United States Government Accountability Office
Washington, DC 20548

November 7, 2008

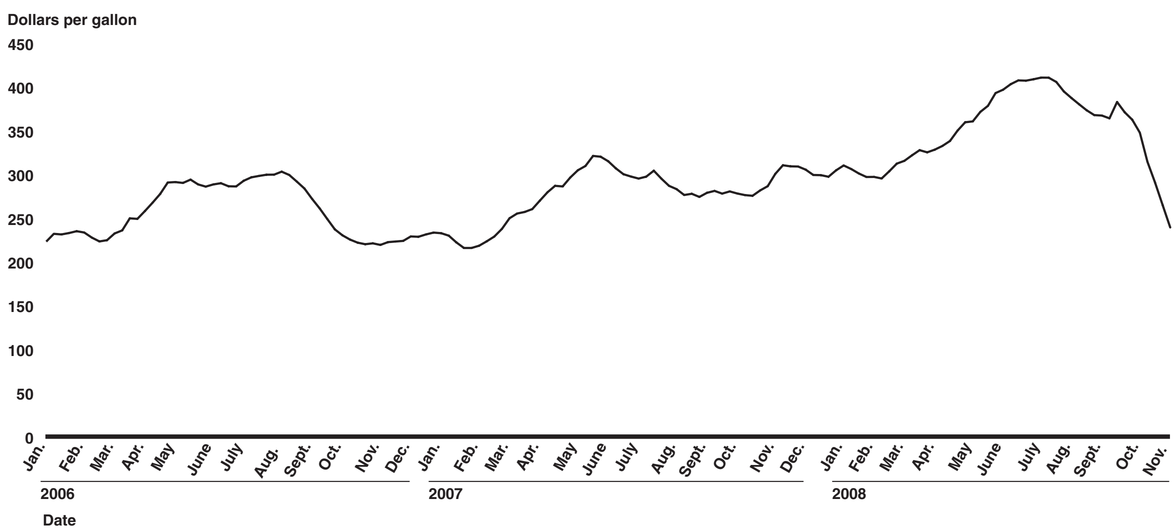
The Honorable John Warner
Ranking Member
Subcommittee on Private Sector and Consumer
Solutions to Global Warming and Wildlife Protection
Committee on Environment and Public Works
United States Senate

Subject: *Energy Efficiency: Potential Fuel Savings Generated by a National Speed Limit Would Be Influenced by Many Other Factors*

Dear Senator Warner:

Gasoline prices are volatile and have increased greatly over the last several years, before dropping again recently. The national average of regular grade retail gasoline prices increased from about $2.24 the week of January 2, 2006, to a peak of $4.11 the week of July 14, 2008, an increase of almost 84 percent, before dropping to about $2.40 the week of November 3, 2008 (see fig. 1).

Figure 1: Weekly U.S. Retail Gasoline Prices, Regular Grade, January 2006 through November 2008



Source: Energy Information Administration.

Note: Prices are in nominal terms and not adjusted for inflation.

High fuel prices have focused attention on conservation. Congress previously used a national speed limit as an approach to conserve fuel when, in 1974, it provided for a national 55 mile per hour (mph) speed limit to reduce gasoline consumption in response to the 1973 Arab oil embargo. The law prohibited federal funding of certain highway projects in any state with a maximum speed limit in excess of 55 mph.[1] In 1987, Congress allowed states to raise the maximum speed limit to 65 mph on rural interstate routes.[2] In 1995, the 55 mph speed limit was repealed.[3] Since then, states have been free to set speed limits without the loss of federal highway funds.

You expressed interest in obtaining information on using a national speed limit to reduce fuel consumption. In response to your request, we reviewed existing literature and consulted knowledgeable stakeholders on the following:

- What is the relationship between speed and the fuel economy of vehicles?
- How might reducing the speed limit affect fuel use?

To address these two objectives, we relied on the expertise of GAO and knowledgeable stakeholders to identify the most relevant economic and transportation literature. Due to limited time and resources, we reviewed these studies and limited our analyses to light-duty vehicles, such as cars, sport utility vehicles, and pickup trucks. We identified the knowledgeable stakeholders from previous relevant GAO work. (For more details, see encl. I.) We provided the draft to the three agencies that we spoke to—the Environmental Protection Agency (EPA), the Department of Energy (DOE), and the Department of Transportation (DOT)—and incorporated relevant technical comments. We did not examine other aspects of implementing a national speed limit, such as potential safety impacts.

In summary, according to these stakeholders and the relevant studies, reducing a vehicle's speed can potentially increase its fuel economy. However, the extent depends on a vehicle's characteristics, for example, its size and the efficiency of its engine and transmission. Furthermore, even though a lowered speed limit could reduce total fuel consumption, other factors—including driver behavior and road conditions and congestion—also affect fuel consumption.

According to Literature and Stakeholders, Reducing a Vehicle's Speed Can Potentially Increase Its Fuel Economy, Depending on the Vehicle's Characteristics

For a vehicle traveling at high speed, reducing its speed increases fuel economy. In general, at speeds over approximately 35 to 45 mph, if a vehicle reduces its speed by 5 mph, its fuel economy can increase by about 5 to 10 percent, because air resistance, or drag, increases exponentially as a vehicle goes faster.[4] Conversely, air resistance diminishes more rapidly as a vehicle slows down, thus increasing its fuel economy.

