

Fuel Economy Standards and Risk in the Automotive Industry

Irene Berry

Virginia Polytechnic Institute and State University
2006 ASME WISE Intern

September 2, 2006

Table of Contents

Executive Summary ii

About the Author..... iii

About WISE..... iii

Issue Definition 1

Background..... 3

 Federal policies affecting fuel economy 3

 Comparison of fuel economy levels around the world 8

 Overview of technologies to improve fuel economy 10

 The nature of the automotive industry 11

Issues and Concerns..... 14

 Differences between automakers 14

 The impact of higher CAFE standards 22

 The impact of higher gas prices 24

 Potential effects on employment 27

Policy Implications 32

 CAFE standards 32

 Other policy options 35

 Policy Evaluation 36

Recommendations and Conclusions 41

Appendix A: Major Automakers 45

Appendix B: Most and Least Efficient Vehicles 46

Fuel Economy Standards and Risk in the Automotive Industry

Irene Berry

Virginia Polytechnic Institute and State University
2006 ASME WISE Intern
September 2, 2006

Executive Summary

The United States federal government regulates automobile efficiency through the Corporate Average Fuel Economy (CAFE) standards. Combining these standards with a consumer incentive, like a feebate, based only on efficiency would improve our overall fuel economy, while reducing risks to automakers and autoworkers.

Congress established the first CAFE standards with the Energy Policy and Conservation Act of 1975 (EPCA), which was a direct result of the Arab oil embargo of 1973 and 1974. The recent surge in gas prices has again inspired Congress to try and reduce our oil dependence. During the 109th Congress, members of both the Senate and House of Representatives proposed several bills to increase CAFE standards beyond their current levels.

CAFE standards have kept fuel economy levels above the level market forces alone would have achieved and have served as a floor on fuel economy. Once the price of gasoline fell in 1982, CAFE standards required automakers to maintain high fuel economy levels, even if consumer demand did not require it. However, among developed nations, the U.S. fuel economy levels are the lowest in the world.

One of the main arguments against increasing CAFE standards is that they put U.S. automakers and autoworkers at a competitive disadvantage. The automotive industry is an important part of the U.S. economy, accounting for 10 percent of all jobs. It invests more in R&D than any other industry, over \$16.9 billion in 2003.¹ To avoid negatively impacting the U.S. economy, policymakers should consider how fuel economy policies affect the automotive industry.

Producing automobiles is a very capital intensive and complex process that is affected by long product cycles and a relatively elastic demand for new vehicles. As a result, CAFE standards should be set based on economic and engineering analysis and should give automakers sufficient time to respond.

Although CAFE standards impact individual vehicle efficiency, they do not prepare automakers for future high gas prices or reduce automotive oil consumption. Because of a shift in consumer demand toward larger, less efficient, vehicles, our overall fuel economy has declined and domestic automakers are more dependent on sport utility and truck sales.

To improve fuel efficiency further and reduce the risks to the auto industry from higher gasoline prices, the federal government should create a consumer incentive to complement the CAFE standards. The incentive should encourage all car and truck buyers to purchase more efficient vehicles and should be based only on vehicle efficiency. To avoid straining the federal treasury, a feebate system that rewards buyers of fuel-efficient vehicles and penalizes buyers of inefficient vehicles at time of purchase is recommended.

¹ Raymond M. Wolfe, "Increase in U.S. Industrial R&D Expenditures Reported for 2003 Makes Up for Earlier Decline," National Science Foundation, December 2005.

About the Author

Irene Berry is an undergraduate student in mechanical engineering at Virginia Polytechnic Institute and State University (Virginia Tech). She will graduate in May 2007 with a bachelor's degree in mechanical engineering and an English minor in professional writing. Irene is an active member of the Hybrid Electric Vehicle Team at Virginia Tech and has interests in controls technology and energy policy. This paper was written for the Washington Internships for Students of Engineering (WISE) program in Summer 2006.

About WISE

Sponsored by several multidisciplinary engineering professional associations, Washington Internships for Students of Engineering (WISE) is a highly competitive internship program for undergraduate engineering students in their junior or senior year with an interest in public policy. The goal of the WISE program is to groom future leaders of the engineering profession who are aware of and can contribute to the intersections of technology and public policy. During the nine-week program, interns learn how government officials make decisions on complex technological issues and how engineers can contribute to legislative and regulatory policy decisions. In addition, each intern researches and presents a paper on an engineering-related public policy issue, which is then published in the WISE Journal of Engineering and Public Policy. More information about the WISE program is available at www.wise-intern.org.

Issue Definition

Oil use and dependence directly affects the national security, economy, and the environment of the United States, which imports 13.5 million barrels of petroleum every day from nations such as Saudi Arabia, Venezuela, Iraq, and Nigeria.² Over 8.9 million barrels of which are consumed by American automobiles as motor gasoline. U.S. vehicles account for 10 percent of worldwide oil use and over 40 percent of all U.S. consumption.³ In addition, our automobiles release 17 percent of all U.S. carbon dioxide emissions.⁴ Increased levels of carbon dioxide, one of the main greenhouse gases that traps heat inside the atmosphere, has been shown to have a role in global climate change.⁵ When oil prices are high, the increased costs of operating a vehicle trickle down, slowing economic growth and making consumer prices a political concern. Studies estimate that a two year price shock similar to the one in 1979 and 1980 would cost the U.S. economy around \$0.5 trillion.⁶ To reduce oil dependence, help fight global climate change, and decrease the cost of operating a vehicle, federal policy should help reduce the amount of oil used for personal transportation.

According to then Federal Reserve Chairman Alan Greenspan, in 2005 testimony before the Joint Economic Committee, "it will take time and an appreciable increase in the fuel economy of our stock of motor vehicles to fundamentally change the amount of motor fuel used

² Energy Information Administration (EIA), "Annual Energy Review 2005," U.S. Department of Energy, 27 July 2006, accessed 1 August 2006; available from <http://www.eia.doe.gov/emeu/aer/contents.html>.

³ Ibid.

⁴ U.S. Environmental Protection Agency (EPA), "US Emissions Inventory 2006," 15 April 2006, accessed 27 July 2006; available from [http://yosemite.epa.gov/oar/globalwarming.nsf/UniqueKeyLookup/RAMR6MBSC3/\\$File/06_Complete_Report.pdf](http://yosemite.epa.gov/oar/globalwarming.nsf/UniqueKeyLookup/RAMR6MBSC3/$File/06_Complete_Report.pdf).

⁵ Pew Center on Global Climate Change, "Global Warming Basics," accessed 18 July 2006; available from: <http://www.pewclimate.org/global-warming-basics/>.

⁶ David L. Greene, Donald W. Jones, and Paul N. Leiby, "The outlook for US oil dependence," *Energy Policy*, 26-1 (Jan 1998): 55-69.

on our nation's highways."⁷ The fuel economy of a vehicle is a measure of its efficiency and is usually expressed in miles per gallon (mpg). Increasing the efficiency of our vehicles just five percent each year would reduce oil consumption by 1.5 million barrels of oil a day by 2010.⁸

There are many policy options available to encourage such a shift. However, the primary federal policy is the regulation of fuel economy through the Corporate Average Fuel Economy (CAFE) standards. Congress established the first CAFE standards in 1975 with the Energy Policy and Conservation Act of 1975 (EPCA). This act was a direct result of the Arab oil embargo of 1973 and 1974, which caused oil prices to triple and brought our dependence on Middle East oil into focus.⁹ The recent surge in gas prices has again inspired Congress to try and reduce our oil dependence. During the 109th Congress, members of both the Senate and the House of Representatives proposed several bills to increase CAFE standards beyond their current levels.

There are many issues in the debate over fuel economy. One of the largest arguments against CAFE standards is that they hurt U.S. automakers and put the U.S. auto industry at a competitive disadvantage. With the current financial difficulties at Ford and General Motors (GM), this argument is particularly pertinent. The automotive industry is an important part of the U.S. economy. Jobs related to new vehicle manufacture, sale, and use account for 10% of all U.S. jobs, 3.5 million in direct employment and an additional 3.1 million in spin-off effects.¹⁰ In

⁷ Alan Greenspan, "Statement before the Joint Economic Committee," 3 November 2005, accessed 29 July 2006; available from http://jec.senate.gov/democrats/Documents/Hearings/greenspan_testimony03nov2005.pdf.

⁸ American Council for an Energy-Efficient Economy (ACEEE), "Vehicle Fuel Economy Standards: Big Energy Savings at a Modest Cost," accessed 5 July 2006; available from <http://www.aceee.org/energy/cafe.htm>.

⁹ Robert Bamberger, "Automobile and Light Truck Fuel Economy: The CAFE Standards," Congressional Research Service, The Library of Congress, 20 January 2006, order code IB90122.

¹⁰ Sean P. McAlinden, Kim Hill, and Bernard Swiecki, "Economic Contribution of the Automotive Industry to the U.S. Economy – An Update," Center for Automotive Research (CAR), Fall 2003, accessed 17 June 2006; available from <http://www.cargroup.org/pdfs/Alliance-Final.pdf>.

addition, the auto industry invests more in R&D than any other industry, over \$16.9 million in 2003 compared to only \$15.9 million by the pharmaceutical and medical industries.¹¹ To avoid negatively impacting the entire economy, policymakers should consider how fuel economy policies affect the auto industry.

This paper addresses the impact fuel economy standards have on U.S. automakers and autoworkers by examining current federal fuel economy policy, the nature of the automotive industry and the difference between automakers, and the technologies for improving fuel economy. The risks of higher CAFE standards and the risks of higher oil prices are also analyzed along with policy options.

Background

To understand the current debate over fuel economy, it is important to first examine the policies of fuel economy in the U.S., the nature of the automotive industry, and the technologies available to improve vehicle efficiency.

Federal policies set fuel economy standards for passenger cars and light-duty trucks sold in the U.S.

A variety of federal policies now affect fuel economy. A gas-guzzler tax penalizes people who purchase passenger cars with particularly low mileage, and tax incentives reward people for purchasing hybrid vehicles. However, the federal government's primary policies governing vehicle fuel economy are the CAFE standards begun in 1975. Many provisions of the standards address concerns about impact on the auto industry. EPCA set fuel economy standards as a corporate average to give manufacturers the maximum amount of flexibility. The CAFE of each

¹¹ Raymond M. Wolfe, "Increase in U.S. Industrial R&D Expenditures Reported for 2003 Makes Up for Earlier Decline," National Science Foundation, December 2005.

automaker is the average fuel economy of the vehicles it produces in a given model year (MY). For example, if for MY2006, a company makes 100 cars with a fuel economy of 20 mpg and 10 cars with a fuel economy of 40 mpg, its CAFE for the year is 21.8 mpg.¹² Individual vehicles are not required to meet the standard. To be profitable companies must sell all the vehicles they produce. For this reason, CAFE depends on the fuel economy of the vehicles a company sells.

EPCA distinguished between passenger cars and light trucks,¹³ as well as between U.S.-made and imported vehicles. In 1975, light-duty trucks represented only a small portion of the total fleet and were used primarily for farming and other commercial purposes. To maximize the flexibility of regulations for these vehicles, Congress gave authority over light truck CAFE standards to the Secretary of Transportation. Within the Department of Transportation, the National Highway Traffic Safety Administration (NHTSA) sets light truck CAFE standards. Congress continues to control passenger car standards and further distinguishes between domestically produced and imported vehicles. This distinction was created to abate fears that CAFE standards would adversely affect U.S. automotive employment. The average fuel economy of a firm's imported vehicles and the average fuel economy of its U.S.-made vehicles must both comply with the standard.¹⁴ NHTSA imposed a similar "two-fleet" rule for light trucks beginning in MY1980, but removed it for MY1996 and beyond.¹⁵

EPCA set the first passenger car CAFE standard at 18.0 mpg for MY1978 and 27.5 mpg by MY1985. This amounted to a doubling of new vehicle fuel economy from its 1974 average of

¹² All fuel economy values in this paper are the laboratory CAFE values used by NHTSA to determine compliance with the CAFE standards, not the fuel economy values shown on car stickers.

