Analysis and Future Direction of the Corporate Average Fuel Economy

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Abstract

The Corporate Average Fuel Economy (CAFÉ) standard was first implemented in 1978 as a means to reduce oil consumption from passenger vehicles and light trucks. CAFÉ states that the average fuel economy for each auto manufacturer's vehicles must meet a minimum fuel economy level, in terms of miles per gallon (mpg), which in 2006 is 27.5 mpg for passenger vehicles and 21.6 mpg for light trucks.

CAFÉ has played an important role in increasing passenger vehicle fuel economy from 18 mpg in 1978 to 30.0 mpg in 2005, though fuel prices are also an essential factor. Unfortunately, it is probable that CAFÉ had a negative impact on safety since manufacturers began to produce lighter cars to increase fuel economy and comply with CAFÉ standards. Consequently, these vehicles provided less occupant protection, which in turn resulted in additional traffic fatalities.

Several options exist with respect to the future direction of the CAFÉ program. These include simply raising the CAFÉ standard, changing CAFÉ to be based on a vehicle's physical attributes instead of averaging fuel economy across a manufacturer's entire fleet, classifying more light trucks as passenger vehicles, and tradable fuel economy credits. Whichever strategy to increase fuel economy is selected, auto manufacturers must be given sufficient lead time in order to engineer and implement new fuel-saving technologies into their vehicles without compromising safety and while providing the features American consumers have come to expect and demand.

According to the U.S. Department of Energy, the United States in 1997 consumed 19 million, or 26%, of the 73 million barrels of oil consumed per day worldwide. Of the 19 million barrels consumed per day in the U.S., cars and light trucks consumed about 7.6 billion barrels, or 40% of total U.S. consumption[1]. In an attempt to reduce oil consumption the U.S. government enacted legislation in 1975 to establish the Corporate Average Fuel Economy (CAFÉ) standard, which established minimum fuel economy levels in terms of miles per gallon of gasoline for passenger vehicles and light trucks.

The purpose of this paper is to assess the CAFÉ program as well as examine possible future directions of CAFÉ. In doing so, the benefits and impacts of CAFÉ will be examined from a multi-dimensional perspective, as vehicle fuel economy is the product of a number of interrelated vehicle attributes and market forces, including vehicle size and mass, engine horsepower and technology, and consumer preference and demand. This paper will provide a background history of CAFÉ, provide an overview of the current structure of the CAFÉ program, and then analyze the impact of CAFÉ since its introduction in 1978. The paper will conclude by discussing recent developments and possible future directions of the CAFÉ program.

Background History of CAFÉ

In response to the 1973 oil crisis, the Energy Policy and Conservation Act (EPCA) was signed into law on December 22, 1975. Two of the major items enacted through this legislation were the establishment of the Strategic Petroleum Reserve and the Corporate Average Fuel Economy, which specified that the sales-weighted average of the vehicles for a

[1] 'Automobile Fuel Economy: Potential Effects of Increasing the Corporate Fuel Economy Standards', General Accounting Office, August 2000

given manufacturer's product line meet a minimum fuel economy level and that the administration of CAFÉ would be overseen by the National Highway Traffic Safety Administration (NHTSA). Prior to the establishment to CAFÉ, average fuel economy had declined from 14.8 miles per gallon (mpg) in model year 1967 to 12.9 mpg in 1974. The EPCA that established CAFÉ set a standard of 18 mpg for passenger vehicles beginning with 1978 model year vehicles that gradually increased to 27.5 mpg for model year 1985 vehicles, where the CAFÉ standard remains today. Implementation of the CAFÉ standard represented a more than doubling of average fuel economy between 1974 and 1985. Furthermore, CAFÉ set fuel economy standards for light duty trucks that began at 17.2 mpg for 2-wheel drive vehicles and 15.8 mpg for 4-wheel drive vehicles in model year 1979 that increased to 20.7 mpg by 1991. CAFÉ for light trucks was reduced from 1992-1996 to 20.2 mpg. However, CAFÉ was raised back to 20.7 mpg in 1996 and remained unchanged until the 2004 model year. On March 31, 2003, NHTSA issued new light truck standards that increased light truck CAFÉ to 21.0 mpg for the 2005 model year that increased to 21.6 mpg for 2006 and 22.2 mpg for 2007. In March 2006, NHTSA issued light truck standards for model year 2008-2010 light trucks, which will be: 22.5, 23.1, and 23.5 mpg, respectively.