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[1]Pub. L. No. 93-239, §2, 87 Stat. 1046-1047 (1974). The prohibition on funding was extended indefinitely in 1975. Pub. L. No. 93-643, §154, 88 Stat. 2281, 2286 (1975).

[2]Pub. L. No. 100-17, §174, 101 Stat. 132, 218 (1987).

[3]Pub. L. No. 104-59, §205(d), 109 Stat. 568, 577 (1995).

[4]National Research Council, Committee for Study of Impacts of Highway Capacity Improvement on Air Quality and Energy Consumption, *Special Report 245, Expanding Metropolitan Highways:*

According to existing literature and knowledgeable stakeholders, there is no single speed that optimizes fuel economy for all vehicles. Optimal speed for fuel economy for individual vehicles ranges widely, but is generally between 30 and 60 mph, depending on a vehicle's characteristics. For example, according to the most recent published data—a 1997 study by Oak Ridge National Laboratory, commissioned by the Federal Highway Administration (FHWA), that examined fuel economy at different speeds for nine automobiles and light trucks from model years 1988 through 1997—the optimal fuel economy for a 1994 Jeep Grand Cherokee, a sport-utility vehicle, would be about 26 miles per gallon at a steady 40 mph. In contrast, in a 2008 internal study by the Argonne National Laboratory for the Department of Energy (DOE), examining four vehicles, the optimal fuel economy for a 2005 Toyota Echo, a subcompact car, is about 69 miles per gallon, achieved when traveling at a steady 30 mph. Table 1 shows the speeds at which the 13 vehicles included in those two studies achieve their optimal fuel economy.

Table 1: Optimal Speed for Fuel Economy for Studied Vehicles

Vehicle and year	Optimal steady speed (mph) for fuel economy	Miles per gallon
1997 Toyota Celica [a]	25	52.6
2005 Escape [b]	30	32.4
1993 Subaru Legacy [a]	30	39.7
2005 Echo [b]	30	69.0
1994 Jeep Grand Cherokee [a]	40	25.5
2005 Focus [b]	40	45.1
1994 Chevrolet Pickup [a]	45	27.3
1995 Geo Prizm [a]	45	42.3
1988 Chevrolet Corsica [a]	50	31.2
2005 Jaguar XJ8 [b]	50	37.8
1994 Oldsmobile Cutlass [a]	55	29.1
1994 Mercury Villager [a]	55	31.7
1994 Oldsmobile Olds 88 [a]	55	34.6

Source: GAO analysis of DOE and FHWA data.

Note: This table presents the most recently available data on speed and fuel economy for individual vehicles from two sources.

[a] B.H. West, R.N. McGill, J.W. Hodgson, S.S. Sluder, D.E. Smith, *Development and Verification of Light-Duty Modal Emissions and Fuel Consumption Values for Traffic Models*. (Washington, D.C.: April 1997), and additional project data, April 1998.

[b] Unpublished 2008 internal study by the Argonne National Laboratory for the Department of Energy (DOE).

Implications for Air Quality and Energy Use (Washington, D.C.: National Academy Press, 1995), p. 63.

However, a vehicle's fuel economy also depends on other factors besides air resistance. Factors that enhance fuel economy include engine efficiency enhancements (e.g., fuel injection), electronic and computer controls, more efficient transmissions, and hybrid technology. However, other factors decrease fuel economy (see fig. 2).

Figure 2: Impact of Automotive Characteristics on Fuel Economy

Automotive characteristics	Impact on fuel economy
Engine efficiency (e.g., fuel injection)	↑
Electronic and computer controls	↑
More efficient transmissions	↑
Hybrids	↑
Heavier vehicles	↓
Bigger, more powerful engines	↓
Increased accessory loads like air conditioning and electronics	↓

Source: GAO.

Note: Impact on fuel economy assumes that all other factors are held constant.

In general, over the last 2 decades, fuel economy gains resulting from advances in automotive technologies have largely been offset by increases in vehicle weight, performance, and accessory loads. Specifically, vehicles are heavier than in the past, because they are larger and include more technologies. For example, average vehicle weight has increased from 3,220 pounds in 1987 to 4,117 in 2008, according to the Environmental Protection Agency (EPA).[5] In addition, trends show that recent vehicles, on average, have bigger, more powerful engines that yield better performance—i.e., acceleration and greater speed—at the expense of fuel economy. For example, according to the same EPA report, average horsepower has increased from 118 to 222 over the same period. Further, increased accessory loads, such as air conditioning and electronics, have also reduced fuel economy. According to EPA, from 1987 through 2004, on a fleetwide basis, technology innovation was utilized

[5]*Light-Duty Automotive Technology and Fuel Economy Trends: 1975 through 2008* (Washington, D.C.: U.S. Environmental Protection Agency, September 2008)

exclusively to support market-driven attributes other than fuel economy, such as performance. Beginning in 2005, however, according to EPA's analysis of fuel economy trends, technology has been used to increase both performance and fuel economy, while keeping vehicle weight relatively constant.