¹³ A light truck is a 4-wheel vehicle that was designed for off-road operation, can transport more than 10 people, can provide temporary living quarters, has an open bed, has more cargo space than passenger space, or can be changed to have an open bed by removing the rear seats. Source: National Highway Traffic Safety Administration (NHTSA), "CAFE Overview – Frequently Asked Questions," accessed 10 July 2006; available from <http://www.nhtsa.dot.gov/cars/rules/CAFE/overview.htm>.

¹⁴ D. L. Greene, S. Plotkin, and K.G. Duleep, "Examining the Potential for Voluntary Fuel Economy Standards in the United States and Canada," Argonne National Laboratory, October 2002.

¹⁵ NHTSA engineers are in the process of evaluating the impact of the two-fleet rule for passenger cars.

just 12.9 mpg.¹⁶ NHTSA set the first light-duty truck CAFE standard for MY1978 and increased it each year until MY1986. When oil prices dipped in the mid 1980s, customer demand for fuel-efficient vehicles dropped, and the mix of vehicles a manufacturer could sell shifted. This put automakers under tighter economic pressure to meet CAFE standards. NHTSA relaxed both the light truck and passenger car standards from MY1986 until MY1989 out of concern for the industry. NHTSA returned the passenger car standard back to its previous level for MY1989, and Congress has not raised the level since.¹⁷ NHTSA continued to increase light truck standards from MY1989 until MY1996. In 1994, as a result of a switch in control of Congress and concerns over the impact proposed changes to the light truck CAFE standards would have on automakers, Congress prohibited NHTSA from using appropriated funds to set CAFE standards. Because of this, light truck standards remained at a constant 20.7 mpg from MY1996 until MY2005, when Congress once again gave NHTSA authority to set new standards. NHTSA's MY2005-2007 CAFE rule raises light truck standards to 22.2 mg by MY2007.¹⁸

NHTSA is directed by Congress to establish "maximum feasible" CAFE standards for light trucks that balance technical feasibility, economic feasibility, and the nation's need to conserve oil as well as the impact of other automotive regulations. Concerns over industry competitiveness are addressed by finding the maximum "cost-effective" fuel economy level – from the consumer's perspective. Beginning with actual product plans, NHTSA engineers model the addition of various technologies to improve fuel efficiency. They estimate both the increase in vehicle price and the value of the fuel saved. A fuel economy level is deemed cost-effective if the increase in price from the added technologies will be recovered through fuel saving within a certain number of years. NHTSA also takes the ability of the "least capable" full

¹⁶ Bamberger.

¹⁷ Ibid.

¹⁸ Ibid.

line manufacturer into account. Consequentially, light truck CAFE standards pressure automakers to achieve economically attainable and proven fuel economy improvements.

In March of 2006, NHTSA made several changes to the structure of its CAFE standards for light trucks. These changes were aimed at addressing automaker's concerns that the standards do not apply equally to all producers and that the previous system encouraged automakers to reduce vehicle safety. The final CAFE rule for light truck MYs 2008-2011 established CAFE standards based on vehicle "footprint"¹⁹ instead of weight and set specific standards for each manufacturer instead of a single, uniform standard.²⁰ These Reformed CAFE standards are based on a sliding fuel economy standard for each footprint. They are generally accepted as a significant improvement over previous CAFE standards. However, several environmental and conservation groups have filed a lawsuit over concerns that NHTSA "failed to follow the law by setting fuel economy standards below the technically feasible level."²¹ For MYs 2008-2010, automakers have the option of meeting either unreformed or Reformed CAFE standards. Therefore, the Reformed standards do not truly go into affect until MY2011 so their effectiveness cannot presently be evaluated. Figure 1 shows the CAFE standards for MY1978 to MY2010. Light truck CAFE standards increased only marginally between 1985 and 2005, and passenger car standards have remained the same since MY1990.

¹⁹ The vehicle footprint is the product of the vehicle's wheelbase and track width, and reflects vehicle size.

²⁰ NHTSA, "Average Fuel Economy Standards for Light Trucks Model Years 2008-2011."

²¹ Sierra Club, "Lawsuit, Website Take on Bush Administration over CAFE," 23 May 2006, accessed 29 July 2006; available from <http://www.sierraclub.org/pressroom/releases/pr2006-05-23.asp>.

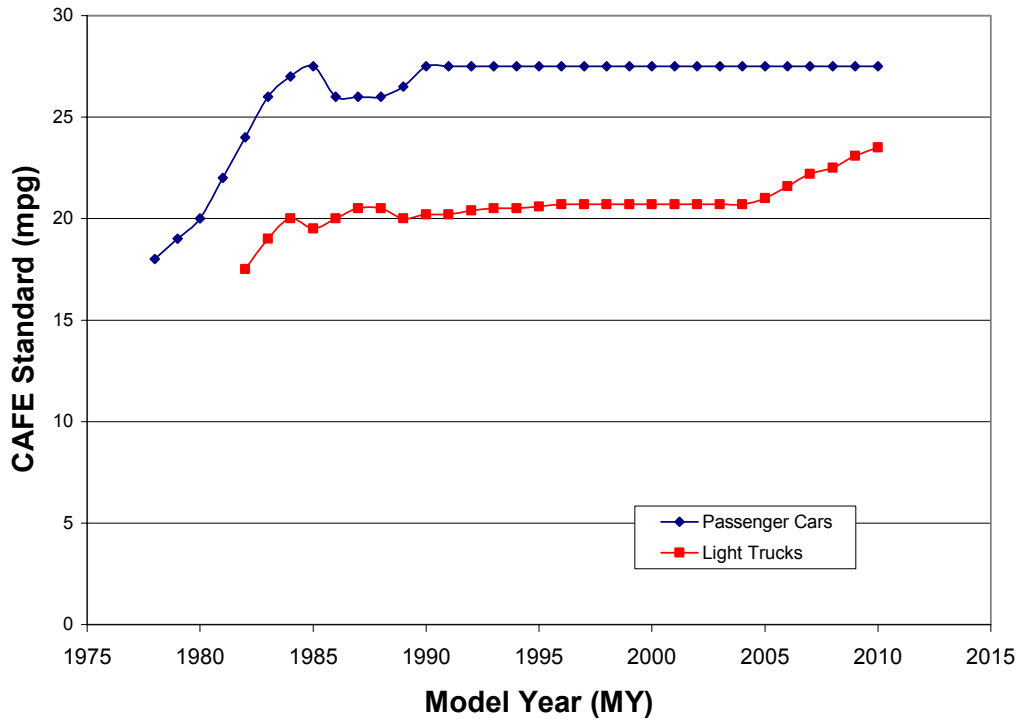


Figure 1. Passenger car and light truck CAFE standards in the U.S. for MY1978 through MY2007. Light truck CAFE standards for MY1979 to MY1981 were separated into two-wheel and four-wheel drive standards and are not shown. MYs 2008-2010 standards are based on unreformed CAFE standards for light trucks. Source: Bamberger (MYs 1975 – 2005) and NHTSA, “Average Fuel Economy Standards for Light Trucks Model Years 2008-2011” (MYs 2007 – 2010).

Other policies have also been used to improve fuel economy in the U.S. The Energy Tax Act of 1978 imposed a gas-guzzler tax on passenger cars with particularly low fuel economy. Cars that have gas mileage below 22.5 are taxed on a sliding scale from \$1,000 for a car with mileage between 22.5 and 22.0 mpg to \$7,700 for a car with fuel economy below 12.5 mpg.²² There is no comparable tax for light trucks. Beginning in 2002, a tax incentive by the federal government allowed consumers to deduct \$2,000 from their taxes if they purchased a certified hybrid vehicle during that tax year. The Energy Policy Act of 2005 changed this to a \$2,000 tax

²² National Research Council (NRC), “Effectiveness and Impact of Corporate Average Fuel Economy (CAFE) Standards,” National Academy of Sciences, 2002, accessed 9 June 2006; available from <http://newton.nap.edu/catalog/10172.html>.

credit to further motivate the market for hybrids.²³ In addition, twenty-two states offer some form of tax incentive for the purchase of advanced technology or alternative fuel vehicles. These include free parking, the ability to use high occupancy vehicle (HOV) lanes regardless of the number of passengers, exemption from sales tax or registration fees, and tax credits. Some companies have also begun offering incentives to encourage their employees to purchase and drive hybrid cars.²⁴

Of the world's largest automotive markets, the U.S. vehicle fleet has the lowest fuel economy.

Analysis for the Pew Center on Global Climate Change compared policies and market forces around the world and converted them into equivalent CAFE standards. Of the six national markets they considered (the U.S., Canada, China, Japan, the European Union, and Australia), the U.S. had the lowest fleet fuel economy. Japan and Europe have the highest equivalent CAFE levels. The Chinese fuel economy standards are the most inflexible; however, there is great uncertainty about the extent to which these standards will actually be enforced.²⁵

Differences in driving conditions and consumer preferences around the world account for many of the differences in fuel economy. Roads are smaller in Europe and Japan, and parking is limited. In addition, people spend more time driving in city and urban areas than on the highway. These characteristics make smaller cars more preferable than the sport utility vehicles (SUVs) and large vehicles common in the U.S. The price of fuel also affects consumer

²³Internal Revenue Service, "Deduction For Hybrid Vehicles: IRS Tax Tip 2006-56," accessed 3 July 2006; available from <http://www.irs.gov/newsroom/article/0..id=107766.00.html>.

²⁴ Hybridcars.com, "Local and Regional Hybrid Car Incentives," accessed 7 July 2006; available from <http://www.hybridcars.com/incentives.html>.

²⁵ Feng An and Amanda Sauer, "Comparison of Passenger Vehicle Fuel Economy and GHG Emission Standards Around the World," Pew Center on Global Climate Change, December 2004, accessed 15 July 2006; available from <http://www.pewclimate.org/docUploads/Fuel%20Economy%20and%20GHG%20Standards%5F010605%5F110719%2Epdf>.

preference. Both gasoline and diesel are taxed heavily abroad.²⁶ In 2004, while regular unleaded gasoline cost an average of \$1.88 per gallon in the U.S.; it cost \$5.24 in Germany, \$4.51 in South Korea, \$3.93 in Japan, and \$2.72 in Australia.²⁷ These higher prices encourage consumers to value fuel economy.

GM and Ford sell vehicles with higher gas mileage in Europe and Asia than they do in the U.S. Ford's Chinese vehicle fleet is one of the most well positioned to meet the new Chinese fuel economy standards for 2008. While fleets at GM, Nissan, DaimlerChrysler, and VW all required more than a 10 percent increase in fuel economy, Ford's fleet would meet the new standard with only a 2 percent improvement.²⁸

However, automakers cannot just transport vehicles they sell in Europe or Japan to the U.S., and begin selling them. Every country sets its own safety and emissions standards. Automakers must demonstrate compliance with these standards through certification testing which can be expensive and take a long time to complete. Because the U.S. has some of the strictest regulations, automakers may need to modify a vehicle design to improve its safety or reduce its nitrogen oxide, particulate, or hydrocarbon emissions.²⁹ In addition, American consumers demand more power and performance. Vehicles that do not meet these expectations are not expected to sell well. These differences between the U.S. and global markets mean that simply increasing U.S. CAFE standards will not necessarily make domestic automakers more competitive internationally.

²⁶ Greene, Plotkin, and Duleep.

²⁷ EIA, "Annual Energy Review 2005."

²⁸ Amanda Sauer and Fred Wellington, "Taking the High Road," World Resources Institute, 2004, accessed 20 June 2006; available from http://pdf.wri.org/china_the_high_road.pdf.

²⁹ Greene, Plotkin, and Duleep.

The technologies exist to significantly improve fuel economy in both the near- and long-term.

Higher fuel economy levels around the world demonstrate the potential to improve American fuel economy. Many of these improvements could come from “conventional” technologies that increase overall vehicle efficiency. Changes in vehicle weight, transmission, aerodynamic drag, and fuel injection accounted for roughly 70 percent of the fuel economy increases between 1976 and 1989.³⁰ Similar changes today could improve vehicle fuel economy by as much as 20 percent.³¹ They include variable valve timing, cylinder deactivation, direct injection, engine supercharging, higher transmission speed, continuously variable transmission, and aerodynamic drag reduction. These technologies have been demonstrated successfully and could be incorporated into production vehicles at any time if they have not already.

