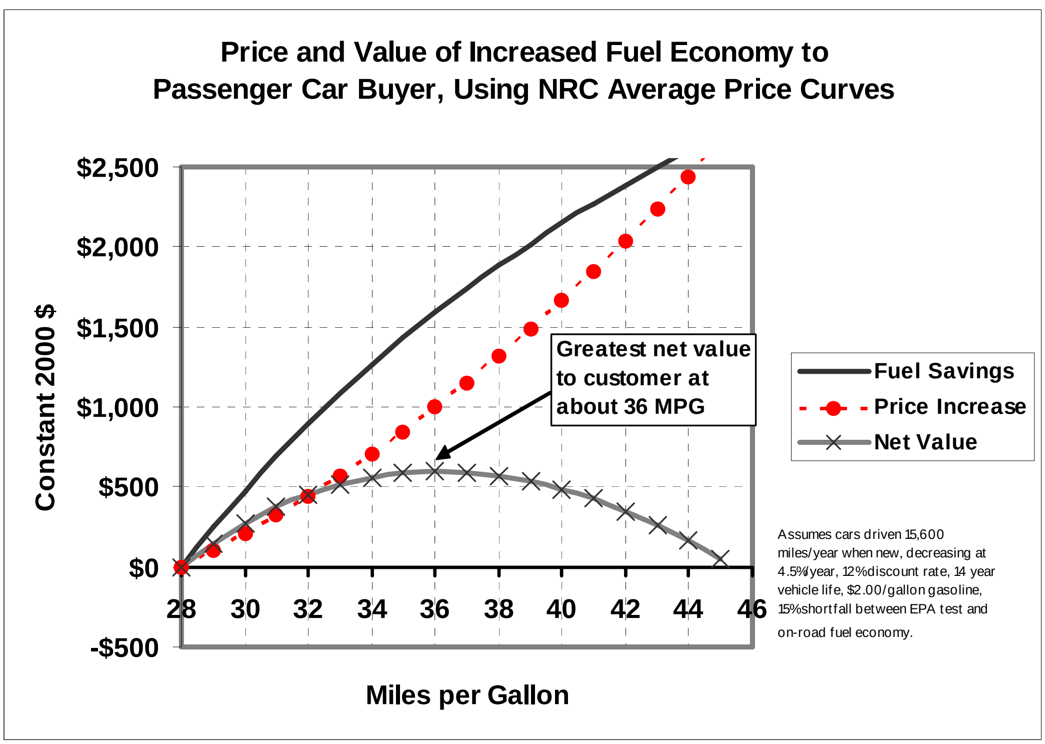

Figure 2. Net Value of Fuel Economy Improvement to Car Buyer Using the NRC 2002 Fuel Economy Cost Estimates and Assuming Gasoline Costs $2.00 (Constant 2000 $).

