

A PRIMER TO FUEL ECONOMY AND EMISSIONS STANDARDS



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Introduction

An important transition within the automotive industry is underway as fuel economy and carbon dioxide (CO₂) emissions regulations quickly accelerate through the year 2025. The industry will be required by regulation to increase fuel efficiency of the U.S. fleet from 27.5 miles per gallon (MPG) for passenger cars and 23.4 MPG for light duty trucks in 2010 to an estimated 54.5 MPG for all vehicles in model year (MY) 2025. 54.5 MPG, a number used by the administration, regulators and frequently reported by media, is an estimate of what the industry must meet in 2025. In reality, it is a representation of a complex set of measurements. The actual fuel economy target required will depend on a variety of factors and will even differ from manufacturer to manufacturer.

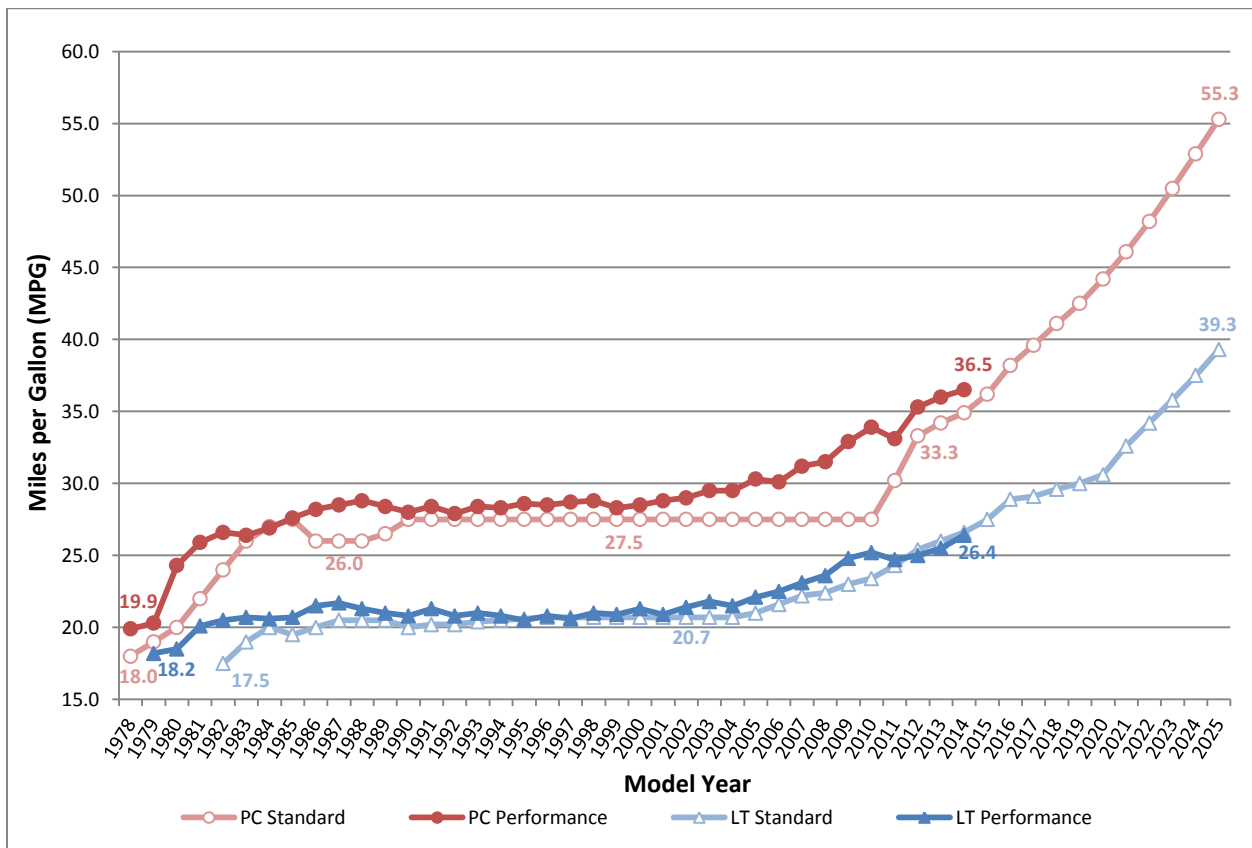
Among the factors that determine the official standard for a vehicle manufacturer are: the footprint of a vehicle, the distribution of truck and passenger car sales, and the market share of credit or incentive enabling technology. The following document will describe some of these factors and identify implications as the industry moves forward.