More advanced technologies such as hybrid-electric vehicles and clean diesels will significantly increase efficiency over the next 5 to 10 years. Hybrid-electric and clean diesel technologies offer the potential for huge increases in efficiency without reductions in performance. Depending on the type and design of the system, a hybrid vehicle can improve fuel economy by as much as 40 percent while increasing torque by up to 20 percent. Only high costs keep hybrid systems from significantly gaining market share. A hybrid system can add as much as \$5,000 or \$10,000 to the cost of producing a vehicle.³² Clean diesels also have huge potential. A gallon of diesel fuel contains roughly 10 percent more energy than a gallon of gasoline; this translates into a similar increase in fuel efficiency. By design, diesel engines are also more efficient. They also offer approximately 25 percent more torque than a conventional

³⁰ Bamberger.

³¹ Jerry Mader and Richard J. Gerth, “The Advanced Power Technology Dilemma: From Hydrocarbons to Hydrogen,” CAR, March 2004, assessed 20 July 2006; available from http://www.cargroup.org/pdfs/CAR%20WHITE%20PAPER_Final%20_Mar04.pdf.

³² Ibid.

gasoline engine. Diesel sales are affected by a number of issues including poor public perception and questions over a diesel's ability to meet tighter emissions standards. However, if diesel technologies advance enough to meet Tier 2 emissions standards³³ and hybrid prices continue to fall; the Department of Energy (DOE) predicts that diesels and hybrids could capture up to 20 percent of the market by 2012.³⁴

In the more distant future, fuel cells and alternative fuels have the potential to further reduce automotive oil consumption. Plug-in hybrids are also being developed, and sufficient improvements in battery technologies will enable the production of a successful electric vehicle in the future.

The automotive industry has many risks.

There are a variety of technical and market uncertainties that make introducing new technologies risky for automakers. Producing an automobile is a capital and labor intensive process that is affected by long product cycles, heavy government regulation, globalization, and elasticity and uncertainty in the demand for new vehicles.

Automakers must invest substantially in time, resources, and labor to produce a new car or light truck. In 2005, the average vehicle contained original equipment parts worth \$13,346.³⁵ Labor costs add between \$500 and \$3,000 per vehicle.³⁶ In addition, the costs of creating a

³³ The EPA's Tier 2 emission standards hold all passenger vehicles (including light trucks and diesels) to the same standard. Source: Brent D. Yacobucci, "Sport Utility Vehicles, Mini-Vans, and Light Trucks: An Overview of Fuel Economy and Emissions Standards," Congressional Research Service, The Library of Congress, 17 December 2004, order code RS20298.

³⁴ David L. Greene, K.G. Duleep, and Walter McManus, "Future Potential of Hybrid and Diesel Powertrains in the U.S. Light-Duty Vehicle Market," Oak Ridge National Laboratory (ORNL), August 2004, assessed 26 June 2006; available from http://www-cta.ornl.gov/cta/Publications/Reports/ORNL_TM_2004_181_HybridDiesel.pdf.

³⁵ Department of Commerce, "U.S. Automotive Parts Industry Annual Assessment," April 2006, accessed 19 July 2006; available from <http://www.ita.doc.gov/td/auto/domestic/2006Parts.pdf>.

³⁶ Walter McManus, "The State of the Auto Industry," University of Michigan, Transportation Research Institute (UMTRI), Automotive Analysis Division (Formerly OSAT), 24 January 2006, assessed 8 July 2006; available from <http://www.osat.umich.edu/research/economic/SofAuto2005.pdf>.

production line are enormous; Nissan recently spent over \$1.4 billion to build a truck plant in Mississippi.³⁷ Engineering and certification costs further increase an automaker's investment. Recovering these costs while maintaining vehicle prices that consumers will pay requires automakers to produce on economies of scale. This means making the same vehicle for 3 to 5 years. For less financially stable companies, model cycles are even longer. These long cycles mean that automakers must set production plans several years in advance.

Government regulation also plays a key role in the auto market. Due to the many societal externalities³⁸ associated with driving a vehicle, the industry is highly regulated. The federal government sets safety standards and emissions standards in addition to fuel economy standards. These regulations sometimes conflict with one another. For example, adding air bags to increase vehicle safety increases vehicle weight, negatively affecting fuel economy. Furthermore, financial resources spent improving vehicle safety or reducing emissions cannot be spent improving fuel economy or other performance characteristics.

Globalization and industry consolidation are redefining automotive competitiveness. Companies now have access to markets around the world, giving them more options for vehicle production. For example, Ford sells vehicles in 105 markets around the world,³⁹ while GM has operations in over 40 different countries.⁴⁰ At the same time, fewer companies are competing in the world automotive market. In the 1960s, there were over 50 independent automakers in the

³⁷ Sholnn Freeman, "Nissan's Turnaround Threatens to Skid," *The Washington Post*, 25 July 2006, D01, accessed 26 July 2006; available from <http://www.washingtonpost.com/wp-dyn/content/article/2006/07/24/AR2006072400977.html>.

³⁸ An externality is a cost from the use of a product or service that is not paid by either the customer or the producer, but by society.

³⁹ Ford Motor Company, "Annual Report 2005," 9 March 2006, accessed 28 June 2006; available from http://www.ford.com/NR/rdonlyres/emwjt42turmgvsborq7bqproy43vwnf4cztbl56l4oos4sf545rswt6jdh3gap4juvgevyld4g43xxky6y5znoot/2005_AR_full.pdf.

⁴⁰ General Motors Corporation (GM), "General Motors Corporation 2005 Annual Report," accessed 28 June 2006; available from http://www.gm.com/company/investor_information/docs/fin_data/gm05ar/download/gm05ar.pdf.

world; by 2004 there were only 12.⁴¹ This consolidation of resources is strengthening the capabilities of the remaining firms, making competition between them fierce. Because the U.S. is the largest and most profitable auto market in the world,⁴² it is becoming one of the most competitive.

Competition is intensified by the elastic demand for new vehicles. While demand for some products is relatively inelastic and does not change even if prices do, short-term demand for vehicles is elastic.⁴³ Any increase in vehicle price will cause demand to decrease by an even greater percentage. This effect is intensified by the maturity of the U.S. market. Over 80 percent of new vehicle sales in 2005 were replacements, not fleet additions.⁴⁴ When people are not satisfied with new vehicles options or prices, they buy fewer vehicles. Because of the many vehicle models on the market, demand for individual brands or types is particularly elastic.

Consumer preferences and perceptions are difficult to change. Because early diesel cars in the U.S. were noisy and dirty with poor performance, the public developed a negative perception of them that is only now beginning to fade. For a technology that is still being developed, speedy market integration is particularly risky. Significant advances in a technology after it has already been commercialized will cause earlier versions to lose value quickly. GM recognized this risk when it began selling the EV1, its first electric vehicle, in California. Out of

⁴¹ John E. Cunningham, Umar Riaz, and Eric J. Johnson, "Life in the Fast Lane," Outlook Journal, Accenture, October 2004, accessed 5 July 2006; available from http://www.accenture.com/Global/Research_and_Insights/By_Subject/High_Performance_Business/LifeOutlook.htm.

⁴² McManus.

⁴³ Pinelopi Koujianou Goldberg, "The effects of the Corporate Average Fuel Efficiency Standards in the U.S.," The Journal of Industrial Economics, 46 (1998): 1–33.

⁴⁴ McManus.

fear that the vehicle would become obsolete or need constant repair, GM chose to lease them instead of selling them.⁴⁵

Because of the nature of the industry, automakers tend to introduce new technologies to the market slowly to minimize risk. Initially, a new technology is usually incorporated into only one product line. This allows companies to test the market before expanding production and staggers the costs of eventual fleet-wide adoption. According to the National Academy of Sciences (NAS) committee that evaluated the effectiveness of CAFE standards, for even an existing and proven technology, market penetration could take four to eight years.⁴⁶ To fully replace the previous technology could take as long as 10 to 15 years.⁴⁷

Issues and Concerns

Federal fuel economy policy is related to a broad number of issues and concerns. This section explores the differences between automakers, the risks associated with higher CAFE standards, the risks of a future increase in gasoline prices, and potential impacts on domestic auto employment.

There are clear differences between automakers that affect their ability to improve fleet fuel economy levels.

The major domestic automakers are GM, Ford, and the Chrysler Group of DaimlerChrysler, otherwise known as the “Big Three” because of their domination of the American auto market beginning after World War I when they held three fourths of the American

⁴⁵ NRC.

⁴⁶ Ibid.

⁴⁷ Andy Burke, Ethan Abeles, and Belinda Chen, "The Response of the Auto Industry and Consumers to Changes in the Exhaust Emission and Fuel Economy Standards (1975-2003): A Historical Review of Changes in Technology, Prices and Sales of Various Classes of Vehicles" *Institute of Transportation Studies*, 1 June 2006, Paper UCD-ITS-RR-04-4.

automotive market.⁴⁸ The other major firms that sell in the U.S. are Toyota, Honda, Nissan, Hyundai-Kia, and VW. Partnerships and alliances between these and other automakers complicate the task of trying to distinguish between them. However, based on government, investment, academic, and news reports, several distinctions can be established. Appendix A lists the individual members, assets, income, and production numbers for these firms in 2005.

The characteristics of each automaker that are most important in the debate over fuel economy are: current CAFE level, fleet mix, technology development, production line flexibility, and general financial situation.

Current CAFE levels

Although each automaker must meet the CAFE standards or pay a fee, actual fuel economy levels vary. A uniform increase in CAFE standards would affect U.S. manufacturers most. As shown in Table 1, Toyota, Honda, Mitsubishi, and Hyundai have the highest passenger car CAFE. For MY2005, Toyota's imported passenger cars had a CAFE 7.6 mpg above the standard, while its domestically produced fleet was 6.8 mpg above the standard. For light trucks, the CAFE levels of automakers were clustered close to the standard. Six of the ten automakers studied, including the Big Three, had CAFE levels within 1 mpg of the light truck standard. Only Toyota, Honda, Mitsubishi, and Hyundai exceeded the standard by more than 2 mpg.

The Environmental Protection Agency (EPA) analyses the passenger car, light truck, and combined (passenger car and light truck) CAFE of automakers each year. This analysis shows that although there are differences in the CAFE levels of automakers, they are closer

⁴⁸ "Automotive industry," *Encyclopædia Britannica*, Encyclopædia Britannica Online, 2006, accessed 31 July 2006; available from <http://search.eb.com/eb/article-65772>.

today than they were in 1987. The greatest difference in CAFE levels for MY2005 is roughly 5 mpg. In 1987, differences were as high as 8 mpg.⁴⁹ Honda and Toyota have the highest combined CAFE levels. For MY2006, Honda's fleet has an average fuel economy of 28.3 mpg and Toyota's averages 27.9 mpg. VW and Hyundai-Kia follow with combined fuel economy levels close to 27.5 mpg. Nissan is next at 24.1 mpg. GM has the highest combined CAFE of the Big Three at 24.0 mpg.⁵⁰ Ford and DaimlerChrysler trail GM slightly at 23.0 mpg and 22.3 mpg, respectively.⁵¹

Table 1. MY2005 CAFE levels for various automakers with the difference between the actual CAFE and the CAFE standard. The MY2005 light truck CAFE standard was 21.0 mpg. The passenger car standard was 27.5 mpg.

