Corporate Average Fuel Economy

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The Corporate Average Fuel Economy (CAFE) are regulations in the United States, first enacted by US Congress in 1975,[1] and intended to improve the average fuel economy of cars and light trucks (trucks, vans and sport utility vehicles) sold in the US in the wake of the 1973 Arab Oil Embargo. Historically, it is the sales-weighted harmonic mean fuel economy, expressed in miles per gallon (mpg), of a manufacturer's fleet of current model year passenger cars or light trucks with a gross vehicle weight rating (GVWR) of 8,500 pounds (3,856 kg) or less, manufactured for sale in the US.

This system would have changed with the introduction of "Footprint" regulations for light trucks binding in 2011, but the 9th Circuit Court of Appeals returned that rule for reconsideration for, among other things, being "arbitrary and capricious".[2] The most recent revision of CAFE that passed in 2007 no longer exempts light trucks classified as SUVs or passenger vans, unless they exceed 10,000 lb (4,500 kg) GVWR; it applies to pickup trucks and cargo vans up to 8,500 lb (3,900 kg) – as was the case for SUVs. In 1999, over half a million vehicles exceeded the GVWR and so the CAFE standard did not apply.[3] In 2011, the standard will change to include many larger vehicles.[4] The US and Canada have the weakest standards in terms of fleet-average fuel economy rating among first world nations, e.g. 25 mpg in the US, versus 45 mpg in the European Union and higher in Japan (2008).[5] However, the US and Canada have the toughest emissions requirements (in terms of parts per million of pollutants). Some higher-mileage vehicles in Europe would not meet US (and California) emissions standards.

The National Highway Traffic Safety Administration (NHTSA) regulates CAFE standards and the US Environmental Protection Agency (EPA) measures vehicle fuel efficiency. US Congress specifies that CAFE standards must be set at the "maximum feasible level" given consideration for:

1. technological feasibility;
2. economic practicality;
3. effect of other standards on fuel economy;
4. need of the nation to conserve energy.

Historically, the EPA has encouraged consumers to buy more fuel efficient vehicles, while the NHTSA expressed concerns that smaller, more fuel efficient vehicles may lead to increased traffic fatalities.[6][7] Thus higher fuel efficiency was associated with lower traffic safety, intertwining the issues of fuel economy, road-traffic safety, air pollution, and climate change. In the mid 2000s, increasing safety of smaller cars and the poor safety record of light trucks began to reverse this association.[8]

If the average fuel economy of a manufacturer's annual fleet of car and/or truck production falls below the defined standard, the manufacturer must pay a penalty, currently $5.50 USD per 0.1 mpg under the standard, multiplied by the manufacturer's total production for the U.S. domestic market.

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http://en.wikipedia.org/wiki/Corporate_Average_Fuel_Economy
Effect on automotive fuel economy

In 2002, a committee of the National Academy of Sciences wrote a report on the effects of the CAFE standard. The report's conclusions include a finding that in the absence of CAFE, and with no other fuel economy regulation substituted, motor vehicle fuel consumption would have been approximately 14 percent higher than it actually was in 2002. One cost of this increase in fuel economy is a possible increase in fatalities, estimated to be 1,300 to 2,600 increased fatalities in 1993, albeit with certain of the committee members dissenting.

A plot of average overall vehicle fuel economy (CAFE) for new model year passenger cars, the required by law CAFE standard target fuel economy value (CAFE standard) for new model year passenger cars, and fuel prices, adjusted for inflation, shows that there has been little variation over the past 20 years. Within this period, there are three distinct periods of fuel economy change:

1. from 1979-1982 the fuel economy rose as the CAFE standard rose dramatically and the price of fuel increased;
2. from 1984-1986 the fuel economy rose as the CAFE standard rose as the price of fuel decreased rapidly;
3. from 1986-1988 the fuel economy rose at a significantly subdued rate and eventually leveled off as the price of fuel fell and the CAFE standard was relaxed before returning to 1986 levels in 1990. These are following by an extended period during which the passenger car CAFE standard, the observed average passenger car fuel economy, and the price of gasoline remained stable, and finally a period starting about 2003 when prices rose dramatically and fuel economy has slowly responded.