In addition to setting average fuel economy standards for passenger vehicles and light duty trucks, CAFÉ also contained several other important provisions, including penalties for noncompliance, the 'two fleet rule', and special treatment of alternative fuel vehicles for CAFÉ calculation purposes. These items, as well as the current structure of CAFÉ, are described in greater detail in the following section.

Current structure of CAFE

To be able to analyze and study potential changes to CAFÉ, it is essential to first understand how CAFÉ for an automobile manufacturer is calculated and how the program is currently structured. It is important to note that CAFÉ for passenger vehicles is set legislatively, while the NHTSA was given the authority to set light truck CAFÉ at the "maximum feasible level" based on technological feasibility, economic practicability, effect of other standards on fuel economy, and the need of the nation to conserve energy. To determine CAFÉ, a given manufacturer's fleet of vehicles is first divided into passenger vehicles and light trucks. Passenger vehicles are defined as any 4-wheel vehicle not designed for off-road use that is manufactured primarily for use in transporting 10 people or less. A light truck is defined as a vehicle that meets one of the following criteria:

a. A 4-wheel drive vehicle or a vehicle that is rated at 6,000 or below pounds gross vehicle weight and has at least four of the following characteristics: approach angle of not less than 28 degrees; breakover angle of not less than 14 degrees; departure angle of not less than 20 degrees; running clearance of not less than 20 centimeters; or front and rear axle clearances of not less than 18 centimeters each.
b. It can perform at least one of the following functions: 1) transport more than 10 people; 2) provide temporary living quarters; 3) transport an open bed; 4) permit greater cargo-carrying capacity than passenger-carrying volume; 5) can be converted to an open bed vehicle to rear seats to form a flat continuous floor with the use of simple tools.

Next, passenger vehicles are subdivided into domestic and import, which is known as the two fleet rule. Passenger vehicles are considered domestic if 75% or more of the cost to the manufacturer is attributable to value added in the U.S., Canada, or Mexico. A passenger vehicle with less than 75% domestic content is classified as an import passenger vehicle. Light trucks were once divided into import and domestic, but this was eliminated beginning in the 1996 model year. As a result, there is now only one category for light trucks. However, an important caveat is that light trucks exceeding 8,500 lbs. gross vehicle weight (GVW) are exempt from CAFÉ.

The two fleet rule was instituted mainly to appease the United Auto Workers (UAW) union, who feared that American auto manufacturers would meet CAFÉ requirements by reducing production (and the associated jobs) of less fuel efficient domestically produced models and importing more fuel efficient vehicles. The UAW hoped the two fleet rule would prevent this by forcing manufacturers to manufacture more fuel efficient vehicles in the U.S., thus maintaining UAW jobs.

The next step is to calculate a manufacturer's CAFÉ for each of the three vehicle categories. For 2006 model year vehicles, a manufacturer's domestic and import fleet of passenger vehicles must separately meet a minimum CAFÉ of 27.5 MPG, and its light trucks must meet a minimum CAFÉ of 21.6 MPG. Fuel economy figures are provided to the NHTSA by the auto manufacturers and are then validated by the U.S. Environmental Protection Agency.

To calculate a manufacturer's CAFÉ, assume that Honda produces four vehicles in 2005: A, B, C, and D. Vehicle A gets 30 mpg, and 300,000 units are manufactured. Vehicle B gets 27 mpg, and 200,000 units are manufactured. Vehicle C gets 25 mpg, and 200,000

units are manufactured. Vehicle D gets 32 mpg, and 300,000 units are manufactured. Honda's CAFÉ would be:

(Total production of Vehicles A, B, C, and D) /
{(Vehicle A production / Vehicle A mpg) + (Vehicle B production / Vehicle B mpg) + (Vehicle C production / Vehicle C mpg) + (Vehicle D production / Vehicle D mpg)}

(300,000 + 200,000 + 200,000 + 300,000) / {(300,000/30) + (200,000/27) + (200,000/25) + (300,000/32)}
= 1,000,000 / (10,000 + 7407.4 + 8000 + 9375) = 28.75 MPG

Since the CAFÉ passenger vehicle standard is 27.5 mpg, Honda is in compliance with CAFE.