	Light Truck CAFE (mpg)		Imported Car CAFE (mpg)		Domestic Car CAFE (mpg)	
	Actual	Difference	Actual	Difference	Actual	Difference
BMW	21.6	0.6	27.5	0.0		
DaimlerChrysler	21.0	0.0	26.3	-1.2	28.7	1.2
Ford	21.5	0.5	28.4	0.9	28.2	0.7
GM	21.5	0.5	29.3	1.8	28.8	1.3
Honda	24.8	3.8	31.5	4.0	36.7	9.2
Hyundai-Kia	24.7	3.7	30.1	2.6		
Mitsubishi	23.5	2.5	30.1	2.6	27.9	0.4
Nissan	21.8	0.8	24.8	-2.7	30.3	2.8
Porsche	18.6	-2.4	24.4	-3.1		
Suzuki	22.8	1.8	29.7	2.2		
Toyota	23.1	2.1	35.1	7.6	34.3	6.8
VW	20.1	-0.9	28.8	1.3		

Source: NHTSA, "Summary of Fuel Economy Performance," March 2005.

Fleet Mix

Fleet mix, the mix of vehicle types and sizes that an automaker sells, can impact CAFE significantly. Assuming that similar technologies are used on both, a large vehicle will almost

⁴⁹ Robert Heavenrich, "Light-Duty Automotive Technology and Fuel Economy Trends: 1975 Through 2006," EPA, July 2006, accessed 20 July 2006; available from <http://www.epa.gov/otaq/cert/mpg/fetrends/420r05001.pdf>.

⁵⁰ This is the combined CAFE for the entire GM group, including Suzuki, Daewoo, Saab, and Isuzu. GM's individual fleet achieved a combined CAFE of 23.8 mpg.

⁵¹ Heavenrich.

always have a lower fuel economy than a small vehicle. Therefore, an automaker that sells more large trucks and SUVs will have a lower CAFE than an automaker that sells only small cars. Under a uniform CAFE standard, this can be a significant disadvantage to full-line manufacturers, firms that produce both small and large vehicles instead of only small ones.

The Big Three sell more large vehicles than most manufacturers. In 2004, minivans, SUVs, and pickups represented over 50 percent of global sales for only GM, Ford, and Toyota.⁵² Within a specific type of vehicle (car, wagon, van, SUV, or pickup), size distribution also affects CAFE. An automaker that sells more large cars will have a lower passenger car CAFE than one that sells mainly subcompact and small cars. Table 2 lists the fleet mixes of selected automakers by percentage of total vehicle sales.

Table 2. Percentage distributions of vehicle type for selected automakers

	Sub-compact Car	Compact Car	Midsize Car	Large Car	Minivan	SUV	Pickup
BMW	2	39	3	34	0	22	0
DaimlerChrysler	1	4	30	39	3	18	5
Ford	1	2	10	9	5	33	40
GM	1	1	9	17	0	30	42
Honda	1	5	46	0	21	26	0
Hyundai-Kia*	–	–	–	–	–	–	–
Nissan	0	5	34	18	3	28	12
Toyota	1	6	16	23	11	23	20
VW	3	16	68	10	2	1	0

Source: Austin, Rosinski, Sauer, and Le Duc.

* WRI and SAM did not report Hyundai-Kia's fleet mix.

Depending on the structure of fuel economy standards, the fleet mix of an automaker can heavily impact its ability to meet the regulation. Previous light truck CAFE standards set a uniform CAFE standard. Because they produced mainly large vehicles even in 1975, domestic

⁵² Duncan Austin, Niki Rosinski, Amanda Sauer, and Colin Le Duc, "Changing Drivers: The impact of climate change on competitiveness and value creation in the automotive industry," World Resources Institute (WRI) and Sustainable Asset Management (SAM), 2003, accessed 13 June 2006; available from http://pdf.wri.org/changing_drivers_full_report.pdf.

automakers had to improve their CAFEs while foreign automakers did not.⁵³ The Reformed CAFE standards for light trucks account for fleet mix and do not favor specific vehicle classes.

Position in Fuel-saving Technologies

An automaker's position in both near-term and long-term technologies will affect its ability to improve its CAFE. The current fuel economy levels of individual vehicles within an automaker's fleet are a good representation of their position in near-term technologies. Japanese automakers have the most efficient vehicles overall. Honda's Insight hybrid, the first vehicle to be certified by California as an advanced technology partial zero-emission vehicle (AT-PZEV), has a fuel economy of 69.4 mpg and Toyota's hybrid Prius has a fuel economy of 65.8 mpg.⁵⁴ However, when MY2006 fleets are divided into classes based on vehicle type and size, the title of most fuel-efficient vehicle is spread. Toyota sells the most efficient vehicle in four of the seventeen classes, as does Ford. Nissan leads in three, and Honda is most efficient in two. GM and Chrysler each claim highest fuel economy in one vehicle class.⁵⁵ Appendix B shows the most and least efficient vehicles by class.

Position in more innovative fuel-saving technologies is based more on research and product development. Research and development in advanced technologies can be expensive; automakers are often forced to focus on specific technologies at the exclusion of others. In 2002, based on analysis by the World Resources Institute (WRI) and Sustainable Asset Management (SAM); Honda, Nissan and Toyota ranked highest in hybrid development.⁵⁶ Honda, Toyota, GM, and Ford all have hybrids in the U.S. market today; although Ford recently

⁵³ NRC.

⁵⁴ These are the laboratory 45/55 fuel economy levels used to determine CAFE, not the fuel economy levels used on car stickers. Source: Heavenrich.

⁵⁵ Heavenrich.

⁵⁶ WRI and SAM did not consider Hyundai-Kia in their analysis.

announced that it would reduce its earlier goal of producing 250,000 hybrids by 2010.⁵⁷ Nissan currently produces two electric vehicles and one hybrid for other markets.⁵⁸ It will introduce a hybrid version of its Altima to the U.S. for MY2007.⁵⁹ In diesel technology, VW is the farthest ahead, while Ford, GM, and Honda lag farthest behind.⁶⁰ Table 3 shows the strategic positioning of several automakers in development of hybrid and diesel technologies. There are many indicators of an automaker's position in fuel-saving technologies that are not included in this analysis.

Table 3. Position of selected automakers in hybrid and advanced diesel technology.

Technology	Ahead	Neutral	Behind
Hybrid	Honda, Toyota	Nissan, GM, Ford, DaimlerChrysler	BMW, VW
Diesel	VW	DaimlerChrysler, Nissan, Toyota, BMW	Ford, GM, Honda

Source: Austin, Rosinski, Sauer, and Le Duc. Adapted by author to reflect changes in hybrid production.

GM and Ford have invested significantly in flex-fuel vehicles that can run on both regular gasoline and ethanol. Increased use of ethanol and other alternative fuels could significantly reduce automotive oil consumption. Partnerships between firms to jointly develop or produce new technologies can also affect leadership positions. For example, Toyota and GM have such

⁵⁷ Sholnn Freeman, "Ford Abandons Pledge On Hybrid Production," *The Washington Post*, 30 June 2006, D01, accessed 14 July 2006; available from <http://www.washingtonpost.com/wp-dyn/content/article/2006/06/29/AR2006062901911.html>.

⁵⁸ Nissan Motor Company, "How Can We Make Your World Greener," accessed 30 July 2006; available from <http://www.nissanusa.com/about/thinking/environment.html>.

⁵⁹ Nissan Motor Company, "Hybrid Vehicle Commercialization," accessed 30 July 2006; available from http://www.nissan-global.com/EN/ENVIRONMENT/CAR/FUEL_COST/TECHNOLOGY/HYBRID/index.html.

⁶⁰ Austin, Duncan, Rosinski, Sauer, and Le Duc.

a partnership over the development of hybrid technologies.⁶¹ Automakers also have the option of buying technologies from suppliers and other manufacturers.

Flexibility of Production

Another differences between domestic and foreign automakers is the ability to incorporate new technologies into production lines quickly. The faster a manufacturer can change a production line, the faster it can respond to changes in the market, shift production, or introduce a new vehicle. A dedicated production line can make only one vehicle model, requires the smallest initial investment, and offers the lowest production costs and largest production volumes. These plants are much more difficult and expensive to change. The changeover time for a typical dedicated production line is 12 months at a cost of over \$50 million. More flexible or agile systems can be changed in less than 3 months and at costs between \$25 and \$10 million.⁶²

The Big Three have historically used dedicated production plants, whereas Japanese automakers, particularly Honda and Toyota, are known for flexible manufacturing. Toyota produces 73 percent of its vehicles on flexible assembly lines, lines that can make at least two different vehicles. Even with recent commitments to flexible production, only 22 percent of Ford vehicles come from similar plants. GM and DaimlerChrysler do better than Ford, but not by

⁶¹ Ibid.

⁶² Debra A. Elkins, Ningjian Huang, and Jeffrey M. Alden, "Agile manufacturing systems in the automotive industry," International Journal of Production Economics, 91-3 (18 October 2004): 201-214.

much.⁶³ Past union agreements governing the type of work employees can do also slow changeover times and increase changeover costs at the Big Three.⁶⁴

Japanese companies also introduce new models to the market more effectively than Ford, GM, and DaimlerChrysler. The Big Three have introduced or are expected to introduce the most new models each year between MY2004 and MY2007. However, the percentage of new vehicles in Nissan, Toyota, and Honda fleets will be greater.

Financial Resources

Availability of financial and capital resources to invest in research and retooling affect an automakers ability to improve its CAFE. In recent years, the Big Three have seen a drop in profits. In 2005, GM posed a net income loss of \$10.5 billion. Ford's net income was 43 percent lower than in 2004 at \$2.02 billion. Toyota saw a net income gain of \$10.9 billion, and Honda made \$4.5 billion.⁶⁵ In 2005, while Nissan, Toyota, and Honda earned a pre-tax profit of more than \$2,300 per vehicle, GM and Ford actually lost money. Ford lost \$590 per vehicle, while GM lost \$2,496.⁶⁶ Appendix A includes tables of 2005 assets and income figure for the automakers analyzed.

Legacy costs⁶⁷ such as previous union agreements, health care costs, a large retiree population, and the Jobs Bank⁶⁸ contribute to some of the Big Three losses. Labor costs alone

⁶³ Phil LeBeau, "It's not just about making better cars in Detroit," CNBC, April 11, 2006, accessed 11 July 2006; available from <http://www.msnbc.msn.com/id/12206342/>.

⁶⁴ Michael Cammisa, Personal Interview, 9 July 2006.

⁶⁵ 2005 Annual Reports for Honda, Toyota, Ford, and GM.

⁶⁶ Harbour Consulting, "Productivity Gap among North American Automakers Narrows in Harbour Report 2006," Harbour Report North America Press Release, June 1, 2006, accessed 9 July 2006; available form <http://www.harbourinc.com/2006PressRelease.asp>.

⁶⁷ Legacy costs are costs from past decisions and commitments that continue to drain profits.

⁶⁸ The Jobs Bank, created in a 1984 agreement between domestic automotive companies and the United Auto Workers (UAW), guarantees pay and benefits for employees whose jobs have been cut due to plant automation

are roughly \$2,900 per vehicle for GM, Ford, and DaimlerChrysler with legacy costs accounting for up to \$1,000 of these costs.⁶⁹

A significant increase in fuel economy standards will create disproportional risks among automakers.

A significant increase in fuel economy standards, such as those proposed by Congress to raise overall fuel economy to 33 mpg by 2016 would magnify differences between automakers and uncertainties in the industry. Given the number of available technologies for improving fuel economy and the potential for tradeoffs in performance and size, automakers would have many options for meeting higher standards. However, without knowing the market for these technologies, automakers would take risks in introducing new vehicles.

In general, when gasoline is inexpensive, people do not value fuel economy. In 1980, the average price of gallon of gasoline was \$2.95⁷⁰; forty two percent of people considered fuel economy first when purchasing a new vehicle. Following the return of cheap oil, by 1987 this percentage had dropped to 4 percent.⁷¹ Studies have shown that buyers will not even pay for a “cost-effective” increase in fuel economy. They either do not consider that paying more for a vehicle with better gas mileage could pay for itself⁷² or perceive a high discount rate on vehicle purchases.⁷³ Selling fuel-efficient vehicles to this market involves taking a risk. When Honda first introduced the Insight (the first hybrid in the U.S. market) it suffered profit losses to “test the

or restructuring. Source: “Jobs bank programs -- 12,000 paid not to work,” The Detroit News, 17 October 2005, accessed 2 August 2006; available from <http://www.detnews.com/2005/autosinsider/0510/17/A01-351179.htm>.