Simple economics would predict that an increase in gasoline prices would lead in the long run to an increase in the average fuel economy of the US passenger car fleet, and that a drop in gasoline prices would be associated with a reduction in the average fuel economy of the entire US fleet. There is some evidence that this happened with an increase in market share of lower fuel economy light trucks and SUVs and decline in passenger car sales, as a percentage of total fleet sales, as car buying trends changed during the 1990s, the impact of which is not reflected in this chart. In the case of passenger cars, US average fuel economy did not fall as economic theory would predict, suggesting that CAFE standards maintained the higher fuel economy of the passenger car fleet during the long period from the end of the 1979 energy crisis to the rise of gasoline prices in the early 2000s. Most recently, fuel economy has increased about one mpg from 2006 to 2007. This
increase is due primarily to increased fuel efficiency of imported cars.\textsuperscript{[15]} Similarly, Simple Economics predicts that due to the US's large percentage consumption of the world's oil supply, that increasing fuel economy would drive down the gasoline prices that US consumers would otherwise have to pay—reductions in petroleum demand in the United States helped create the collapse of OPEC market power in 1986.\textsuperscript{[9]}

The "CAFE" and "CAFE standard" shown here only regards new model passenger car fuel economy and target fuel economy (respectively) rather than the overall US fuel economy average which tends to be dominated by used vehicles manufactured in previous years, new model light truck CAFE standards, light truck CAFE averages, or aggregate data.\textsuperscript{[16][17]}

### Calculation

Fleet fuel economy is calculated using a harmonic mean, not a simple arithmetic mean (average) \textsuperscript{[3]}— namely, the reciprocal of the average of the reciprocal values. For a fleet composed of four different kinds of vehicle A, B, C and D, produced in numbers \( n_A, n_B, n_C \) and \( n_D \), with fuel economies \( f_A, f_B, f_C \) and \( f_D \), the CAFE would be:

\[
\frac{n_A + n_B + n_C + n_D}{\frac{n_A}{f_A} + \frac{n_B}{f_B} + \frac{n_C}{f_C} + \frac{n_D}{f_D}}
\]

For example, a fleet of 4 vehicles getting 15, 13, 17, and 100 mpg has a CAFE of slightly less than 19 mpg:

\[
\frac{4}{\frac{1}{15} + \frac{1}{13} + \frac{1}{17} + \frac{1}{100}} = 18.83
\]

While the arithmetic mean fuel economy of the fleet is just over 36 mpg:

\[
\frac{15 + 13 + 17 + 100}{4} = 36.25
\]

The harmonic mean captures the fuel economy of driving each car in the fleet for the same number of miles, while the arithmetic mean captures the fuel economy of driving each car using the same amount of gas (i.e. the 13 mpg vehicle would travel 13 miles with one gallon while the 100 mpg vehicle would travel 100 miles).

For the purposes of CAFE, a manufacturer's car output is divided into a domestic fleet (vehicles with more than 75 percent U.S., Canadian or post-NAFTA Mexican content) and a foreign fleet (everything else). Each of these fleets must separately meet the requirements. The two-fleet requirement was developed by the United Automobile Workers (UAW) as a means to ensure job creation in the US. The UAW successfully lobbied Congress to write this provision into the enabling legislation – and continues to advocate this position.\textsuperscript{[18]} The two fleet rule for light trucks was removed in 1996.

For the fuel economy calculation for alternative fuel vehicles, a gallon of alternative fuel is deemed to contain 15% fuel (which is approximately the amount of gasoline in a gallon of E85) \textsuperscript{[19]} as an incentive to develop alternative fuel vehicles.\textsuperscript{[20]} The mileage for dual-fuel vehicles, such as E85 capable models, is computed as the average of its alternative fuel rating -- divided by 0.15 (equal to multiplying by 6.666) -- and its gasoline rating. Thus an E85-capable vehicle that gets 15 mpg on E-85 and 25 mpg on gasoline might logically be rated at 20 mpg. But in fact the average, for CAFE purposes, despite perhaps only one percent of the fuel used in E85-capable vehicles is actually E85, is computed as 100 mpg for E-85 and the standard 25 mpg for gasoline, or 62.5 mpg.\textsuperscript{[9]} However, the total increase in a manufacturer's average fuel economy rating due to dual-fueled vehicles cannot exceed 1.2 mpg.\textsuperscript{[21]}

Manufacturers are also allowed to earn CAFE "credits" in any year they exceed CAFE requirements, which they may use to offset deficiencies in other years. CAFE credits can be applied to the three years before or
after the year in which they are earned. The reason for this flexibility is so manufacturers are penalized only for persistent failure to meet the requirements, not for transient non-compliance due to market conditions.