Though the formula for calculating light truck CAFÉ is currently the same as for passenger vehicles, the NHTSA published a new rule in April 2006 that allows manufacturers to comply with either the current CAFÉ system or the 'Reformed CAFÉ System' for model year 2008-2010 light trucks. Beginning in the 2011 model year, all light truck fleets must conform to the Reformed CAFÉ system. Under the Reformed CAFÉ system, light trucks must meet or exceed the fuel economy standard set for its size and weight, or footprint, which is calculated by multiplying the distance between the centerline of the tires (the track) by the distance between the centers of the axles (the wheelbase). Therefore, large trucks such as a Hummer have a different target mpg than a smaller truck such as a Honda CR-V.

In addition to producing more fuel-efficient vehicles, manufacturers can also increase their CAFÉ by producing alternative or flexible fuel vehicles. For example, if a vehicle runs

exclusively on an alternative fuel, its CAFÉ mpg is its fuel economy divided by 0.15. This means an alternative fuel vehicle that gets 15 mpg on the alternative fuel would be rated at 100 mpg for CAFÉ purposes. In the case of duel fuel vehicles, suppose a vehicle runs on gasoline 50% of the time and gets 25 mpg, and ethanol 50% of the time getting 15 mpg. The CAFÉ mpg for this vehicle would be: 1/{(0.5/25) + (0.5/100)} = 40 mpg. The 100 is obtained by dividing 15 mpg by 0.15. For model years 1993-2010, the maximum increase in any given year from alternative fuel vehicles to a manufacturer's passenger or light truck fleet CAFÉ is 1.2 mpg.

If a given manufacturer fails to meet CAFÉ standards for either their domestic passenger, import passenger, or light truck fleet, the manufacturer is subject to a penalty of $5.50 per tenth of a MPG under CAFÉ multiplied by the total volume of vehicles sold in the affected category. For example, if Toyota's light truck CAFÉ is 21.3 mpg for model year 2006, it is 0.3 mpg under the CAFÉ light truck standard of 21.6. The penalty would be (21.6 –21.3) x 10 x $5.50 x (number of light trucks Toyota manufacturers in model year 2006). Between 1983 and 2003, over $650 million in CAFÉ penalties have been levied, all against European manufacturers. The single largest CAFÉ penalty ever levied was for $27,985,925 against BMW for their 2001 model year import passenger vehicle fleet[2], when their CAFÉ was 25.0 mpg.

However, it is possible for a manufacturer to obtain credits to reduce or eliminate its CAFÉ penalties by exceeding CAFÉ standards in a given year. Using the above example of Honda, Honda exceeded the CAFÉ standard by 1.25 mpg. Therefore, for 2005 Honda would get a credit of: (28.75-27.5) x 10 x production volume of 1,000,000 vehicles = $12,500,000.

[2] Summary of CAFÉ fines collected, http://www.nhtsa.gov/cars/rules/CAFE/FINES-COLLECTED-SUMMARY.html

This credit can be carried forward for three years, which means if Honda fails to meet CAFÉ standards in 2007 and is fined $5,000,000, it can apply the $12,500,000 credit obtained in 2005 to offset the $5,000,000 fine. If a manufacturer does not have any stored credits, it can choose to file a carry back plan that describes how it will exceed CAFÉ standards in the subsequent three years, thus generating excess credits to offset their current year deficit.

Analysis of CAFÉ

Twenty-eight years have elapsed since CAFÉ first took effect in 1978, which is a sufficient amount of time to examine the impact CAFÉ standards have had on vehicle performance, including fuel economy, horsepower, and safety.

Three vehicle performance measures can be used to gauge the impact of CAFÉ: fuel economy expressed in miles per gallon of gasoline, 0-60 miles per hour (mph) acceleration measured in seconds, and horsepower. These attributes will be examined in the context of three time periods: 1978-1985, 1987-2001, and 2001-2005. The baseline for these measures is 1978, which was the first year CAFÉ standards were applied. In that year, CAFÉ was set at 18.0 mpg and actual CAFÉ for all passenger vehicles sold was 19.9 mpg, 1.9 mpg above the standard. By 1985, the CAFÉ standard had increased to 27.5 mpg, while actual passenger vehicle CAFÉ increased 39.6% from 19.9 mpg in 1978 to 27.6 mpg in 1985. In terms of light trucks, actual CAFÉ increased 12% from 18.2 in 1979 to 20.7 mpg in 1985. Overall, total fleet (passenger vehicles plus light trucks) CAFÉ increased 28% from 19.9 in 1978 to 25.4 in 1985. The highest CAFÉ level ever achieved by the total fleet of passenger vehicles and light trucks was 26.2 mpg in 1987.