U.S. Fuel Economy and CO₂ Regulation

Historically, light duty vehicles in the United States were held to a fuel economy standard. Fuel economy regulations in the United States are regulated by the National Highway Transportation Safety Agency (NHTSA). In response to the 1973 oil crisis, the U.S. Congress passed the Energy Policy and Conservation Act (EPCA) in 1975, established the Corporate Average Fuel Economy (CAFE) program in an attempt to decrease U.S. dependence on foreign oil. CAFE refers to the average fuel efficiency—measured in miles per gallon (MPG)—of all the vehicles a company produces for a given MY that are sold in the United States. Figure 1 shows historical and future required CAFE, as well as actual performance to the regulation.¹

¹ NHTSA. (2014). "Summary of Fuel Economy Performance (Public Version)." National Highway Traffic Safety Administration, U.S. Department of Transportation. June 26, 2014. <http://www.nhtsa.gov/staticfiles/rulemaking/pdf/cafe/June_2014_Summary_Report.pdf>.

Figure 1 Corporate Average Fuel Economy Summary by Year (Actual Performance & Regulatory Standard) for Passenger Cars (PC) and Light Trucks (LT), MYs 1978-2025



Source: NHTSA 2009, NHTSA 2011, and NHTSA 2014

From 1978 to 1985, the combined CAFE requirement for passenger cars increased more than 50 percent from 18.0 MPG to 27.5 MPG, and the actual fuel economy of vehicles sold also increased. In response to petitions from automakers struggling to meet CAFE requirements, NHTSA relaxed the standard for MYs 1986-1989.² For MY 1990 the CAFE standard was restored to its 1985 level of 27.5 MPG and remained unchanged until MY 2011.³

From the mid-1980s through 2010, CAFE requirements for passenger cars remained virtually unchanged, while light truck regulation increased starting in 2005. Improvements in vehicle efficiency were used to satisfy consumer preferences for performance (e.g., improved horsepower, torque, and acceleration) and other features (e.g., improved ride and handling, safety, air conditioning, stereos, power seats and mirrors, sun roofs, and emissions equipment) rather than increasing fuel economy.⁴ In addition, a shift in

² Klier, Thomas and Joshua Linn. (2011). "Corporate Average Fuel Economy Standards and the Market for New Vehicles." Federal Reserve Bank of Chicago. January 2011. <<https://www.chicagofed.org/~media/publications/working-papers/2011/wp2011-01-pdf.pdf>>.

³ Yacobucci, Brent D. and Robert Bamberger. (2007). "Automobile and Light Truck Fuel Economy: The CAFE Standards." Congressional Research Service. January 19, 2007. <<http://www.cnire.org/NLE/CRSreports/07Jan/RL33413.pdf>>.