⁶⁹ McManus.

⁷⁰ In 2005 dollars.

⁷¹ M, Kubik, “Customer Views on Transportation and Energy (Third Edition),” National Renewable Energy Laboratory (NREL), January 2006, accessed 10 June 2006; available from www.nrel.gov/docs/fy06osti/39047.pdf.

⁷² Thomas S, Turrentine and Kenneth S, Kurani, “Car buyers and fuel economy?” Energy Policy, 34 (2006), In Press Corrected Proof available online 24 April 2006 through Science Direct.

⁷³ David Gerard and Lester B, Lave, “The Economics of CAFE Reconsidered: A Response to CAFE Critics and A Case for Fuel Economy Standards,” Regulatory Analysis 03-10 (Oct 2003).

market.” As production volume has increased and Honda has identified and targeted the hybrid market, it has just begun to break even on sales of the Civic Hybrid.⁷⁴

Consumers value performance, size, and reliability – features that do not pay for themselves – more than fuel efficiency. Since 1985, when CAFE standards leveled off, vehicle size and power have increased substantially.⁷⁵ As shown in figure 2, between 1987 and 2006, the share of light trucks grew from 27.8 to 50.4 percent.⁷⁶ Consumers have also demanded better acceleration, as indicated by the decrease in 0-60 time over the last few years⁷⁷. If CAFE standards were raised and automakers could not meet consumer expectations while improving fuel economy, they would face the risk that consumers would chose not to buy vehicles. They would also face the risk that consumers would purchase only the less efficient vehicles within a fleet. To meet the standards, automakers would then have to reduce the prices of their most efficient models. Studies have shown that lowering CAFE levels this way costs more than adding fuel-saving technologies.⁷⁸

⁷⁴ Patrick Calpin, Personal Interview, 27 June 2006.

⁷⁵ Heavenrich.

⁷⁶ Ibid.

⁷⁷ The 0-60 time of a vehicle is the time it takes to accelerate from 0 to 60 miles per hour (mph).

⁷⁸ David L. Greene, Philip D. Patterson, Margaret Singh, and Jia Li, “Feebates, rebates, and gas-guzzler taxes: a study of incentives for increases in fuel economy,” *Energy Policy*, 33 (2005): 757-775.

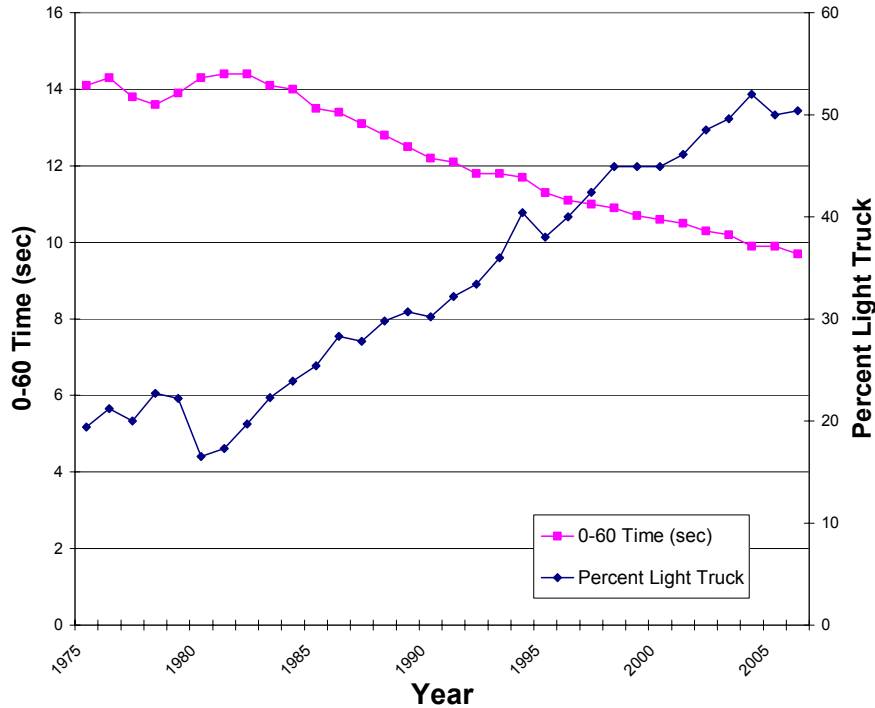


Figure 2. Light truck percentage of total fleet and average 0 to 60 mph time for new vehicles from 1975 to 2006. Source: Heavenrich.

Higher gasoline prices will create risks for automakers with low CAFE levels and fleet mixes heavy in large, inefficient vehicles.

When gasoline prices are high, consumers purchase fewer vehicles; and they purchase smaller, more efficient vehicles. The oil price shock of 1979 “turned the market upside down in a matter of weeks.”⁷⁹ Suddenly small, efficient cars were selling and large ones were gathering in new car lots.⁸⁰ Between 1978 and 1980, overall vehicle sales fell by 25 percent.⁸¹

Automakers that produce smaller vehicles and have better CAFE levels will be more competitive in a volatile future market with higher gasoline prices. In two separate studies, the Office for the Study of Automotive Transportation (OSAT) at the University of Michigan analyzed

⁷⁹ Kiseok Lee and Shawn Ni, “On the dynamic effects of oil price shocks: a study using industry level data,” *Journal of Monetary Economics*, 49-4, (May 2002): 823-852.

⁸⁰ *Ibid.*

⁸¹ ORNL, *Transportation Energy Book*, Edition 25, 11 May 2006.

the impact of a sudden increase in oil prices and a significant growth in demand for hybrids and advanced diesels. If automaker business strategies remain the same, the Big Three could see profits fall by billions of dollars and sales decline by up to 75 percent.⁸² U.S. auto employment could fall if production shifted to overseas facilities that already produce more efficient vehicles.⁸³

Current high gasoline prices are already impacting the auto market. From January to June 2006, as gas prices rose from \$2.35 to \$2.99 a gallon,⁸⁴ light truck sales fell by 7 percent. Car sales rose 3 percent. Without large cash incentives, SUV sales would have fallen by an even greater percentage.⁸⁵ As gas prices reached record levels, June 2006 total vehicle sales were down 11 percent compared to June 2005.⁸⁶

These market changes are hitting manufacturers of large and inefficient vehicles hardest. In the second quarter of 2006, Ford's North American operations reported a \$797 million pretax loss, due primarily to a drop in demand for SUVs and pickups.⁸⁷ In June 2006, sales at GM were 26 percent lower than in 2005. In the same month, Nissan, the Chrysler group of DaimlerChrysler, and Ford were also hit; with sales 19, 15, and 7 percent lower than a year before. Toyota, in contrast, saw June sales rise by 14 percent from last year, and sales at

⁸² Walter McManus, Alan Baum, Roland Hwang, Daniel D. Luria, and Gautam Barua, "In the Tank: How Oil Prices Threaten Automakers Profits and Jobs," UMTRI, Office for the Study of Automotive Transportation (OSAT) and the Natural Resources Defense Council, July 2005, accessed 9 June 2006; available from <http://www.nrdc.org/air/transportation/inthetank/inthetank.pdf>.

⁸³ Ibid.

⁸⁴ EIA, "Monthly Energy Review July 2006," 26 July 2006, accessed 31 July 2006; available from <http://www.eia.doe.gov/emeu/mer/pdf/mer.pdf#search=%22Monthly%20Energy%20Review%20July%202006%22>.

⁸⁵ McManus.

⁸⁶ Sholnn Freeman, "Big Three Post Sales Declines in June," The Washington Post, 4 July 2006, D01, accessed 20 July 2006; available from <http://www.washingtonpost.com/wp-dyn/content/article/2006/07/03/AR2006070300272.html>.

⁸⁷ Sholnn Freeman, "Ford Lost \$123 Million in 2nd Quarter," The Washington Post, 20 July 2006, D03, accessed 20 July 2006; available from <http://www.washingtonpost.com/wp-dyn/content/article/2006/07/20/AR2006072000348.html>.

Honda were flat. Small vehicles at these automakers helped compensate for declines in overall pickup and SUV sales.⁸⁸

Economic models predict increases in the price of oil. Based on Energy Information Administration (EIA) analysis published in December 2005, world oil prices will remain high through 2007, but will fall to around \$47 a barrel in 2010.⁸⁹ EIA projects a trend of increasing oil prices through 2030. Under the reference case, the price of a barrel of oil in 2030 is projected to be \$56.97. The high scenario predicts a price of \$95.71 and the low scenario predicts a price of \$33.78 a barrel.⁹⁰ The key characteristic of these projections is the wide range of oil prices. As reflected in recent months, oil and gasoline prices are becoming more and more volatile and uncertain. Figure 3 shows EIA's estimates for future oil prices.

⁸⁸ Sholnn Freeman, "Big Three Post Sales Declines in June."

⁸⁹ Price projections are in 2004 dollars.

⁹⁰ EIA, "Annual Energy Outlook 2006 with Projections to 2030," Feb 2006, accessed 10 July 2006; available from <http://www.eia.doe.gov/oiaf/aeo/index.html>.

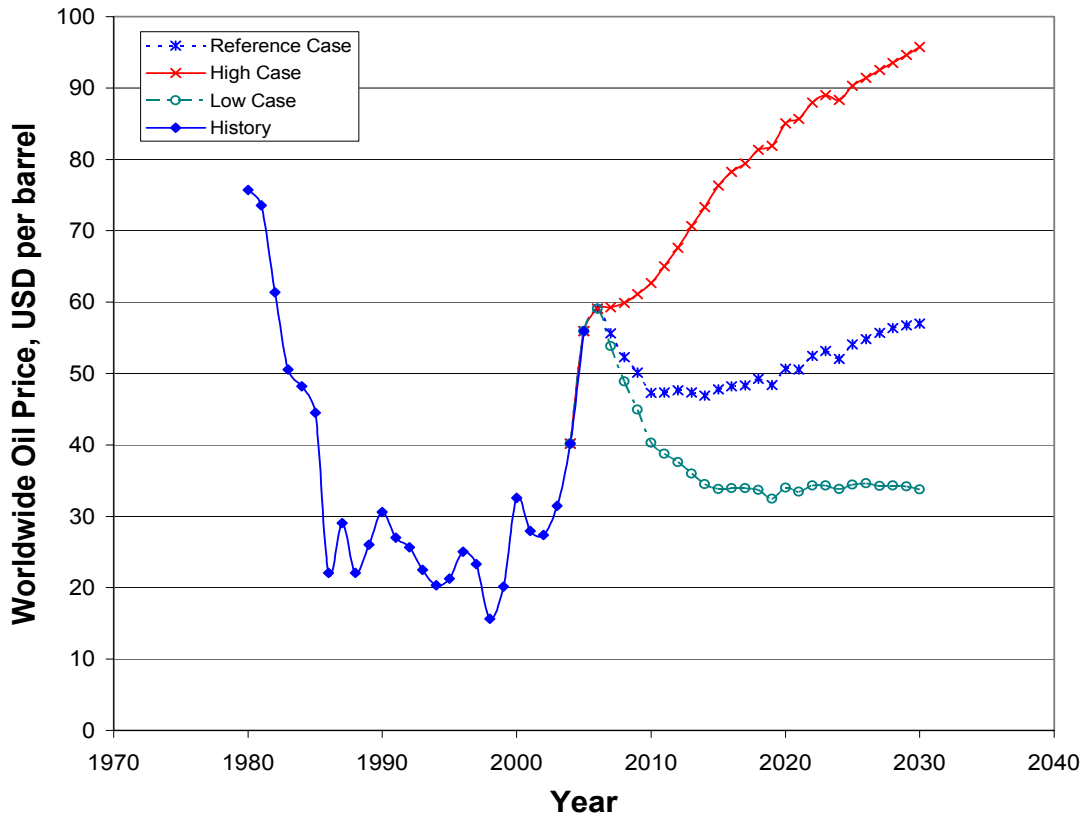


Figure 3. Oil price predictions from the EIA showing reference, high, and low price cases from now until 2030. Source: EIA, “Annual Energy Outlook 2006 with Projections to 2030,” February 2006, accessed 17 July 2006; available from <http://www.eia.doe.gov/oiaf/aeo/index.html>.