The impact of CAFÉ can also be viewed from the perspective of horsepower and acceleration. 1978 passenger vehicles on average had 3.68 horsepower (hp) per 100 lbs. of weight. This ratio dipped slightly by 1982, and rebounded to 3.84 hp / 100lbs in 1985[3]. As a result, average 0-60 mph passenger vehicle acceleration actually *decreased* from 13.5 seconds[4] in 1978 to a low point of approximately 14.2 seconds in 1982. It was not until 1985 that vehicles could accelerate at about the same rate as 1978 vehicles.

Between 1987 and 2001, the CAFÉ standard was unchanged at 27.5 mpg and actual passenger vehicle CAFÉ remained in a narrow range between 28.5 to 28.8 mpg. However, during that same time period the vehicle horsepower to weight ratio increased 33% from 3.98 hp to 5.31 hp per 100 lbs. Unsurprisingly, average 0-60 mph passenger vehicle acceleration decreased from about 13.1 seconds in 1987 to 10.5 seconds in 2001.

From 2001 to 2005, actual passenger vehicle CAFÉ increased from 28.8 to 30.0 mpg, even though the CAFÉ standard remained unchanged at 27.5 mpg. Horsepower rose only slightly, from 5.31 hp / 100 lbs. in 2001 to 5.54 hp / 100 lbs in 2005.

In looking at the three time periods discussed above (1978-1985, 1987-2001, and 2001-2005), several trends can be identified. In the period of 1978-1985, total fleet fuel economy increased by 28%. The fuel economy, acceleration, and horsepower data clearly indicates that during this period manufacturers invested their research and development funds into increasing fuel economy to meet rising and mandated CAFÉ standards instead of increasing horsepower and acceleration. Some of the technological improvements implemented to meet the new standards included front wheel drive, improved engines, expanded use of fuel injection, and improved aerodynamics, as well as vehicle weight

[3] '2004 Automotive Fuel Economy Program', National Highway Traffic Safety Administration, 2004
[4] 'A New CAFÉ', ACCESS, University of California Transportation Center, Fall 2001
http://www.uctc.net/access/access19.pdf

reductions. However, between 1987-2001, once the CAFÉ standard had been met manufacturers began to significantly increase vehicle horsepower and acceleration. On the other hand, this trend reversed from 2001 to 2005 as fuel economy increased 4% while average passenger vehicle horsepower remained virtually unchanged.

In examining the impact of CAFÉ, a critical question to ask is what extent CAFÉ influenced fuel economy and whether the new vehicle fleet would have experienced similar fuel economy levels had CAFÉ not been enacted, given market forces and fuel prices. Though passenger vehicle fuel economy undoubtedly has increased, particularly from 1978 to 1985, it is difficult to quantify the amount CAFÉ regulation and rising fuel prices separately contributed to increased fuel economy. According to the U.S. Department of Energy, gasoline prices increased from $0.65 per gallon in 1978 (all gasoline prices are unadjusted for inflation) to $1.25 in 1981, and leveled off at about $1.20 between 1982-1985[5]. Fuel prices remained relatively stable throughout the 1990s at about $1.25 per gallon. However, gasoline prices spiked from 2002-2005 from about $1.40 to $2.35 per gallon.

Comparing fuel prices to fuel economy shows that fuel economy corresponds closely with fuel prices. When fuel prices increased from 1978-1985, fuel economy did as well. Furthermore, as fuel prices remained steady throughout the 1990s, vehicle performance increased significantly while fuel economy did not. Finally, the 68% increase in gasoline prices between 2001-2005 was accompanied by a 4% rise in average passenger vehicle fuel economy. Therefore, rising fuel prices probably would likely have driven increases in fuel economy regardless of CAFÉ. For example, increasing fuel costs would provide a stronger incentive for both manufacturers and consumers to invest in new (and more costly)

[5] 'Annual Energy Review 2005', Energy Information Administration, U.S. Department of Energy http://www.eia.doe.gov/emeu/aer/pdf/perspectives.pdf

technologies to improve fuel economy. In addition, higher fuel prices result in consumers purchasing smaller and more fuel-efficient vehicles, which in turn would raise average fuel economy.