**Historical standards**

Fuel economy regulations were first introduced in 1978, only for passenger vehicles. The next year, a second category was defined for light trucks. These were distinguished from heavy duty vehicles by a gross vehicle weight rating (GVWR) of 6000 pounds or less. The GVWR threshold was raised to 8500 pounds in 1980 and has remained at that level through 2007. Thus certain large trucks and SUV's are exempt, such as the Hummer and the Ford Excursion. From 1979-1991, separate standards were established for two wheel drive (2WD) and four wheel drive (4WD) light trucks, but for most of this period, car makers were allowed to choose between these separate standards or a combined standard to be applied to the entire fleet of light trucks they sold that model year. In 1980 and 1981, respectively, a manufacturer whose light truck fleet was powered exclusively by basic engines which were not also used in passenger cars could meet standards of 14 mpg and 14.5 mpg.

**CAFE standards for each model year in miles per gallon**

<table>
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<tr>
<th>Model Year</th>
<th>Passenger Cars</th>
<th>Light Trucks</th>
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<td>4WD</td>
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<tr>
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Since 1980, the traditional Japanese manufacturers have increased their combined fleet average fuel economy by 1.6 miles per gallon according to the March 30, 2009 Summary of Fuel Economy Performance published annually by NHTSA. During this time, they also increased their sales in the US by 221%. The traditional European manufacturers actually decreased their fleet average fuel economy by 2 miles per gallon while increasing their sales volume by 91%. The traditional US manufacturers, Chrysler, Ford and General Motors, increased their fleet average fuel economy by 4.1 miles per gallon since 1980 according to the latest government figures. During this time the sales of US manufacturers decreased by 29%.

Current standards

Cars and light trucks are considered separately for CAFE and are held to different standards. As of early 2004, the average for cars must exceed 27.5 mpg, and the light truck average must exceed 20.7 mpg. Trucks under 8500 pounds must average 22.5 mpg in 2008, 23.1 mpg in 2009, and 23.5 mpg in 2010. After this, new rules set varying targets based on truck size "footprint."

In late 2007, CAFE standards received their first overhaul in more than 30 years. On December 19, President Bush signed into law the Energy Independence and Security Act of 2007, which requires in part that automakers boost fleetwide gas mileage to 35 mpg by the year 2020. This requirement applies to all passenger automobiles, including "light trucks." Politicians had faced increased public pressure to raise CAFE standards; a July 2007 poll conducted in 30 congressional districts in seven states revealed 84-90% in favor of legislating mandatory increases.[23]

Overall fuel economy for both cars and light trucks in the U.S. market reached its highest level in 1987, when manufacturers managed 26.2 mpg (8.98 L/100 km). The average in 2004 was 24.6 mpg.[22] In that time, vehicles increased in size from an average of 3,220 pounds to 4,066 pounds (1,461 kg to 1,844 kg), in part due to an increase in truck ownership during that time from 28% to 53%.

A number of manufacturers choose to pay CAFE penalties rather than attempt to comply with the regulations. As of model year 2006, BMW, DaimlerChrysler, Volkswagen, Ferrari, Porsche and Maserati failed to meet CAFE requirements.[24]

For the 2008 model year, Mercedes-Benz had the lowest fleet average while Lotus had the highest.[25]

Future

http://en.wikipedia.org/wiki/Corporate_Average_Fuel_Economy
The effect of Energy Independence and Security Act on CAFE standards

On December 19, 2007, President George W. Bush signed the Energy Independence and Security Act. This Act aims at improving vehicle fuel economy. The Act set a goal for the national fuel economy standard of 35 miles per gallon (mpg) by 2020. This would increase the fuel economy standards by 40 percent and save the United States billions of gallons of fuel.[26] This standard is the first standard that has been set above the Corporate Average Fuel Economy standards (CAFE) since it was created in 1975.

CAFE standards since 1975 have increased very slowly till date. In 1978, the CAFE standard for passenger cars was 18.0mpg. At the time of the signing of the Energy Independence and Security Act (EISA) in 2007, the standard for passenger cars was 27.5mpg which was the same as the standard that was set in 1990. This has been the peak standard for passenger cars. This peak standard was first set in 1985 and then it was lowered to 26mpg in 1986 and got back to the peak again in 1990. The combined standard for light trucks experienced a much more gradual increase from 17.5mpg in 1982 to 22.2mpg in 2007. The light truck Average Fuel Economy Standards for model years (MY) 2005 to 2007 were 21.0mpg for MY2005, 21.6mpg for MY2006 and 22.2mpg for MY2007.[27] In 2006, the rule making for light trucks for model years 2008 - 2011 included a reform to the structure for CAFE standards for light truck and gave manufacturers the option for model years 2008-2010 to comply with the reformed standard or to comply with the unreformed standard. The reformed standard was based on the vehicle foot print.[28] The unreformed standard for 2008 was set to be 22.5mpg.