Domestic auto employment will be affected by changes in the industry and the national economy.

Historical analysis of the domestic auto industry since 1975 shows that employment has not been directly impacted by CAFE standards. The indirect consequences of CAFE standards on employment are still under debate. During the period that CAFE standards increased the most, 1978 to 1985, domestic automotive employment fell from 1,005 to 699 thousand in 1982 before rising to 884 thousand in 1985.⁹¹ However, the economic growth rate of the nation and

⁹¹ Sean P, McAlinden, Kim Hill, and Bernard Swiecki, “Economic Contribution of the Automotive Industry to the U.S. Economy – An Update,” Center for Automotive Research (CAR), Fall 2003, accessed 11 June 2006; available from <http://www.cargroup.org/pdfs/Alliance-Final.pdf>.

increased competition due to globalization account for most if not all losses. Jobs were moved overseas or cut as a result of loss of market share by domestic automakers and improvements in productivity at domestic auto manufacturing plants.⁹²

Future changes in the auto industry from either CAFE standards or a change in market demand could impact employment under three scenarios: by causing a significant decrease in market share of domestic automakers, causing automakers to shift production overseas, or causing automakers to invest heavily in research and retooling.

Loss of Jobs due to loss of Big Three Market Share

Future changes in the market or CAFE standards that cause the Big Three to lose market share could impact employment. Because previous (unreformed) CAFE standards did not affect all automakers equally, they may have contributed to the decline in domestic market share; however, this is still under debate.⁹³ If future CAFE standards do impact market share, it could affect employment.

GM and DaimlerChrysler build their entire U.S. fleet in North America and Ford builds 90 percent of its domestically sold vehicles here.⁹⁴ This translates into over 170 thousand domestic jobs with GM; 140 thousand with Ford; and 97 thousand with DaimlerChrysler.⁹⁵ In comparison, in 2005, all foreign automakers employed only 63 thousand.⁹⁶ Any change in production or market share due to CAFE would force firms to close plants and cut jobs. GM and

⁹² David L. Green, "Why CAFE worked," *Energy Policy*, 26-8, (July 1998): 595-613.

⁹³ NRC.

⁹⁴ NHTSA, "Reforming the Automobile Fuel Economy Standards Program," December 2003, accessed 8 June 2006; available from http://www.nhtsa.dot.gov/cars/rules/CAFE/rulemaking/ANPRM_Dec22-2003.html.

⁹⁵ GM, Ford, and DaimlerChrysler Annual Reports for 2005.

⁹⁶ Department of Commerce, "US Automotive Industry Employment Trends," March 2005, accessed 11 June 2006; available from <http://www.ita.doc.gov/td/auto/domestic/staffreports/Jobloss.pdf#search=%22Department%20of%20Commerce%2C%20%E2%80%99CUS%20Automotive%20Industry%20Employment%20Trends%22>.

Ford are already restructuring, due to declining profits. In January 2006, Ford announced plans to close 14 manufacturing facilities and cut 25,000 to 30,000 jobs by 2012.⁹⁷ The company now plans to accelerate and increase those plans based on recent declining profits. GM will close 12 production and operations facilities and cut 30,000 jobs by 2008.⁹⁸

An increase in domestic production with foreign automakers could offset losses with the Big Three. The international share of total U.S. automotive production has increased steadily from its 1982 value of 1.3 percent; it represented 26.9 percent in 2003.⁹⁹ Approximately 80 percent of Honda vehicles sold in the U.S. are manufactured in North America.¹⁰⁰ Toyota's North American production is increasing so fast that it needs the equivalent of an entire new assembly plant each year to meet demand.¹⁰¹ However, foreign automaker employees in the U.S. are not as well compensated as Big Three employees. The average compensation (wage and benefits) for all motor vehicle and equipment manufacturing workers in 2001 was \$69,500.¹⁰² Automotive manufacturing employees with foreign companies were paid \$64,078.¹⁰³ These companies site many reasons to explain why the UAW has failed to gain ground including comparable benefits and a more open working environment.

⁹⁷ Ford.

⁹⁸ GM.

⁹⁹ Sean McAlinden and Bernard Swiecki, "The Contribution of the International Auto Sector to the U.S. Economy: An Update," CAR, March 2005, accessed 19 June 2006; available from <http://www.cargroup.org/pdfs/AIAMFinal.PDF>.

¹⁰⁰ Honda Motor Company, "Annual Report 2005," 23 June 2005, accessed 27 July 2006; available at <http://world.honda.com/investors/annualreport/2005/pdf/ar2005.pdf>

¹⁰¹ Harbour Consulting.

¹⁰² McAlinden, Hill, and Swiecki.

¹⁰³ McAlinden and Swiecki.

Loss of Jobs due to Increase in Overseas Production

An increase in demand for efficient vehicles could affect employment if automakers respond by shifting production overseas. Few hybrid and diesel components are currently produced in the U.S. Although Ford's Escape Hybrid is assembled in Kansas City, Missouri, most of its hybrid components are imported. Japan produces the most hybrid components of any country.¹⁰⁴ Similarly, most diesel components are made in Europe, where diesels represent over 33 percent of the market.¹⁰⁵ Many U.S. assembly, engine, and transmission plants produce only large vehicle parts. GM has at least four plants that are dedicated to producing only large and midsize SUVs. Ford has similar facilities in Missouri and Michigan. DaimlerChrysler's Newark, Delaware facility manufactures only a single midsize SUV.¹⁰⁶ Jobs at these plants could be at risk if production shifts suddenly toward more efficient vehicles. Domestic jobs with automotive suppliers would also be significantly affected. OSAT interviewed suppliers to determine the impact of a shift in vehicle production. Based on those interviews, component production needs to reach levels of 200,000 to 250,000 units to encourage suppliers to increase or start domestic production of a part.¹⁰⁷

Demand is not the only factor that influences plant location. Automakers must balance many issues when deciding where to build a production plant. Access to the market and lower transportation costs favor domestic production, but the price of labor and access to resources all

¹⁰⁴ Patrick Hammett, Michael Flynn, and Maitreya Kathleen Sims, "Fuel-Saving Technologies and Facility Conversion: Costs, Benefits, and Incentives," UMTRI, OSAT, November 2004, accessed 14 June 2006; available from <http://deepblue.lib.umich.edu/bitstream/2027.42/3129/2/98560.pdf>.

¹⁰⁵ Diesel Technology Forum, "Demand for Diesel: The European Experience," July 2001, accessed 17 July 2006; available from <http://www.dieselforum.org/fileadmin/templates/whitepapers/EuropeanExperience.PDF>.

¹⁰⁶ McManus, Baum, Hwang, Luria, and Barua.

¹⁰⁷ Hammett, Flynn, and Sims.

encourage producers to locate facilities overseas. Other factors include political motivations and access to future markets.¹⁰⁸

The import-domestic distinction of early CAFE standards, intended to protect American jobs and bring production of fuel-efficient vehicles into the U.S., may have actually caused reductions in U.S. employment. Instead of bringing production of fuel-efficient vehicles to the U.S., automakers shifted production of some inefficient vehicles, such as Ford's Crown Victoria, abroad.¹⁰⁹ Likewise, foreign automakers that had previously manufactured small vehicles in the U.S. and imported larger ones shifted some small vehicle production overseas to improve the CAFE of their imported fleet.¹¹⁰ NHTSA removed this distinction and rule for light trucks beyond MY1995.¹¹¹ The distinction remains for passenger cars.

Increase in Jobs due to Increased Investment

If automakers begin to produce more fuel-efficient vehicles in the U.S., employment will not be impacted as much and could actually increase if fuel prices remain high.¹¹² Domestic hybrid production is beginning to develop. Toyota will open a hybrid manufacturing plant in Georgetown, Kentucky, in late 2006.¹¹³ GM also announced in February 2006 that it would begin production of a hybrid transmission at its plant in Baltimore.¹¹⁴ Because many U.S.-made vehicles already have diesel versions that are sold in Europe, U.S. facilities that produce these

¹⁰⁸ Cammissa.

¹⁰⁹ Greene, Plotkin, and Duleep.

¹¹⁰ Cammissa.

¹¹¹ NRC.

¹¹² Hammett, Flynn, and Sims.

¹¹³ Toyota, "Toyota will start producing hybrids in the U.S. in late 2006 at its plant in Georgetown, KY," 17 May 2005, accessed 10 July 2006; available from <http://www.toyota.com/about/news/manufacturing/2005/05/17-1-kentucky-hybrid.html>.

¹¹⁴ GM, "General Motors Announces Production of First Light-Duty, Hybrid Transmission to Be Manufactured in the U.S." 2 Feb 2006, accessed 16 July 2006; available from http://www.gm.com/company/gmability/adv_tech/100_new_s/hybridtrans_02036.html.

vehicles could be converted relatively easily, assuming that diesel technologies can meet emissions standards.

If market risks were eliminated, automakers could respond to higher standards by increasing R&D and retooling efforts. Based on the assumption that costs can be passed onto consumers without a decline in vehicle sales, the Union of Concerned Scientists (UCS) modeled the impact of increasing the passenger car CAFE standard to 40 mpg by 2015. If automobile manufacturers invest significantly in research, development, and retooling, such a CAFE standard could create over 40,000 automotive jobs in the U.S.¹¹⁵ Bezdek and Wendling studied the impact of raising passenger car CAFE standards to 33.0 mpg and light truck standards to 24.8 mpg for 2010 under similar assumptions. In a risk-free market, they found that a significant increase in fuel economy standards could increase automotive employment as well as the national GDP.¹¹⁶

Policy Implications

Because of financial difficulties at the Big Three and the nature of the automotive industry, any policy affecting vehicle fuel economy must take economic implications into account. The current CAFE standards for light trucks have increased fuel economy levels above what market forces would have achieved and have done so without negatively impacting the automotive industry in the short-term.¹¹⁷ However, as noted in a recent EPA report on fuel economy trends, the MY2006 combined (car and light truck) new vehicle fleet has an average

¹¹⁵ Union of Concerned Scientists, "Creating Jobs, Saving Energy and Protecting the Environment: An Analysis of the Potential Benefits of Investing in Efficient Cars and Trucks," July 2004, accessed 6 July 2006; available from http://www.ucsusa.org/clean_vehicles/fuel_economy/jobs-energy-fuel-economy.html.

¹¹⁶ Roger H. Bezdek and Robert M. Wendling, "Potential long-term impacts of changes in US vehicle fuel efficiency standards," *Energy Policy* 33 (2005) 407-419.

¹¹⁷ NRC.

fuel economy of only 21.0 mpg, an entire mpg lower than the 1987 level of 22.1 mpg.¹¹⁸ This decline is due to the increase in fleet share of large trucks and SUVs. Our low average fuel economy has serious implications on our oil consumption and the future competitiveness of the American auto industry; it should be addressed.

Passenger car and light truck CAFE standards that are technically and economically feasible have a role in federal fuel economy policy.

CAFE standards have kept fuel economy levels above the level market forces alone would have achieved and have served as a floor on fuel economy.¹¹⁹ As shown in Figure 4, early CAFE standards and gasoline prices both increased substantially in the late 1970s. Actual fleet fuel economy followed these increases. Once the price of gasoline fell, CAFE standards required automakers to maintain high fuel economy levels. Without such regulation, our vehicles would be less efficient today than they are.¹²⁰ Vehicles, however, would be more efficient now if CAFE standards had not leveled off in the 1990s. When the CAFE standards stopped increasing, automakers shifted focus to other vehicle attributes, such as power and size. During this period, the average fuel economy of imported passenger cars actually declined from a 1983 high and approached the limit set by the CAFE standards.¹²¹ Future CAFE standards should prevent this trend by continuing to push automakers to make more efficient vehicles.

¹¹⁸ Heavenrich.

¹¹⁹ NRC.

¹²⁰ Ibid.

¹²¹ Ibid.