⁴ Knittel, Christopher R. (2011). "Automobiles on Steroids: Product Attribute Trade-Offs and Technological Progress in the Automobile Sector." American Economic Review, 101(7): 3368-3399. December 2011. <<http://pubs.aeaweb.org/doi/pdfplus/10.1257/aer.101.7.3368>>.

market share from passenger cars to SUVs during that period led to lower overall CAFE requirement than would have been expected had the vehicle segmentation mix remained constant.⁵

The intent of the CAFE standard is to reduce or limit the use of petroleum for light duty vehicle transportation. For nearly 40 years this has been the standard to which vehicle manufacturers were held to in regards to fuel economy; however, in 2007 a U.S. Supreme Court ruling of *Massachusetts vs. Environmental Protection Agency (EPA)* forced the EPA to rule on greenhouse gases (including CO₂) as a pollutant.⁶ In 2009, the EPA released its endangerment finding, in which it declared that greenhouse gases (GHGs), including those from motor vehicles, endanger the health and welfare of Americans and merit regulation.⁷ Due to the close relationship between fuel economy and tailpipe CO₂ emissions, the EPA was essentially required to regulate fuel economy—a task that had traditionally been the domain of NHTSA. Subsequent to the ruling, NHTSA and the EPA have created what is referred to as a harmonized CAFE and GHG regulation for light duty vehicles through MY 2021. The EPA rule has additional regulation set through 2025, while NHTSA has augural regulations through 2025 which will be reviewed during the mid-term evaluation.

Regulation of GHG emissions from vehicles has also taken place at the state level in California. In 2002, the California State Assembly passed a law requiring California Air Resource Board (ARB) to regulate GHG emissions from vehicles. In September 2004, CARB approved regulatory standards which would limit GHG emissions from new passenger vehicles and light duty trucks beginning with MY 2009.⁸ In order to proceed with the new standards, CARB required a waiver from EPA, which it requested in December 2005.⁹ After the April 2007 Supreme Court ruling, the EPA announced two public hearings to consider the California waiver request.¹⁰ In May 2009, CARB agreed to harmonize its GHG emissions standards with those proposed by EPA and NHTSA in return for a waiver from EPA,¹¹ and in June 2009, EPA granted the waiver.¹²

Although this paper will mainly address CO₂ emitted, it is important to note the other greenhouse gases emitted by light vehicles are also considered by EPA. The EPA finding identified six greenhouse gases – carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF₆) – as a threat to public health and welfare of the current and future

⁵ Ibid. Knittel. (2011).

⁶ Supreme Court. (2007). “Supreme Court of the United States: *Massachusetts et al. V. Environmental Protection Agency et al.*” Legal Information Institute, Cornell University Law School. April 2, 2007. <<https://www.law.cornell.edu/supct/html/05-1120.ZS.html>>.

⁷ Federal Register. (2009). “Endangerment and Cause or Contribute Findings for Greenhouse Gases Under Section 202(a) of the Clean Air Act.” Federal Register, National Archives and Records Administration, 77(239): 66496-66546. December 15, 2009. <http://www.epa.gov/climatechange/Downloads/endangerment/Federal_Register-EPA-HQ-OAR-2009-0171-Dec.15-09.pdf>.

⁸ CARB. (2007). “Fact Sheet: Climate Change Emissions Standards for Vehicles.” California Air Resources Board, California Environmental Protection Agency. May 30, 2007. <<http://www.arb.ca.gov/cc/ccms/factsheets/ccfaq.pdf>>.

⁹ Under the Clean Air Act, California is allowed to set standards that are stricter than federal standards, but required a waiver from the EPA to do so. Once California receives a waiver, other states can elect to adopt California’s standards.

¹⁰ Ibid. CARB. (2007).

¹¹ Nichols, Mary D. (2009). Letter to The Honorable Lisa P. Jackson, Administrator of the United States Environmental Protection Agency and The Honorable Ray LaHood, Secretary of the United States Department of Transportation. California Air Resources Board, California Environmental Protection Agency. May 18, 2009. <<http://www.epa.gov/otaq/climate/regulations/air-resources-board.pdf>>.