To achieve the target of 35mpg authorized under EISA for the combined fleet of passenger cars and light truck for MY2020, NHTSA is required to continue raising the CAFE standards. In determining a new CAFE standard, NHTSA must assess the environmental impacts of each new standard and the effect of this standard on employment. With the EISA, NHTSA needed to take new analysis including taking a fresh look at the potential impacts under the National Environmental Policy Act (NEPA) and assessing whether or not the impacts are significant within the meaning of NEPA.

NHTSA has to issue its new standards eighteen months before the model year for fleet. According to NHTSA report, in order to achieve this industry wide combined fleet of at least 35mpg, NHTSA must set new standards well in advance of the model year so as to provide the automobile manufacturers with lead time enough to make extensive necessary changes in their automobiles. The EISA also called for a reform where the standards set by the Transportation Department would be attribute based so as to ensure that the safety of vehicles is not compromised for higher standards.

New CAFE credit trading provisions

CAFE changes enacted by the 110th Congress (The Energy Independence and Security Act P.L. 110-140, H.R. 6), instructed NHTSA to establish a credit trading and transferring scheme to allow manufacturers to transfer credits between categories, as well as sell them to other manufacturers or non-manufacturers. In addition, the period over which credits could be carried forward was extended from three years to five. Traded or transferred credits may not be used to meet the minimum standard in the domestic passenger car fleet, however they may be used to meet the 'attribute standard'.[29] This latter allowance has drawn criticism from the UAW which fears it will lead manufacturers to increase the importation of small cars to offset shortfalls in the domestic market.

These new flexibilities were implemented by regulation on March 23, 2009 in the Final Rule for 2011 Model Year Passenger Cars and Light Trucks.

Calculations using official CAFE data, and the newly proposed credit trading flexibility contained in the September 28, 2009 Notice of Proposed Rulemaking show that ninety-eight percent of the benefit derived from just the cross fleet credit trading provision flows to Toyota. According to these calculations 75% of the benefit from the two new CAFE credit trading provisions, cross fleet trading and 5-year carry-forward, falls to foreign manufacturers. Toyota can use the provision to avoid or reduce compliance on average by 0.69 mpg per year through 2020,
- Hyundai (1.01 mpg),
- Nissan (0.65),
- Honda (0.83 mpg),
- Mitsubishi (0.13 mpg),
- Subaru (0.08),
- Chrysler (0.14 mpg),
- GM (0.09 mpg), and
- Ford (0.18 mpg) also benefit.

The estimated value of the CAFE exemption gained by Toyota is $2.5 billion; Honda’s benefit is worth $0.8 billion, and Nissan’s benefit is valued at $0.9 billion in reduced CAFE compliance costs. Foreign companies gained $5.5 billion in benefits compared with the $1.8 billion that went to the Detroit Three.

**Future**

The CAFE rules for trucks were officially amended at the end of March 2006. However, the 9th Circuit Court of Appeals has overturned the rules, returning them to NHTSA, stating that the rules must be made stricter. These changes would have segmented truck fleets by vehicle size and class as of 2011. All SUVs and passenger vans up to 10,000 pounds GVWR[31] would have had to comply with CAFE standards regardless of size, but pickup trucks and cargo vans over 8500 pounds gross vehicle weight rating (GVWR) would have remained exempt.

Under the new final light truck CAFE standard 2008-2011, fuel economy standards would have been restructured so that they are based on a measure of vehicle size called "footprint," the product of multiplying a vehicle's wheelbase by its track width. A target level of fuel economy would have been established for each increment in footprint using a continuous mathematical formula. Smaller footprint light trucks had higher fuel economy targets and larger trucks lower targets. Manufacturers who made more large trucks would have been allowed to meet a lower overall CAFE target, manufacturers who make more small trucks would have needed to meet a higher standard. Unlike previous CAFE standards there was no requirement for a manufacturer or the industry as a whole to meet any particular overall actual MPG target, since that will depend on the mix of sizes of trucks manufactured and ultimately purchased by consumers. Some critics pointed out that this might have had the unintended consequence of pushing manufacturers to make ever-larger vehicles to avoid strict economy standards.[32] However, the equation used to calculate the fuel economy target had a built in mechanism that provides an incentive to reduce vehicle size to about 52 square feet (the approximate midpoint of the current light truck fleet.)