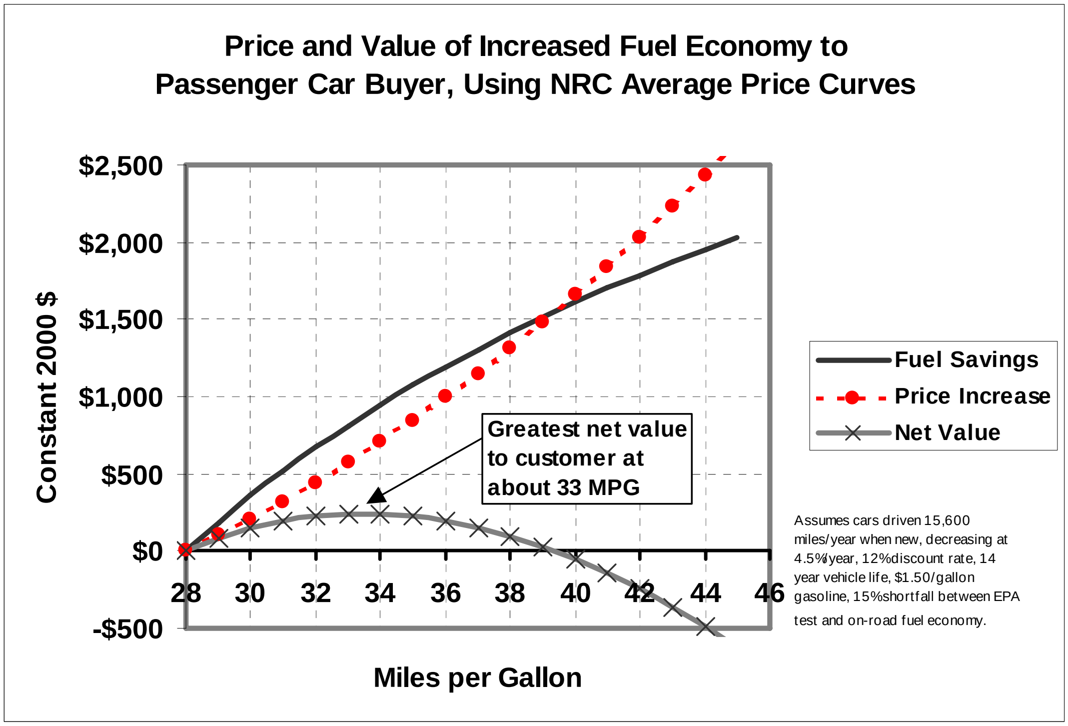

Figure 3. Net Value of Fuel Economy Improvement to Car Buyer Using the NRC 2002 Fuel Economy Cost Estimates and Assuming Gasoline Costs $1.50 (Constant 2000 $).

In addition, it is rare that a consumer finds a clear trade-off between fuel economy and cost. Higher fuel economy may come with a smaller engine, a manual transmission, or a completely different model. It's up to the consumer to infer what the price of higher fuel economy really is. Finally there is substantial uncertainty about the actual fuel economy a car will get on the road. Even if the EPA estimate is accurate on average, any given motorist might get 7 mpg less or 7 mpg more in actual use.

From the manufacturer's perspective, moving from a sales-weighted average of 28 to 40 miles per gallon would require completely redesigning all product lines, a project that would take 8-10 years and billion of dollars for engineering and retooling; all for a fuel economy increase about which individual car buyers are likely to be indifferent.

The NRC (2002) fuel economy study considered the undervaluing of fuel economy in their cost-efficient fuel economy calculations. (A fuel economy increase was considered cost-efficient if the marginal cost of the increase was less than or equal to the marginal benefit in fuel savings to the consumer). In estimating the cost-efficient levels of fuel economy achievable by near-term technologies, the NRC report considered two alternative ways consumers might value fuel economy. One assumed that car buyers compare the discounted present value of fuel savings over the full life of a vehicle to increased cost of fuel economy technologies needed to achieve it. The other assumed car buyers were willing to pay for technologies with a simple payback period of three years or less. Using the full lifetime method and assuming gasoline priced at $1.50 (constant 2000 $) per gallon, the NRC Committee estimated that fuel economy improvements of 12% to 27% were cost-efficient for passenger cars, and from 25% to 42% for light trucks;

the larger the vehicle, the larger the estimate percent fuel economy improvement. However, using the simple 3-year payback rule, the cost-efficient fuel economy changes ranged from -3% to +3% for cars and 2% to 15% for light trucks. Valuing fuel economy as both consumers and manufacturers say they do, little or no improvement was justified.

In June of 2006, at the request of Senators Biden, Lugar and Obama, I recalculated cost-efficient fuel economy levels using the NRC Committee's spreadsheet model but assuming gasoline prices of $2.50 and $3.05 (current $) per gallon and accounting for the discounted present value of fuel savings over the full lifetime of a vehicle. At these prices, the overall cost-efficient fuel economy improvements for the light-duty vehicle fleet were 41% and 50%, respectively.

Finally, the consumption of oil produces additional costs that are of great significance to us as a nation but are generally not considered by individuals in their car purchase decisions:

1. Economic costs of oil dependence
2. Military, strategic and foreign policy costs of oil dependence
3. Climate change impacts of carbon dioxide emissions
4. Other environmental impacts

By my estimates, the economic costs of oil dependence alone exceeded $300 billion last year. Military and foreign policy costs are extremely difficult to measure in dollars but in my opinion they are at least as great a problem for our nation. All of these additional costs of oil use are what economists call public goods (or bads). In general, consumers give them little or no weight in their individual purchase decisions. Such problems must be addressed by public policy if they are to be solved.

What policies will work?

While there are many policies that can reduce transportation petroleum consumption and greenhouse gas emissions, I will focus on those that can have the greatest impact on new vehicle fuel economy: fuel economy regulation, fuel economy fees and rebates ("feebates"), the price of gasoline, and research and development of new automotive technologies.

If the market for fuel economy were efficient, taxing gasoline would be an efficient solution. Since the market for fuel economy is not efficient, many governments have chosen to adopt fuel economy standards. The European Union, Japan, China, Canada, Australia, South Korea and the United States all have fuel economy standards for light-duty vehicles (An and Sauer, 2004). Japan has also recently successfully implemented fuel economy standards for heavy trucks. In many of these countries gasoline prices exceeded $4 and even $5 per gallon last year (EIA, 2006, table 11.8). Yet fuel economy standards are still needed because of the inefficiency of the market for fuel economy and because markets are not concerned with the public goods, such as energy security and preserving the global climate. Raising gasoline taxes is a less effective way to increase fuel economy than standards or feebates. Nevertheless, higher fuel taxes are an important complementary policy because they send a consistent message to consumers that reducing fuel consumption is important, they mitigate against the very small increase in driving that fuel economy increases would otherwise produce, and they can be used to offset the loss of revenues to maintain and improve transportation infrastructure that would otherwise occur.