On the other hand, it is likely that rising fuel prices alone would not have resulted in the same fuel economy increase that was accomplished through CAFÉ standards, particularly in the 1978-1985 timeframe. As previously noted, the fuel economy of passenger vehicles increased 39% between 1978 and 1985 to meet the mandated CAFÉ standard of 27.5 mpg. During that period, gasoline prices doubled. In comparison, gasoline prices increased 68% from 2001 to 2005 but having already exceeded the 27.5 mpg CAFÉ standard and without a higher legislatively mandated CAFÉ target, the increase in gasoline prices resulted in a 4% rise in fuel economy. The relatively small increase between 2001 to 2005 compared to the large increase between 1978-1985 can be explained by the fact that consumers consider a number of factors when purchasing an automobile, such as performance, fuel economy, reliability, safety, price, styling, and comfort and convenience features. In response, manufacturers produce vehicles that result in the optimal balance of these factors and cannot produce vehicles that sacrifice performance, comfort, and convenience to significantly increase fuel economy without significant risk to vehicle sales. As fuel prices rose and consumers demanded more fuel-efficient vehicles in the 2001-2005 period, manufacturers responded by introducing vehicles that collectively raised passenger vehicle fuel economy 4%. In comparing the 1978-1985 and 2001-2005 time periods, it appears unlikely that fuel economy would have increased 39% from 1978-1985 solely by market forces. This is demonstrated by the fact that when unconstrained by CAFÉ standards and guided by market forces, as they were from 2001-2005, fuel economy increased but by only 4%. Therefore it

can be concluded that in the absence of regulation, higher fuel prices will increase consumer demand for more fuel efficient vehicles, which will in turn provide manufacturers with the incentive to increase the fuel efficiency of their vehicles.

In summary, consumer demand, fuel prices, and legislatively mandated CAFÉ standards all contributed to the fuel economy levels that exist today. Though CAFÉ standards probably raised fuel economy more than market forces would have between 1978-1985, it is very difficult to draw any conclusions as to where fuel economy levels would be today if CAFÉ had never been enacted.

Impact of CAFÉ on vehicle safety

One of the most controversial aspects of the CAFÉ program has been the relationship between CAFÉ and vehicle safety. Opponents of CAFÉ argue that because CAFÉ raised fuel economy too much too quickly, manufacturers were forced to achieve higher fuel standards by reducing vehicle weight, which in turn made cars less safe and resulted in higher vehicle fatality rates. Conversely, CAFÉ supporters argue that CAFÉ has had no impact on safety and that any claims of higher fatality rates cannot be substantiated.

Three studies have been produced that conclude that CAFÉ did indeed compromise vehicle safety through reduced vehicle weight. Robert Crandall, an economist at the Brookings Institution, authored a 1989 study in the Journal of Law and Economics on the subject[6]. In his study, he estimated that CAFÉ alone resulted in a vehicle weight reduction of about 500 lbs. and that this reduction resulted in 2,000-4,000 additional traffic deaths over the 10-year life span of 1989 model year vehicles. Second, a 1997 NHTSA study determined that

[6] 'The Effect of Fuel Economy Standards on Vehicle Safety', Robert D. Crandall and John D. Graham, Journal of Law and Economics, April 1989. http://www.fortfreedom.org/s51.htm

reducing the weight of passenger cars by 100 lbs. and keeping all other vehicle's weight equal would result in about 300 additional highway fatalities per year. On the other hand, reducing the weight of light trucks by 100 lbs. and keeping other vehicle weights the same would result in no effect on highway fatalities[7]. A third study by the Transportation Research Board concluded that the 'downweighting and downsizing that occurred in the late 1970s and early 1980s, some of which was due to CAFÉ standards, probably resulted in an additional 1,300 to 2,600 traffic fatalities in 1993'[8].