¹² EPA. (2009). “EPA Grants California GHG Waiver.” U.S. Environmental Protection Agency. June 30, 2009. <<http://yosemite.epa.gov/opa/admpress.nsf/6427a6b7538955c585257359003f0230/5e448236de5fb369852575e500568e1b!OpenDocument>>.

population. The automobile emits four (CO₂, CH₄, N₂O, and HFCs) of the regulated pollutants.¹³ However, tailpipe CO₂ represents approximately 88.7 percent of GHG emissions from light vehicles, and is directly related to fuel consumption (Table 1).¹⁴ Clearly meaningful reductions in CO₂ must be focused on tailpipe emissions. While the authors note this difference, for this paper, unless otherwise stated, CO₂ and GHG will be considered interchangeable. It is important to note that while CO₂ is the dominate pollutant for today's vehicles; other pollutants may restrict the use of certain advanced technology due to the high global warming potential of those pollutants.

Table 1 CO2 Equivalent Emissions from Light Duty Vehicles Broken Up by Source or Process

Greenhouse Gas Emissions source or process	Tg CO ₂ (equivalent)	Percentage of total
Tailpipe CO₂ (w/o A/C)	1,076	88.6%
CO₂ from A/C	47.2	3.9%
HFC-134a (Leakage)	61.8	5.1%
N2O	28.2	2.3%
CH4	1.9	0.2%
Total	1,215	

Source: MY 2012-2016 U.S. fuel economy and GHG Regulatory Impact Analysis

2 Fundamental Regulatory Structure

2.1 Vehicle Attributes (Attribute Based Standards)

Certain vehicle attributes define the target levels of efficiency for both the GHG and CAFE standards. Under the previous CAFE standards, the only attribute used to define targets was whether a vehicle was defined as a car or a truck. Under the current GHG and CAFE standards, targets are defined by whether a vehicle is a car or truck and the footprint of the vehicle (footprint = wheelbase x track width). The following section discusses how a manufacturer's target is defined by those attributes.

2.1.1 Vehicle Footprint Classification

Since the 2012 MY, light duty vehicles fuel efficiency targets have been set using a footprint-based method. This regulation requires vehicles of differing sizes (footprints) to have different CO₂ targets.¹⁵ The targets are represented by an equation and affiliated curve. There are separate footprint curves for passenger cars and light trucks, and each company's fuel economy standard is based on the footprint of vehicles it produces. Table 2 provides an example of several vehicles and the targeted fuel economy for each of those vehicles based on their footprint. Each company will have a unique fleet wide fuel economy target determined by the production-weighted mix of its passenger car and light truck fleet. A

¹³ Proposed Rulemaking to Establish Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards, Environmental Protection Agency (EPA) and National Highway Traffic Safety Administration (NHTSA). Page 26

¹⁴ Final Rule Making to Establish Light –Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards Regulatory Impact Analysis, Environmental Protection Agency (EPA), p. 2-4 (<http://www.epa.gov/otaq/climate/regulations/420r10009.pdf>)

¹⁵ NHTSA defines as vehicles footprint as the product of the average track width (measured in inches and rounded to the nearest tenth of an inch) times the wheelbase (measured in inches and rounded to the nearest tenth of an inch) divided by 144 and then rounded to the nearest tenth of a square foot. (U.S Department of Transportation, National Highway Traffic Safety Administration Laboratory Test Procedures for 49 CFR Part 357, Automotive Fuel Economy Attribute Measurements; TP-537-01, March 30, 2009)

manufacturer is only evaluated on this fleet average and individual vehicles may fail to meet their targets as long as the fleet average meets or over-complies with the fleet target.

Table 2. Examples of vehicles and fuel economy targets based on size of vehicle, MY 2017, 2021, and 2025