The Ninth Circuit Court of Appeals found these new Light Truck rules to be arbitrary and capricious; contrary to the Energy Policy and Conservation Act; incorrectly set a value of zero dollars to the global warming damage caused by truck emissions; failed to set a "backstop" to prevent trucks from emitting more CO₂ than in previous years; failed to set standards for vehicles in the 8,500 to 10,000 lb (4,500 kg) range; that the environmental impact assessment was inadequate, and that the rules may have had significant negative impact on the environment. The court directed NHTSA to prepare a new standard as quickly as possible and to fully evaluate that new standard's impact on the environment.[2]
In addition to the new light truck rules of 2006 and the Ninth Court decision, in December 2007 Congress passed the Energy Independence and Security Act of 2007 which will affect CAFE standards of both cars and trucks and additionally work trucks and medium and heavy duty on-highway vehicles. This standard requires ratable increases in fuel efficiency during the model years 2011 to 2020 reaching 35 mpg in 2020 for the total fleet of passenger and non-passenger automobiles. In the years 2021 to 2030 the standards requires MPG to be the "maximum feasible" fuel economy. The law allows NHTSA to issue additional requirements for cars and trucks based on the "footprint" model or other mathematical standard. Additionally each manufacturer must meet a minimum standard of the higher of either 27.5 mpg for passenger automobiles or 92% of the projected average for all manufacturers. National Highway Traffic Safety Administration (NHTSA) is directed based on National Academy of Sciences studies to set medium and heavy-duty truck MPG standards to the "maximum feasible". Additionally the law phases out the mpg credit previously granted to E85 flexible-fuel vehicle manufacturers and adds in one for biodiesel, and it adds a requirement that NHTSA publish replacement tire fuel efficiency ratings. The bill also adds support for initial state and local infrastructure for plug-in electric vehicles. How the Ninth Court decision will be reconciled to this new law remains undecided, but if the court issue is resolved and the new law goes into effect and if actual achieved combined corporate CAFE remains at 26.7 mpg until then, then average fleet-wide new vehicle mpg would increase by 0.8 mpg a year starting in 2011.

On April 22, 2008 NHTSA responded to this Energy Independence and Security Act of 2007 with proposed new fuel economy standards for cars and trucks effective model year 2011.[33] It is not clear how the 9th Circuit Court of Appeals case will interact with these new rules. The new rules also introduce the "footprint" model for cars as well as trucks, where if a manufacturer makes more large cars and trucks they will be allowed to meet a lower standard for fuel economy. This means that an overall fuel efficiency for a particular manufacturer nor the fleet as a whole cannot be predicted with certainly since it will depend on the actual product mix manufactured. However, if the product mix is as NHTSA predicts, car fuel economy would increase from a current standard of 27.5 mpg\textsubscript{US} (8.55 L/100 km; 33.0 mpg\textsubscript{imp}) to 31.0 mpg\textsubscript{US} (7.59 L/100 km; 37.2 mpg\textsubscript{imp}) in 2011. The new regulations are designed to be "optimized" with respect to a certain set of assumptions which include: gas prices in 2016 will be $2.25 a U.S. gallon (59.4¢/L), all new car purchasers will pay 7% interest rates on their vehicles purchases, and only care about fuel costs for the first 5 years of a vehicle's life, and that the value of global warming is $7 per ton CO\textsubscript{2}. This corresponds to a global warming value of $4.31 savings a year per car under the new regulations. Further, the new regulations assume that no advanced hybrids (Toyota Prius), plug-in hybrids and extended range electric vehicles (Chevrolet Volt), electric cars (Th!nk City), nor alternative fuel vehicles (Honda Civic GX) will be used to achieve these fuel economies. The new rules also propose again that California (and the other States following California's lead) be stripped of their historic right to set their own more stringent automotive air pollution standards.