Conversely, David Greene, a Corporate Research Fellow at the Oak Ridge National Laboratory, published a report entitled 'The Effect of Fuel Economy on Vehicle Safety: A Reexamination' in 2004[9] that drew two conclusions. First, higher mpg is significantly correlated with fewer fatalities. Second, national aggregate accident statistics cannot support the assertion that increased fuel economy has resulted in increased traffic fatalities.

Based on these studies, it appears as that CAFÉ caused at least some additional traffic fatalities, though the exact amount is difficult to determine. All of the studies, however, emphasized that traffic fatalities are the result of a number of different factors in addition to vehicle mass and size, such as vehicle design, presence of (or lack of) safety features such as side airbags and stability control, road design, seat belt use, driver experience, alcohol, etc. More importantly, a General Accounting Office report noted that providing manufacturers 6-10 years lead time before higher fuel standards would take effect should be sufficient to minimize negative safety effects because fuel savings would be achieved using technology

[7] 'Automobile Fuel Economy: Potential Effects of Increasing the Corporate Fuel Economy Standards', General Accounting Office, August 2000
[8] 'Effectiveness and Impact of Corporate Fuel Economy Standards', Committee on the Effectiveness and Impact of Corporate Average Fuel Economy (CAFE) Standards, Board on Energy and Environmental Systems, Division on Engineering and Physical Sciences, Transportation Research Board, 2002
[9] 'The Effect of Fuel Economy on Vehicle Safety: A Reexamination', David Greene and Sanjana Ahmad, November 2004 http://cta.ornl.gov/cta/Publications/Reports/TRB_05_1336_AhmadGreene.pdf

instead of weight reductions[10]. This is a critical factor to consider when contemplating possible changes to CAFÉ standards.

Future directions and policy recommendations

Given the current structure of CAFÉ and twenty-eight years of data on fuel economy and vehicle safety since its implementation in 1978, what will happen to CAFÉ in the future? In April 2006 NHTSA increased light truck CAFÉ to 23.5 mpg by the 2010 model year and introduced the reformed CAFÉ system, which sets fuel economy targets based on a combination of vehicle length and width instead of the traditional CAFÉ system based on the average fuel economy across a manufacturer's light truck fleet. Given the path that NHTSA has set for light truck CAFÉ, what other options exist to improve vehicle fuel economy?

There are several alternate paths for the CAFÉ program, such as: 1) retaining the basic CAFÉ structure but eliminating the two fleet rule, changing the definitions of passenger vehicles and light trucks, and raising the CAFÉ standard; 2) modifying fuel economy regulations, which would include the introduction of tradable fuel economy credits, feebates, and attribute based fuel economy targets; and 3) adoption of energy reduction policies that would be used in lieu of or in conjunction with increases in CAFÉ.

The first option is to maintain the basic structure of CAFÉ, which calculates fuel economy on a sales weighted basis and sets a minimum fleetwide average mpg target, but eliminate the two fleet rule and change the definitions of passenger vehicles and light trucks. As previously noted, under the two fleet rule manufacturers' domestic and import passenger vehicle fleets are required to separately meet the 27.5 mpg fleetwide average fuel economy.

[10] 'Automobile Fuel Economy: Potential Effects of Increasing the Corporate Fuel Economy Standards', General Accounting Office, August 2000

Originally, this rule was intended to protect American jobs. However, there has not been any substantive analysis indicating that elimination of the two fleet rule would directly result in the loss of U.S. manufacturing jobs, or conversely, that maintaining the rule would protect American jobs. Thus, the rule appears to no longer be justifiable and could be eliminated.

As light truck sales have dramatically increased, revisions to the classification of passenger vehicles and light trucks could be implemented to help minimize the effect of different CAFÉ standards for passenger vehicles and light trucks. This discrepancy has become an increasingly important issue due to the sheer number of light trucks sold each year in the United States. Consider that in 1979, only 10% of new vehicle sales were light trucks, which at that time were primarily used for work and/or freight transportation purposes. In 2003, sales of light trucks (7,898,421), of which many were now being used mainly for personal transport, exceeded those of passenger vehicles (7,893,881) for the first time. This trend continued in 2004, with 8,380,031 light trucks sold to 8,017,060 passenger vehicles sold. Though passenger vehicle CAFÉ increased to 30.0 in 2005, light truck CAFÉ held steady at 21.4 mpg. This is the reason overall fleet CAFÉ remained between 24.6 and 25.6 mpg from 1987-2005. Furthermore, though light truck CAFÉ standards are set to rise to 23.5 mpg by 2010, they are still lower than the passenger vehicle standard of 27.5 mpg. Because of this, auto manufacturers have an incentive to classify its vehicles as light trucks in order to meet the lower fuel standard. Two possible changes to address this issue would be to modify the criteria for defining a light truck and passenger vehicle to more broadly define passenger vehicles or reduce the economic incentive for a manufacturer to classify its vehicles as light trucks by raising the light truck CAFÉ standard.