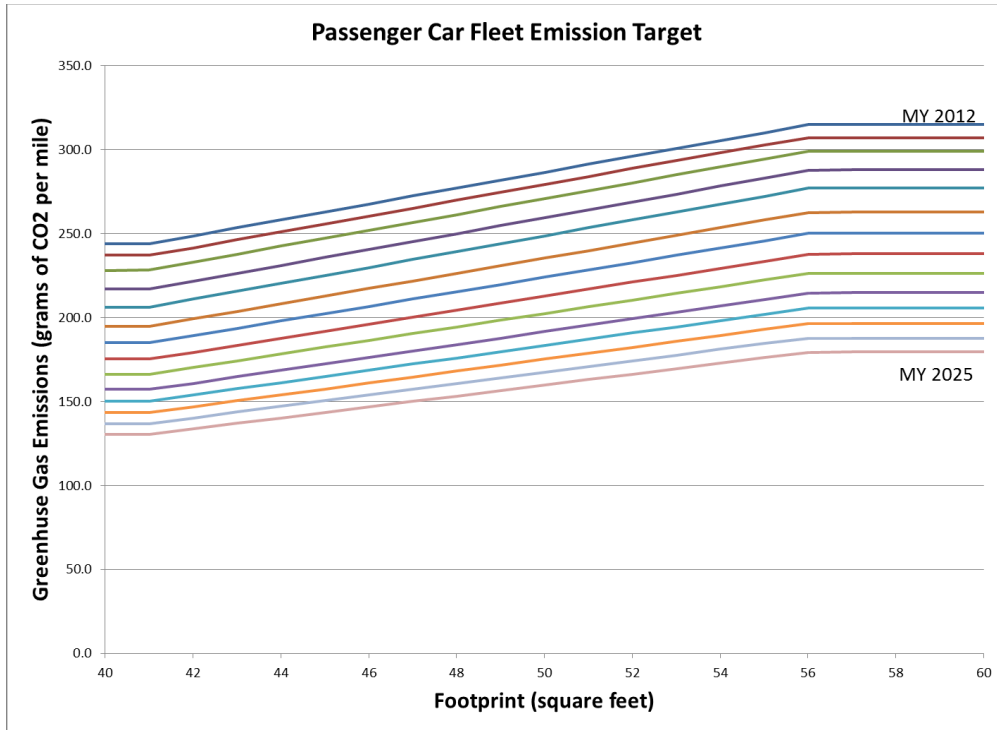
Vehicle Model	Footprint (sq. ft.)	MY 2017 Unadjusted Fuel Economy Target (MPG)	MY 2021 Unadjusted Fuel Economy Target (MPG)	MY 2025 Unadjusted Fuel Economy Target (MPG)
Honda Civic	43.4	41.4	48.2	57.9
Nissan Altima	47.1	38.4	44.7	53.7
Toyota Camry	46.9	38.5	44.9	53.9
VW Passat	47.2	38.3	44.6	53.6
BMW 7 series	55.6	32.9	38.3	45.9
Jeep Cherokee	45.8	33.1	38.1	45.9
Ford F-series	67.5	25.1	27.2	32.8
Chevrolet Traverse	55.5	28.5	32.3	38.9

Source: Manufacturer websites, fueconomy.gov

The footprint model is intended to encourage manufacturers to make all light vehicles, regardless of size, more efficient. This is an important difference to the non-attribute based average method used prior to 2012. With the non-attribute based average method, companies could balance a product portfolio between small fuel efficient vehicles, and larger less fuel efficient vehicles. In times of relatively low gasoline prices, market forces often led to greater demand for larger vehicles, which in turn led to higher prices for larger vehicles. Those same dynamics led to lower demand (and even lower prices) for smaller more fuel efficient ones. However, the non-attribute based average method did not necessarily lead manufacturers to maximize fuel efficiency for larger vehicles. Instead, it may have focused fuel efficiency with smaller less expensive vehicles—and often deeply discounted prices.