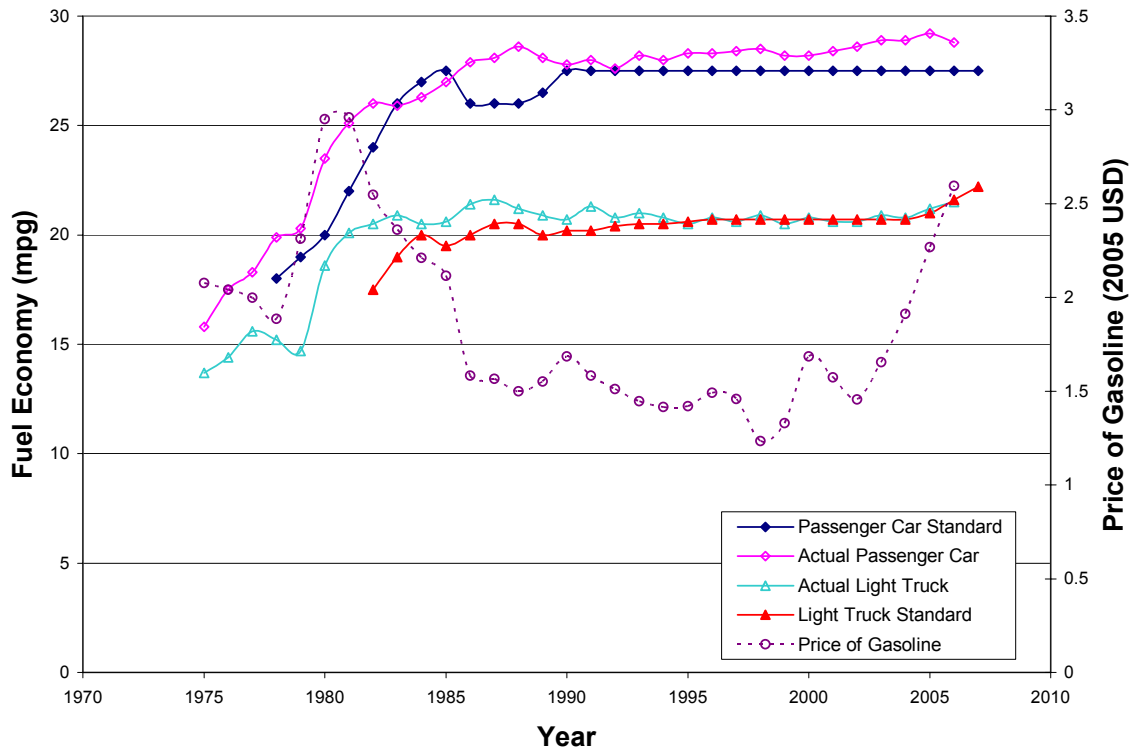


Figure 4. Actual average fuel economy levels and CAFE standards for both passenger cars and light trucks with the price of gasoline since 1975. Sources: NTSA. "Summary of Fuel Economy Performance." March 2005 and EIA. "Short-Term Energy Outlook (July 2006)".

NHTSA sets light truck CAFE standards that based on cost-benefit analysis of different technologies and associated fuel savings. These standards are technically and economically feasible and grant automakers enough time to respond. To ensure that passenger car standards are also set at technically and economically feasible levels, Congress should give NHTSA authority to set passenger car CAFE standards. To minimize the impact of difference in fleet mix, CAFE standards should also be attribute-based and set individually for each automaker.

However, analysis of this type depends on many assumptions including the price of gasoline, the cost of a technology, the increase in fuel economy, and the required payback period. As Greene and DeCicco show, depending on the values assumed, cost-benefit analysis can result in a broad range of appropriate CAFE standards, which has fueled some debate

about how well NHTSA sets CAFÉ standards.¹²² This debate will continue for many years.

CAFE standards should be part of a larger policy package.

NHTSA's CAFE standards consider short-term economic impacts; however, they do not prepare automakers for future high gas prices or reduce automotive oil consumption. Since 1980, the average fuel economy of both light trucks and passenger cars have remained relatively constant or increased. However, as shown in figure 5, as the percentage of light trucks in the market has increased, our overall vehicle fuel economy has actually declined.

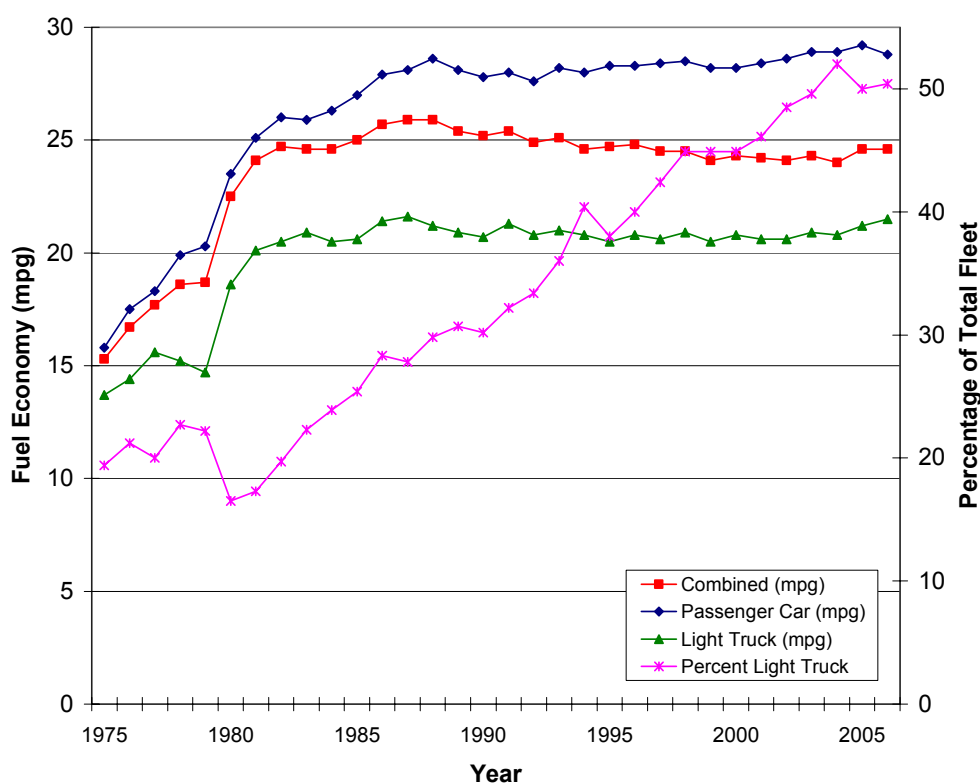


Figure 5. Average fuel economy for passenger cars, light trucks, and the overall new vehicle fleet since 1975 with the market share of light trucks. Source: Heavenrich.

¹²² David L. Greene and John DeCicco, "Engineering-Economic Analyses of Automotive Fuel Economy Potential in the United States," *Annual Review of Energy and the Environment* 25 (2000): 477-536.

An additional policy is needed to complement CAFE standards. This policy should minimize current and future risks to both the American public and the auto industry by

- *Maintaining consumer choice* – To be politically feasible, a policy that affects fuel economy would do so without changing our way of life. This means maintaining vehicle options and vehicle features that consumers value.
- *Minimizing the risks of the policy to the auto industry* – Reducing the risks associated with a policy would make it easier for automakers to improve vehicle efficiency. A policy could minimize risk by reducing the impact of the differences between them and removing uncertainty from the market.
- *Improving fuel economy levels* – Fuel economy levels beyond what is deemed “cost-effective” are necessary to account for the social externalities of driving a vehicle.¹²³ The ideal policy would improve the fuel economy of both individual vehicles and the fleet average.
- *Minimizing future risk to the auto industry* – To maintain the competitiveness of automakers in a future with higher oil and gasoline prices, the ideal policy would encourage a shift toward more efficient vehicles, regardless of vehicle size and the differences between automakers. As noted above, when gas prices are high, people tend to buy smaller, more efficient vehicles. A successful policy would encourage a shift in production toward these vehicles.

¹²³ Gerard and Lave.

- *Minimizing costs to government* – With the tight budget constraints of today's government, a policy would be successful if it does not require significant administrative efforts or financial resources.

Several additional policies have been proposed to raise vehicle fuel economy.

Various think tanks, committees, and industry groups have proposed policies to address this issue of fuel economy. Policy options include increasing the gas tax, allowing automakers to trade CAFE credits, creating incentives for automakers to produce hybrids and advanced diesels, and using tax incentives to create demand for fuel efficiency. Each policy is evaluated based on the criteria outlined above.

Increasing the Gas Tax

Increasing the gas tax has been proven to be a cost-effective way to curb our oil consumption.¹²⁴ However, given the current political environment, it is not a viable policy option: many of recent House and Senate bills to increase CAFE standards were created to address consumer pain at the pump.

CAFE standards with Credit Trading

Credit trading would make achieving higher fuel economy standards more cost-effective for the industry, reducing the risks of the policy and its impact on consumers. Automakers with CAFEs above the standard would earn CAFE credits. These credits could then be sold to firms that did not meet the standard at a price determined by the market. To place an upper limit on compliance costs, the government would also sell credits at a predetermined price. Austin and

¹²⁴ David Austin and Terry Dinan, "Clearing the air: The costs and consequences of higher CAFE standards and increased gasoline taxes," Journal of Environmental Economics and Management, 50-3 (Nov 2005): 562-582.

Dinan estimate that when credit trading is allowed, automakers would have to spend only two thirds of the amount required without trading.¹²⁵ This would translate to consumers as minimal changes in vehicle performance and cost.

Credit trading could raise fuel economy levels beyond what CAFE standards alone would achieve. Because compliance costs would be lower, NHTSA could set higher standards. In addition, the opportunity to sell credits would encourage automakers that already meet the standard to further improve their CAFE. The idea of having to buy credits from competitors could encourage others to increase their fleet efficiency. However, the ability to buy credits (from either competitors or the government) could encourage some automakers not to raise their fuel economy levels.

Although short-term risks to automakers engaging in credit trading would be smaller than with CAFE standards alone, the long-term risks of a future increase in oil prices could actually increase. Because the amount of the credits is based on the CAFE standards, they would also be attribute-based and would not encourage automakers to shift to a more efficient fleet. Furthermore, if automakers chose to purchase credits instead of increasing the efficiency of their fleet, they would face the same future risks.

Many organizations and groups support this policy option. The NAS committee concluded that allowing automakers to trade CAFE credits and capping credit price could significantly improve the current system.¹²⁶ H. R. 3762 introduced in September 2005 by House Science Committee Chairman Sherwood Boehlert (R-NY) and 22 other members of the House

¹²⁵ Ibid.

¹²⁶ NRC.

and the “Fuel Economy Reform Act” introduced in the Senate in July 2006 both included provisions for credit trading.

Manufacturer Incentives

Manufacturer incentives, most likely in the form of tax credits, would encourage automakers to increase their capacity to produce hybrids, clean diesels, and other fuel-efficient vehicles. The tax credit would help pay for a certain percentage of the retooling costs associated with changing a production line, so that the automaker could produce these vehicles. It would create minimal risks to the industry and the average American.

Companies would not be forced to change vehicle designs, and consumer options would remain diverse. In addition, incentives would remove many of the initial costs for companies that did choose to begin or expand production of more efficient vehicles, reducing the risks of such changes.

A manufacturer incentive could increase current fuel economy and reduce future risks, assuming that demand also increases. Without a demand for fuel economy, automakers will have little reason to change production lines, even with reduced costs. This would leave them unprepared for future high gas prices. However, manufacturer incentives would allow automakers to respond to market changes faster. OSAT estimates that by encouraging domestic production of hybrid and diesel powertrains, a manufacture tax credit would save several thousand jobs that would otherwise be lost, assuming an increase in demand for hybrids and diesels.¹²⁷

¹²⁷ Hammett, Flynn, and Sims.