If the basic structure of CAFÉ is retained, the next logical question would be how high CAFÉ standards can be raised. On this subject, it appears clear that technologies exist that can significantly reduce fuel consumption over the next 15 years. What is less certain is the level where the marginal cost to implement these technologies is lower than the marginal benefit of the fuel savings. However, since a precedent has been set (with the new light truck CAFÉ standards) for gradually increasing CAFE, it is reasonable for manufacturers to expect that the federal government will continue to impose gradual increases to CAFÉ. The challenge is to raise CAFÉ to a level that is both realistic from a cost, performance, and technical standpoint and does not force manufacturers to degrade vehicle performance and comfort today's consumers demand. It has been estimated that CAFÉ for passenger vehicles can realistically be increased 12-27% by 2015 and 25-42% for light trucks[11].

Tradable fuel economy credits offer another option to the current CAFÉ structure. Under this system, manufacturers achieving fuel economy levels higher than the targeted level would be given credits, while manufacturers whose vehicle fuel economy that is lower than the target would have to purchase credits from other manufacturers or the government. The first advantage of this system is that it creates flexibility in meeting fuel economy targets. For example, if the cost to the manufacturer of increasing fuel economy to the target level is greater than the market price for credits, then the manufacturer could purchase credits without sacrificing the performance of its vehicles. On the other hand, if the cost of increasing fuel economy to the target level were lower than the credit cost, the manufacturer would then allocate its resources to increase the fuel economy of its vehicles. This system would also help to establish the market value of fuel economy improvements. Furthermore, a system of

[11] 'The Geography of Urban Transportation Third Edition', Chapter 10 Transportation and Energy, pg. 290, Hanson and Giuliano, 2004

tradable credits would add a financial incentive to manufacturers to generate as many credits as possible to sell (or use themselves) at a later date.

A variation of the tradable credits system is the feebate system. This system would establish a target fuel economy for each vehicle class, possibly similar to the reformed CAFÉ system, as opposed to the sales-weighted average system of CAFÉ. Manufacturers who do not meet the fuel economy target would pay a fee or would receive a rebate from the government if they exceed the target.

The next option for reforming CAFÉ is to implement a Uniform Percentage Increase (UPI), which means all manufacturers would be required to improve its CAFÉ by a certain percentage, perhaps 10%. While this would allow for incremental improvements in fuel economy by each manufacturer, it rewards those who begin with the lowest CAFÉ because they would need to achieve the least amount of improvement. Conversely, it is unfair to those companies who have already achieved high fuel economy because it would force them to achieve higher fuel economy targets than any other manufacturer. Because of these reasons, the UPI does not appear to be a strategy worth pursuing due to equity concerns.

A completely different approach to reducing fuel consumption instead of raising CAFÉ standards is to increase gasoline taxes. This option would encourage consumers to purchase more fuel-efficient vehicles as well as motivate manufacturers to produce them. If this were accomplished national fuel consumption would also decrease, thereby achieving the same goal that CAFÉ strives for. However, increasing fuel taxes solely for the purpose of reducing fuel consumption would be politically difficult since the gas tax has always been used to pay for transportation projects and not as an instrument to influence consumer behavior. Furthermore, attempts to raise fuel taxes, even to pay for transportation projects,

have stalled. In addition, some argue that gas taxes unfairly punish rural families that must drive long distances, as well as the poor. Despite the political difficulties, a recent Brookings Institution study concluded that an increase in gasoline taxes is a less costly option for reducing fuel consumption than raising CAFÉ standards. Specifically, the report stated that a 3.0 mpg CAFÉ increase would result in a decrease of 5.242 billion gallons of gasoline used but cost $4.841 billion, or $0.93 per gallon, in economic value. However, a tax of $0.111 per gallon could accomplish the same 5.242 billion gallon reduction, though at a much lower cost[12].