On January 26, 2009, President Barack Obama directed the Department of Transportation to review relevant legal, technological, and scientific considerations associated with establishing more stringent fuel economy standards, and to finalize the 2011 model year standard by the end of March. This single-model year standard was issued March 27, 2009 and is about one mpg lower than the fuel economy standards previously recommended under the Bush Administration. "These standards are important steps in the nation's quest to achieve energy independence and bring more fuel efficient vehicles to American families," said Secretary LaHood. The new standards will raise the industry-wide combined average to 27.3 miles per US gallon (8.62 L/100 km; 32.8 mpg\textsubscript{imp}) (a 2.0 mpg\textsubscript{US} (2.4 mpg\textsubscript{imp}) increase over the 2010 model year average), as estimated by the National Highway Traffic Safety Administration (NHTSA). It will save about 887,000,000 U.S. gallons (3.36 × 10\textsuperscript{9} L) of fuel and reduce carbon dioxide emissions by 8.3 million metric tons. This 2011 single-year standard will use an attribute-based system, which sets fuel economy standards for individual vehicle models, based on the "footprint" model. Secretary LaHood also noted that work on the multi-year fuel economy plan for model years after 2011 is already well underway. The review will include an evaluation of fuel saving technologies, market conditions and future product plans from the manufacturers. The effort will be coordinated with interested stakeholders and other federal agencies, including the Environmental Protection Agency.[34] The news rules were immediately challenged in court again by the Center for Biological Diversity as not addressing the inadequacies found by the previous court rulings.[35] The interaction between these future rules, the collapse of the auto industry in the United States, the listing by EPA on March
20, 2009 of CO₂ as a global warming pollution dangerous to human welfare, and the willingness indicated by environmental groups to apply once again to the courts for a ruling that these standards are inadequate, again left the future of fuel economy standards in the United States in doubt.

On May 19, 2009 President Barack Obama proposed a new national fuel economy program which adopts uniform federal standards to regulate both fuel economy and greenhouse gas emissions while preserving the legal authorities of DOT, EPA and California. The program covers model year 2012 to model year 2016 and ultimately requires an average fuel economy standard of 35.5 miles per US gallon (6.63 L/100 km; 42.6 mpg) in 2016 (of 39 miles per gallon for cars and 30 mpg for trucks), a jump from the current average for all vehicles of 25 miles per gallon. Obama said, "The status quo is no longer acceptable."[36] The result is a projected reduction in oil consumption of approximately 1.8 billion barrels over the life of the program and a projected total reduction in greenhouse gas emissions of approximately 900 million metric tons. Ten car companies and the UAW embraced the national program because it provides certainty and predictability to 2016 and includes flexibilities that will significantly reduce the cost of compliance. Stated goals for the program included: saving consumers money over the long term in increased fuel efficiency, preserving consumer choice—the new rules do not dictate the size of cars, trucks and SUVs that manufacturers can produce; rather it requires that all sizes of vehicles become more energy efficient, reduced air pollution in the form of greenhouse gas emissions and other conventional pollutants, one national policy for all automakers, instead of three standards (a DOT standard, an EPA standard and a California standard that would apply to 13 other states), and industry desires: clarity, predictability and certainty concerning the rules while giving them flexibility on how to meet the expected outcomes and the lead time they need to innovate. The new policy will result in yearly 5% increases in efficiency from 2012 through 2016, 1.8 Billion barrels of oil saved cumulatively over the lifetime of the program and significant reductions in greenhouse gas emissions equivalent to taking 177 million of today's cars off the road.[37]

There are a large number of technologies that manufacturers can apply to improve fuel efficiency short of implementing hybrid or plug-in hybrid technologies. Applied aggressively, at a cost of several thousand dollars per vehicle, the Union of Concerned Scientists estimates that these technologies can almost double MPG.[38]

Some technologies, such as four valves per cylinder, are already widely applied in cars, but not trucks. Manufacturers dispute how effective these technologies are, their retail price, and how willing customers are to pay for these improvements. Payback on these improvements is highly dependent on fuel prices.[39]

Active debate

CAFE does not directly offer incentives for customers to choose fuel efficient vehicles, nor does it directly affect fuel prices. Rather, it attempts to accomplish these goals indirectly by making it more expensive for automakers to build inefficient vehicles by introducing penalties.[9] The conservative Heartland Institute contends that CAFE standards do not work economically to consumers' benefit, that smaller cars are more likely to be damaged in a collision, and that insurance premiums for them are higher than for many larger cars.[40] However, the Insurance Companies' Highway Loss Data Institute publishes data showing that larger vehicles are more expensive to insure.[41]

CAFE advocates assert most of the gains in fuel economy over the past 30 years can be attributed to the standard itself,[42] while opponents assert economic forces are responsible for fuel economy gains, where higher fuel prices drove customers to seek more fuel efficient vehicles.[43] CAFE standards have come under attack by some conservative think tanks, along with safety experts, car and truck manufacturers, some consumer and environment groups, and organized labor.[40]