According to Literature and Stakeholders, a Reduced Speed Limit Is Only One of Many Factors That Could Affect Total Fuel Use

Lowering speed limits can potentially reduce total fuel consumption. According to literature we reviewed examining the impact of the national speed limit enacted in 1974, the estimated fuel savings resulting from the 55 mph national speed limit ranged from 0.2 to 3 percent of annual gasoline consumption. According to DOE's 2008 estimate, a national speed limit of 55 mph could yield possible savings of 175,000 to 275,000 barrels of oil per day.[6] This range is consistent with estimates of the impact of the past national speed limit. According to the Energy Information Administration, total U.S. consumption of petroleum for 2007 was about 21 million barrels of oil per day.

However, other factors, including drivers' compliance with a reduced speed limit, would affect the actual impact of a lower speed limit on the amount of fuel savings. Reducing the speed limit does not necessarily mean that drivers will comply. In fact, in 1975, under the previous national speed limit, about half of the states reported more drivers exceeding the national speed limit of 55 mph than complying with it. States may vary in their ability to enforce the reduced speed limit, in part due to cost and limited resources, affecting driver compliance.

Moreover, a national speed limit would not affect many of the miles driven in the United States, such as those in urban areas, where most vehicles are already traveling at lower speeds due to lower speed limits or congestion. According to FHWA, fewer than one quarter of the vehicle miles traveled (VMT) in the United States would likely be directly affected by a changed speed limit. In addition, congestion forces some vehicles to travel slowly, no matter what the speed limit, meaning a reduction would have little or no impact on fuel consumed on congested roads.

Other external conditions also affect fuel economy, such as road conditions, including whether a road is steep or flat, and weather conditions, including wind speed and direction. Finally, other aspects of driver behavior may also affect fuel consumption. For example, driver behavior may be affected by fuel prices. Higher prices may cause people to drive less or purchase more fuel-efficient vehicles. Similarly, driving at a consistent speed can reduce fuel consumption. In contrast, aggressive driving such as accelerating or stopping quickly can increase fuel consumption. In addition, proper vehicle maintenance—including regularly changing automobile fluids and filters and properly inflating tires—improves fuel economy.

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[6]In calculating these estimates, DOE assumed, among other things, a compliance rate of 50 percent and that the speed limit would affect 35 percent of on-road (highway) mileage, which means roughly a third of travel is on roads where a decrease in the speed limit would have an effect. DOE's estimates include savings from on-road heavy duty trucks.

The speed limit is only one tool among many for potentially conserving fuel. Certain realities, such as congestion on our nation's roads, how people drive and maintain their vehicles, and emerging technologies, are other potential considerations as the nation looks for options to conserve fuel.

We are sending copies of this report to interested congressional committees, the Administrator of Environmental Protection Agency, the Secretary of Energy, and the Secretary of the Department of Transportation. We also will make copies available to others on request. In addition, this report will be available at no charge on the GAO Web site at http://www.gao.gov.

Sincerely yours,

Mark E. Gaffigan
Director, Natural Resources and Environment

Susan A. Fleming
Director, Physical Infrastructure

Enclosures-2

Enclosure I: Scope and Methodology

To identify literature pertaining to these two objectives, we relied on the expertise of GAO to conduct an initial search of economic and transportation literature. Through this search, we identified two seminal studies that summarized the relevant research through 1997. We subsequently conducted a search for literature published after 1997 in databases such as National Technical Information Service (NTIS), Transportation Research Information Services (TRIS), and EconLit using key words such as "speed limit" and "energy use." This search identified additional selected reports and studies issued by federal and state agencies, transportation and energy research organizations, and academia. We also interviewed officials from Department of Transportation, Department of Energy, and Environmental Protection Agency as well as representatives from various associations with relevant experience and knowledge and asked them to identify recent literature that may pertain to our two objectives. We identified the knowledgeable stakeholders from previous relevant GAO work.

Using these methods, we identified studies that were mentioned in both the literature and by the knowledgeable stakeholders. However, due to limited time and resources, we were only able to review a limited number of studies. As such, we identified a set of key studies from our list of relevant research to include in our review. We selected these studies judgmentally based on (1) relevance to the current work and (2) soundness of the methodology. A GAO economist and a technologist reviewed the methodology and scientific reasoning of these selected literature and found them to be sound and sufficiently reliable for the purposes of this report. Also, we limited our analyses to light-duty vehicles, such as cars, sport utility vehicles, and pickup trucks. We did not examine other aspects of implementing a national speed limit, such as potential safety impacts.

Enclosure II: GAO Contacts and Staff Acknowledgments

GAO Contact

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Staff Acknowledgments

In addition to the contacts named above, key contributors to this report were Karla Springer and Raymond Sendejas, Assistant Directors; Cindy Gilbert; Terence C. Lam; Tina Y. Paek; Madhav S. Panwar; Amy Rosewarne; Ilga Semeiks; Joseph D. Thompson; and Barbara Timmerman.

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