In listing and evaluating the possible options for increasing fuel economy, which options appear to be the most feasible and likely to be implemented? Because of the democratic process present in the U.S. and the broad group of stakeholders involved, policy changes generally occur gradually and incrementally. With respect to CAFÉ, change is also likely to be gradual and incremental. One change fitting these criteria would be to gradually raise CAFÉ, which is being done for light trucks, and apply the Reformed CAFÉ standard, which is used to calculate light truck CAFÉ and bases fuel economy standards on a vehicle's physical attributes instead of averaging fuel economy across a manufacturer's entire fleet, as CAFÉ currently does, to passenger vehicles. Since the Reformed CAFÉ system is already scheduled for implementation, manufacturers will be accustomed to the system and have already begun to integrate the requirements of the reformed CAFÉ standard into their light truck product plans. Therefore, it would not be a great stretch to expand the use of the reformed standard to passenger vehicles. Doing so would eliminate the need for manufacturers to sell high fuel economy or alternative fueled vehicles simply to increase their

[12] 'Impacts of Long Range Increases to the Corporate Fuel Economy Standard', AEI-Brookings Joint Center for Regulatory Studies, October 2002

average fleetwide fuel economy and focus on producing and improving the fuel economy of vehicles that the consumer market demands. It is important to note, however, that passenger vehicle CAFÉ standards are set by legislative action and not by NHTSA. As a result, proposing potential changes to passenger vehicle CAFÉ would likely become more politicized than light truck changes were.

In the longer term, it is plausible that tradable fuel economy credits could be implemented to supplement the CAFÉ system. A recent TRB report[13] concluded that tradable credits would be less costly than the current CAFÉ system, would provide more flexibility and options to automotive companies, provide a better understanding of the cost of fuel economy changes, and provide incentives to manufacturers to improve fuel economy. As a result, tradable credits might enable higher fuel efficiency standards to be implemented while also reducing the economic costs of meeting those standards.

Conclusion

The CAFÉ standard was first implemented in 1978 as a means to reduce oil consumption from passenger vehicles and light trucks. Since then, CAFÉ has played an important role in increasing passenger vehicle fuel economy from 18 mpg in 1978 to 30.0 mpg in 2005. The impact of CAFÉ was particularly evident from 1978-1985, when passenger vehicle fuel economy increased 50% and total fleet fuel economy increased by 28%. In all likelihood, fuel economy would not have risen at this rate in the absence of CAFÉ standards. However, CAFÉ is not the sole reason for increased fuel economy since increases in fuel economy can be attributed to both rising fuel prices and CAFÉ standards. For example,

[13] 'Effectiveness and Impact of Corporate Fuel Economy Standards', Committee on the Effectiveness and Impact of Corporate Average Fuel Economy (CAFE) Standards, Board on Energy and Environmental Systems, Division on Engineering and Physical Sciences, Transportation Research Board, 2002

increasing fuel prices correlated with increasing fuel economy from 2001-2005 even though the CAFÉ standard has remained unchanged since 1985. Unfortunately, it is probable that CAFÉ had a negative impact on safety since manufacturers began to produce lighter cars to increase fuel economy and comply with CAFÉ standards. Consequently, these vehicles provided less occupant protection, which in turn resulted in additional traffic fatalities.

In looking to the future, there appears to be consensus that fuel economy can be raised, but there is not consensus as to how much fuel economy can be raised or the best way to achieve that objective. No matter what strategy or fuel economy level is selected, the lessons learned from the CAFÉ experience indicate that fuel economy cannot be raised too much too quickly. This is because manufacturers need sufficient lead time, on the order of 6-10 years, to engineer and implement new fuel-saving technologies into their vehicles to meet any new standards. Without sufficient lead time auto manufacturers will likely turn to vehicle weight reductions to meet higher fuel efficiency standards, since this is the simplest method of increasing fuel economy. However, doing so will likely result in less safe vehicles and additional vehicle-related fatalities. On the other hand, if given sufficient lead time, manufacturers should be able to produce vehicles that achieve greater fuel economy levels while also providing the acceleration, roominess, safety, and comfort and convenience that American consumers have come to expect and demand.

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