Effect on traffic safety

Historically, NHTSA has expressed concerns that automotive manufacturers will increase mileage by reducing vehicle weight, which might lead to weight disparities in the vehicle population and, increased danger for
occupants of lighter vehicles. However, vehicle safety ratings are now made available to consumers by NHTSA[44] and by the Insurance Institute for Highway Safety.[45] A National Research Council report found that the standards implemented in the 1970s and 1980s "probably resulted in an additional 1,300 to 2,600 traffic fatalities in 1993.[9] A Harvard Center for Risk Analysis study found that CAFE standards led to "2,200 to 3,900 additional fatalities to motorists per year.[46] The Insurance Institute for Highway Safety's 2007 data show a correlation of about 250-500 fatalities per year per MPG.[47] Proponents of higher CAFE standards argue that it is the "Footprint" model of CAFE for trucks that encourages production of larger trucks with concomitant increases in vehicle weight disparities, and point out that some small cars such as the Mini Cooper and Toyota Matrix are four times safer than SUVs like the Chevy Blazer.[47] They argue that the quality of the engineering design is the prime determinant of vehicular safety, not the vehicle's mass. In a 1999 article based on a 1995 IIHS report, USA Today said that 56% of all deaths occurring in small cars were due to either single vehicle crashes or small cars impacting each other. The percentage of deaths attributed to those in small cars being hit by larger cars was one percent.[48] In 2006, IIHS found that some of the smallest cars have good crash safety, while others do not, depending upon the engineering design.[49] In a 2007 analysis, IIHS found that 50 percent of fatalities in small four-door vehicles were single vehicle crashes, compared to 83 percent in very large SUVs. The Mini Cooper had a fatality rate of 68 per million vehicle-years, compared to 115 for the Ford Excursion.[47] A 2005 IIHS plot shows that in collisions between SUVs weighing 3,500 lb (1,600 kg) and cars, the car driver is more than 4X more likely to be killed, and if the SUV weighs over 5,000 lb (2,300 kg) the car driver is 9 times more likely to be killed, with 16 percent of deaths occurring in car-to-car crashes and 18 percent in car-to-truck crashes.[50] Recent studies find about 75 percent of two-vehicle fatalities involve a truck, and about half these fatalities involve a side-impact crash. Risk to the driver of the other vehicle is almost 10 times higher when the vehicle is a one ton pickup compared to an imported car. And a 2003 Transportation Research Board study show greater safety disparities among vehicles of differing price, country of origin, and quality than among vehicles of different size and weight.[51] These more recent studies tend to discount the importance of vehicle mass to traffic safety, pointing instead to the quality of engineering design as the primary factor.[52]

**Increased oil and automobile usage**

*Main article: Jevons paradox*

As fuel efficiency rises, people drive their cars more, which offsets some of the gains that might be had in carbon dioxide emissions from the higher standards. While driving more results from the increased economic benefit to consumers of higher efficiency vehicles, the National Academies Report (Page 19)[9] estimates this "rebound effect" as reducing the gains from increased fuel economy by only 10-20 percent.

It is also possible that because higher-efficiency vehicles are more expensive, auto buyers may choose to keep their older cars (some of which are less efficient) for longer before making a new purchase.[40]

However, associated costs, such as increased deaths, may be more than offset by savings on a global scale, because increased CAFE standards reduce reliance on increasingly expensive and unreliable sources of imported petroleum[53] and lower the probability of global climate change by reducing US emissions of carbon dioxide.

**Economic arguments**

In the May 6, 2007 edition of *Autoline Detroit*, Bob Lutz, a automobile designer/executive of BMW and Big Three fame, asserted that the CAFE standard was a failure and said it was like trying to fight obesity by requiring tailors to make only small-sized clothes.[54]

Proponents state that automobile-purchasing decisions that may have global effects should not be left entirely up to individuals operating in a free market.[9]
Automakers have said that small, fuel-efficient vehicles cost the auto industry billions of dollars. They cost almost as much to design and market but cannot be sold for as much as larger vehicles such as SUVs, because consumers expect small cars to be inexpensive.[48] In 1999 USA Today reported small cars tend to depreciate faster than larger cars, so they are worth less in value to the consumer over time.[48] However, 2007 Edmunds depreciation data show that some small cars, primarily premium models, are among the best in holding their value.[55]