A manufacturer tax credit would require a significant investment in financial resources. OSAT estimates that depending on the demand for hybrids and advanced diesels and the number of production lines that would be changed or expanded, tax credits would cost the treasury between \$233 and \$1,072 million.¹²⁸ By maintaining domestic production, these investments could then bring in between \$72 and \$259 million in tax collections.¹²⁹

The National Commission on Energy Policy supported the use of manufacturer tax credits to encourage domestic production of hybrids and advanced diesels.¹³⁰ The UAW supports manufacturer incentives as part of a “Marshall Plan” for the automotive industry.¹³¹

Consumer Incentives

Consumer incentives such as a new vehicle tax credit, an extension of the gas-guzzler tax to light trucks, or a “feebate” system would encourage demand for fuel-efficient vehicles. These incentives would offer a onetime incentive or tax at the time of vehicle purchase, depending on the fuel economy of the vehicle. A feebate system would combine tax credits or “rebates” on highly fuel efficient vehicles with taxes or “fees” on vehicles with poor efficiency. All vehicles with fuel economy levels above a designated “pivot” range would receive a rebate. All vehicles with fuel economy below the pivot point would be assessed a fee. The amount of fees and rebates would vary based on the fuel economy of the vehicle, but could also depend on vehicle class.

¹²⁸ OSAT modeled the impact of several different 2009 market shares for hybrids and diesels: 2.7 percent, 7 percent, and 11 percent.

¹²⁹ Ibid.

¹³⁰ National Commission on Energy Policy, 2004, “Ending the Energy Stalemate: A Bipartisan Strategy to Meet America’s Energy Challenges,” December 2004.

¹³¹ United Auto Workers, “Energy and the Environment,” 2006, accessed 29 July 2006; available from <http://www.uaw.org/cap/06/issues/issue05.cfm>.

Depending on the amount of the incentive, consumer incentives could drive fuel economy levels much higher than CAFE standards. They would create the greatest increase when applied to all vehicles. Under only a gas-guzzler tax, automakers would likely improve fuel economy levels only enough to avoid the tax.¹³² An incentive program that only affected vehicles at the upper fuel economy range would also have limited effectiveness. There would be no incentive for automakers to improve the fuel economy of 10.0-mpg vehicles to 10.5 mpg.

Consumer incentives could reduce both current and future risks to automakers. Consumer incentives would reduce current risks by stimulating demand and removing uncertainty from the market. Companies would be able to invest more in achieving efficiency, knowing that consumers would absorb more of the costs. An incentive based only on efficiency, without consideration for vehicle class or type, would shift the market toward more efficient and smaller vehicles. This would reduce the risks of future high gas prices by preparing automakers for market changes. If designed correctly, feebates would be revenue neutral.

Because consumer incentives would encourage a market shift toward smaller vehicles, they would burden some drivers. Incentives that reward people for purchasing small vehicles would burden consumers who carpool or need extra cargo space. Fees or taxes on trucks and other large vehicles would aggravate the already hot debate over commercial vehicle tax policy.¹³³ In addition, incentives that distinguish between vehicle classes could create “perverse incentives” for automakers to modify vehicle designs to alter class designations.¹³⁴

¹³² Greene, Patterson, Singh, and Li.

¹³³ Todd BenDor and Andrew Ford, “Simulating a combination of feebates and scrappage incentives to reduce automobile emissions,” *Energy*, 31-(8-9) (July 2006): 1197-1214.

¹³⁴ K.C. Johnson, “Feebates: An effective regulatory instrument for cost-constrained environmental policy,” *Energy Policy*, Corrected Proof available online 8 November 2005 through Science Direct.

Automakers support the use of market forces and consumer incentives to achieve higher fuel economy levels. The Alliance for Automobile Manufacturers favor consumer incentives that would encourage the purchase of fuel-efficient vehicles.¹³⁵ Honda prefers consumer incentives that are based on fuel economy and do not favor a specific technology.¹³⁶

Recommendations and Conclusions

Combining CAFE standards and market incentives would reduce the short-term risks of the policies by creating demand for fuel economy. This same policy package would prepare automakers for future high gas prices by shifting the market toward more efficient and smaller vehicles, improving our overall fuel economy.

NHTSA should continue to set CAFE standards for light trucks and should be given authority over passenger car standards. NHTSA engineers set CAFE standards that are based on extensive technical and economic analysis in a process that is open and transparent. These standards take the nature of the auto industry into account and minimize the risks to automakers and autoworkers. Passenger car CAFE standards are not based on this level of analysis and should be.

To improve fuel efficiency further and reduce future risks to the auto industry, the federal government should create an incentive system that encourages all car and truck buyers to purchase more efficient vehicles. This system should be based entirely on efficiency, without regard for vehicle size or weight. To avoid straining the federal treasury, a feebate system that

¹³⁵ The Alliance of Automobile Manufacturers, "Fuel Economy: Our Position on CAFE," 1 Oct, 2006, accessed 31 June 2006; available from http://www.autoalliance.org/fuel/cape101_position.php?PHPSESSID=c85aef86_987b31f4c5332757680fad70.

¹³⁶ Honda, "Fuel Economy," Federal Position Paper, 2006, accessed 6 July 2006; available from http://corporate.honda.com/america/government_relations/article.aspx?id=Position_Papers/Federal_Position_Paper_0019.htm.

rewards buyers of fuel-efficient vehicles and penalizes buyers of inefficient vehicles is recommended.

Several different options have been proposed for the shape of the feebate curve. The most common is a feebate that is proportional to gallons per mile (gpm). Under this system every gallon of fuel saved is worth the same amount. For example, someone who buys a vehicle that gets 20 mpg will use, on average, 5 gallons to travel 100 miles. Someone who buys a vehicle that gets 25 mpg will use only 4 gallons, and someone who buys a 33.3-mpg vehicle will use only 3 gallons. Under the gpm feebate system, the difference in the feebate value between the 33.3 mpg and 25 mpg vehicles will be the same as the difference between the 25-mpg feebate and 20-mpg feebate. Figure 6 shows a curve using this system. Positive feebate values represent rebates and negative feebate values represent fees.

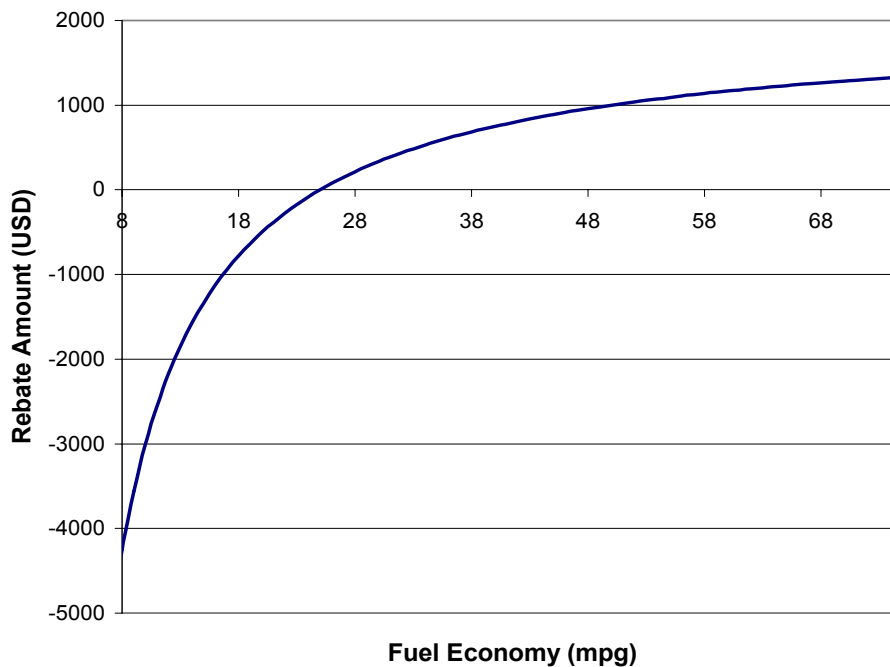


Figure 6. Possible feebate system. The feebate amount is proportional to gallons per mile (gpm).

Many issues related to fuel economy and industry competitiveness could not be considered here. They include state and local policies, alternative fuel use, research and

development (R&D), and other competitiveness initiatives. Additional study in these and other areas is recommended. Policymakers should also consider the use of state and local policies to create demand for efficient vehicles. An information campaign that educates consumers about the value of fuel economy could be effective. Regulators should also clarify the role of alternative fuels in the fuel economy debate. The potential of R&D partnerships such as the Department of Energy's FreedomCAR program and the Motor Vehicle Manufacturing Technology program at the National Institute of Standards and Technology should be studied.

Appendix A: Major Automakers

Table A-1. Major automotive groups.

<u>DaimlerChrysler</u> Mercedes Benz Smart Chrysler Dodge Jeep	<u>Ford</u> Ford Mazda Aston Martin Jaguar Volvo Land Rover Lincoln Mercury	<u>GM</u> GMC Opel Saab Isuzu Suzuki Daewoo Chevrolet Cadillac Buick HUMMER Pontiac Saturn	<u>Honda</u> Honda Acura
<u>Hyundai-Kia</u> Hyundai Kia	<u>Nissan</u> Nissan Infiniti	<u>Toyota</u> Toyota Scion Lexus	<u>VW</u> Volkswagen Bentley Skoda Bugatti Audi Lamborghini SEAT

Table A-2. Economic and production statistics for major automakers, in U.S. Dollars.

	Net Assets (billions)	Net Income 2005 (billions) (loss)	Employment US/Global (thousands)	2006 US vehicle sales (millions)
Honda	\$86.758	\$4.527	33/138	1.575
Ford	\$269.476	\$2.024	140/300	3.779
Toyota	\$226.604	\$10.907	37/NA	2.27
DaimlerChrysler	\$71.433	\$3.628	97/383	NA
General Motors	\$194.236	(\$10.567)	173/335	17.455
Nissan*	\$92.042	\$4.465	NA/183	NA
VW	\$169.651	\$14.175	NA/345	NA
Hyundai-Kia	NA	NA	NA	NA

Sources: 2005 Annual Reports of Honda, Toyota, DaimlerChrysler, Ford, GM, and VW; 2004 Annual Report of Nissan.

* Nissan values are for 2004; all others are for 2005.

Appendix B: Most and Least Efficient Vehicles

Table B-1. Most and least efficient vehicles in each class. Note that the fuel economy levels given are the laboratory 45/55 fuel economy levels. These are the readings used to determine compliance with CAFE standards, not the fuel economy levels reported on vehicle stickers.

	Most Efficient	Fuel Economy (mpg)	Least Efficient	Fuel Economy (mpg)
Two Seater	Honda INSIGHT	68.4	Lamborghini L-147-148 MURCIELAGO	13.0
Mini-compact Car	BMW MINI COOPER	35.1	Aston Martin V12 VANQUISH	15.2
Subcompact Car	Toyota YARIS	41.6	Maserati COUPE CAMBIOCORSA	17.1
Compact Car	Honda CIVIC HYBRID	58.8	Bentley Continental GT	16.2
Midsize Car	Toyota PRIUS	65.8	Bentley ARNAGE	13.8
Large Car	Toyota AVALON	29.7	Bentley ARNAGE LWB	13.8
Small Wagon	Toyota Scion XB	37.0	VW S4 AVANT	20.4
Midsize Wagon	Ford FOCUS SW	33.1	Mercedes-Benz E55 AMG	19.8
Large Wagon	Chrysler PACIFICA 2WD	22.7	Mercedes-Benz R500	17.4
Midsize Van	Ford FREESTYLE FWD	26.5	Ford MONTEREY WAGON FWD	22.1
Large Van	GM G1500-2500 AVANA 2WD CARGO	19.9	Ford E150 CLUB WAGON	17.9
Small SUV	Subaru FORESTER AWD	28.7	Chrysler WRANGLERTJ 4WD	18.7
Midsize SUV	Ford ESCAPE HYBRID FWD	38.5	Mitsubishi MONTERO	19.0
Large SUV	Nissan MURANO FWD	25.9	Ford NAVIGATOR 2WD	17.0
Small Pickup	Subaru BAJA AWD	26.3	Subaru BAJA AWD	26.3
Midsize Pickup	Mazda B2300 2WD	29.0	Mazda B4000 4WD	19.8
Large Pickup	Nissan FRONTIER 2WD	25.7	GM K1500 SIERRA AWD	17.7

Source: Heavenrich.