Fuel economy and greenhouse gas emissions standards can take many forms. Japan and China's fuel economy standards vary with vehicle weight. The EU's greenhouse gas standards are a voluntary agreement on an industry-wide target between the government and industry. The U.S. Corporate Average Fuel Economy Standards require the sales weighted harmonic mean fuel economy of a manufacturer's imported and domestic passenger car fleets to meet a single fuel economy target. The target is the same for all manufacturers regardless of the types of vehicles they sell. The newly reformed light truck fuel economy standard assigns each manufacturer a different target depending on the "footprint" (wheelbase time track width) of the trucks it sells. The new reformed standard is likely, in my opinion, to prove to be an important and valuable innovation that could be extended to include the passenger car standards in a unified system. Unfortunately, the NHTSA did not do a thorough study of how vehicle designs might change under the new reformed standards and what the consequences of such changes might be. This study still needs to be done if we are to be confident that the new reformed system will not have significant unintended consequences.

Feebates are a market-based policy that circumvents the market failure of undervaluing fuel economy. A feebate system imposes fees on high fuel consumption vehicles and gives rebates to low fuel consumption vehicles. Fees increase in proportion to the gallons per mile by which a vehicle exceeds a target value and rebates increase in proportion to the gallons per mile by which a vehicle's fuel consumption is below the target value. Because the market signal is given at the time of vehicle purchase, feebates avoid the market failure that makes gasoline taxes relatively ineffective in promoting fuel economy. Today we have a partial feebate system in the form of gas-guzzler taxes that apply only to passenger cars.

Feebates have certain advantages over fuel economy standards. Because a fee avoided or a rebate gained is always valuable, there is a continuing incentive for manufacturers to adopt the latest technologies and apply them to improving fuel economy. Published studies show that feebates, like fuel economy standards, will work almost entirely through the adoption of fuel economy technology rather than by shifting the mix of vehicles sold. Feebate systems can be designed to be revenue neutral, revenue enhancing or a net cost to the government and net subsidy to industry and consumers. An appropriately designed feebate system can actually increase the sales revenues of vehicle manufacturers.

Feebates have the disadvantage that the quantity of fuel economy improvement is not certain, as it is with a fuel economy standard. Also, depending on how the feebate system is designed, some manufacturers will be net receivers of rebates while others will be net payers of fees. Such effects can be reduced by designing attribute based feebate systems, in the same way that the current light-truck fuel economy standards are adjusted according to the sizes of light trucks.

Future technological advances will expand the possibilities for efficiency improvement and substitution of clean alternative energy sources if industry, academia and government aggressively pursue research and development. I will not dwell on the importance of research and development of advanced automotive technologies but simply note that continued technological progress is essential. The technologies available today are amazing improvements over technologies available three decades ago. Still, they are not up to the task of reducing transportation's greenhouse gas emissions to acceptable levels nor of achieving sustainable, secure energy for transportation in the 21st century. To accomplish these goals we will need advanced vehicle and fuel technologies, and the sooner the better.

References

1. An, F. and A. Sauer, 2004. "Comparison of Passenger Vehicle Fuel Economy and Greenhouse Gas Emission Standards Around the World", Pew Center on Global Climate Change, Arlington, Virginia, December, 2004.
2. International Energy Agency (IEA), 2006. *World Energy Outlook 2006*, OECD, Paris.
3. National Research Council (NRC), 2002. *Effectiveness and Impact of Corporate Average Fuel Economy (CAFE) Standards*, National Academies Press, Washington, D.C.
4. Turrentine, T. and K. Kurani, 2005. "Automotive fuel economy in the purchase and use decisions of households", presented at the 2005 Annual Meeting of the Transportation Research Board, Washington, D.C., January, 2005.
5. U.S. Department of Energy, Energy Information Administration, 2006. *Annual Energy Review 2005*, DOE/EIA-0384(205), Washington, D.C.
6. U.S. Environmental Protection Agency (EPA), 2006. "Light-Duty Automotive Technology and Fuel Economy Trends: 1975 through 2006", EPA420-R-06-011, Office of Transportation and Air Quality, Ann Arbor, Michigan, July, 2006.