### Automaker viewpoints & consumer preferences

Historically, automakers and some conservative groups have believed consumers don't prioritize fuel economy. In 2003, Alliance of Automobile Manufacturers spokesman Eron Shosteck asserted automakers produce more than 30 models rated at 30 mpg or more for the US market, and they are poor sellers.[56] In 2004, GM retiree Charles Amann said statistically, consumers do not pick the weak-performing vehicle when given a choice of engines.[57] However, after a spike in gas prices, a 2006 Consumer Reports survey concluded fuel economy is the most important consideration in consumers' choice of vehicle[58] and a 2007 Pew Charitable Trusts survey found that nine out of ten Americans favor tougher CAFE standards, including 91% of Democrats and 85% of Republicans.[59] In 2007, the 55 mpg Toyota Prius outsold the top-selling SUV, the 17 mpg Ford Explorer.[60][61] In late 2007, GM Vice Chairman Bob Lutz called hybrid gasoline-electric vehicles the "ideal solution",[62] In 2008, GM advertised fuel economy improvements and their upcoming Chevrolet Volt Extended Range Electric Vehicle,[63][64], and developed corporate branding for their fuel economy technologies, and though GM Chairman Rick Wagoner admitted he doesn't know which fuel efficiency technologies consumers really want he said "we are moving fast with technologies like E-85 (ethanol), all-electric, fuel cells and a wide range of hybrid offers."[65][66]

In 1999, automakers asserted they couldn't lobby for the repeal of CAFE standards, because consumers would learn small cars are unsafe and not buy them, or would try to sue the manufacturers.[48] However, NHTSA's public record shows the automakers publicly express opposition to CAFE increases.[16]

### SUVs and minivans created due to original mandate

The definitions for cars and trucks are not the same for fuel economy and emission standards. For example, a Chrysler PT Cruiser is defined as a car for emissions purposes and a truck for fuel economy purposes.[9] Under the current light truck fuel economy rules, the PT Cruiser will have a higher fuel economy target (28.05 mpg beginning in 2011) than it would if it were classified as a passenger car.[67] CAFE standards signaled the end of the traditional long station wagon, but legendary former Chrysler CEO Lee Iacocca developed the idea of marketing the minivan as a station wagon alternative, while certifying it in the separate truck category to allow compliance with less-strict emissions standards. Eventually, this same idea led to the promotion of the SUV.[68][69]

New York, New Jersey, Pennsylvania, Connecticut and California disagreed with the NHTSA statement in the 2008-2011 Light Truck standard which claimed preemption of the state greenhouse gas regulations, on the basis that fuel economy and carbon dioxide emissions are one and the same. The EPA[70] claims, contrary to NHTSA, that the use of alternative fuels allows greenhouse gas emissions to be controlled somewhat independently of fuel efficiency.

### Calculations of MPG overestimated

The United States Environmental Protection Agency (EPA) laboratory measurements of MPG have consistently overestimated fuel economy of gasoline vehicles and underestimated diesel vehicles.[71] John DeCicco, the automotive expert for the Environmental Defense Fund (EDF), estimated that this results in about 20% higher actual consumption than measured CAFE goals.[72] Starting with 2008-model vehicles, the EPA has adopted a new protocol for estimating the MPG figures presented to consumers. The new protocol includes...
driving cycles more closely representative of today's traffic and road conditions, as well as increased air conditioner usage.[73] This change does not affect how the EPA calculates CAFE ratings; the new protocol changes only the mileage estimates provided for consumer information.[74][75]

NHTSA spends one-third of one percent of its budget on CAFE, or $0.014 per US citizen,[76][77]

Other arguments in favor

Other conservative groups support higher gas mileage on the basis of national security,[78] or on the basis of stewardship of the Earth.[79]

See also

- Air pollution
- Battery electric vehicle
- California Air Resources Board
- Carbon tax
- Emission standard
- Energy Independence and Security Act
- Range-extended vehicle
- Fuel efficiency
- Fuel economy in automobiles
- Hybrid electric vehicle
- Light truck
- Miles per gallon
- Miles per gallon gasoline equivalent
- National Highway Traffic Safety Administration
- Plug-in hybrid
- Road-traffic safety
- United States Environmental Protection Agency

References

3. ^ a b "CAFE Overview" (http://www.nhtsa.dot.gov/cars/rules/cafe/overview.htm) . NHTSA.

http://en.wikipedia.org/wiki/Corporate_Average_Fuel_Economy


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**External links**

- NHTSA: Corporate Average Fuel Economy (http://www.nhtsa.dot.gov/portal/site/nhtsa/menuitem.d0b5a45b55bfbe582f57529c6ba046a0/)

**News**

- Calls for US regulators to consider more aggressive fuel efficiency standards (http://www.planetark.com/dailynewsstory.cfm/newsid/49350/story.htm)

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