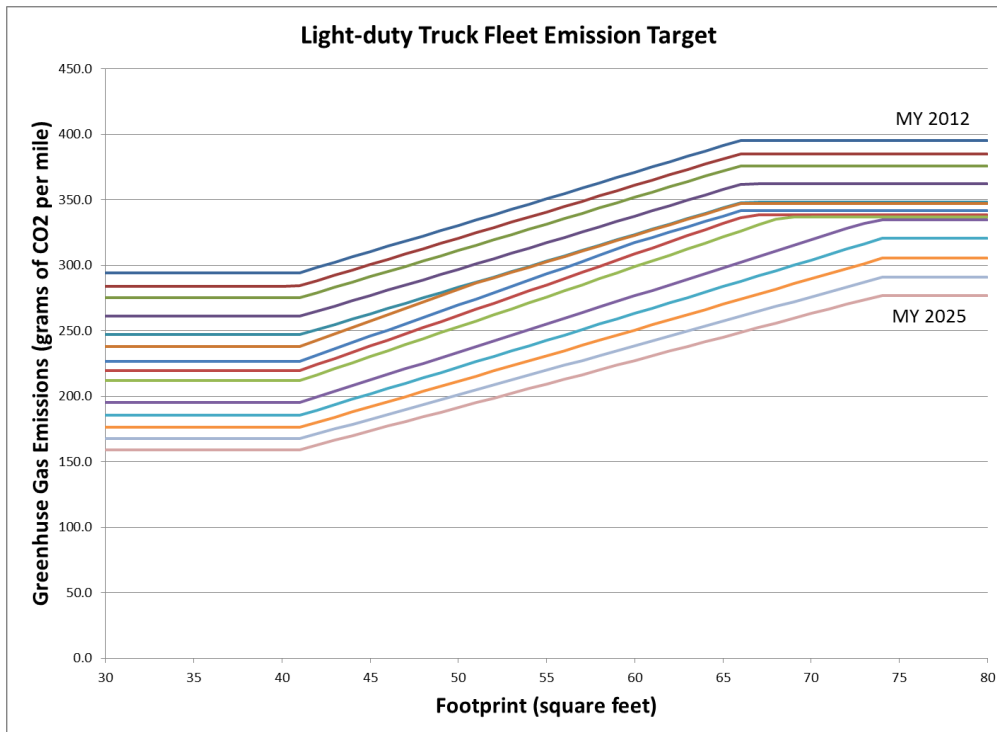
Figure 2 and Figure 3 present footprint curves for MYs 2012 through 2025 of passenger cars and light trucks, respectively. Generally, smaller footprint vehicles (those to the right on the x-axis) are required to achieve a lower CO₂ standard than larger footprint vehicles (those to the left on the x-axis). The standard becomes more stringent each year (represented as a shift downward).

Figure 2. Passenger car GHG targets, MY 2012-2025



Source: U.S. Federal Register Vol. 77 Num. 199

Figure 3. Light-duty truck GHG targets, MY 2012-2025



Source: U.S. Federal Register Vol. 77 Num. 199

For passenger cars, the CO₂ compliance values associated with the footprint curves will be reduced on average by 5 percent per year from the MY 2016 projected passenger car industry-wide compliance level through MY 2025. For light trucks, the CO₂ compliance standards are less stringent (on average 3.5 percent per year) than passenger cars for years 2017 through 2021, and then match the passenger car increases (5 percent per year) for 2021 through 2025.¹⁶ This differential in rate of change between passenger car and light trucks was implemented to lessen the negative impact on use cycles for some light duty trucks.

2.1.2 Definition of Car and Truck for Regulatory Purposes

Almost since the inception of CAFE, there were separate efficiency targets for automobiles defined as passenger automobiles (passenger cars) and those defined as non-passenger automobiles (light-duty trucks). This distinction still exists today and is a key part of defining how stringent the standard is for certain vehicles. In many cases the distinction between what is considered a passenger car and light-duty truck is easy to identify; however, for a segment of vehicles such as small compact utility vehicles (CUVs), similar looking vehicles can be classified as either a passenger car or light-duty truck depending on a few key attributes. These attributes include the transmission in use and geometric measurements of the vehicle. This section provides a general description for determining a passenger car and light-duty truck. For a full definition of vehicle classifications please consult United States Code of Federal Regulations Title 49 CFR 523.¹⁷

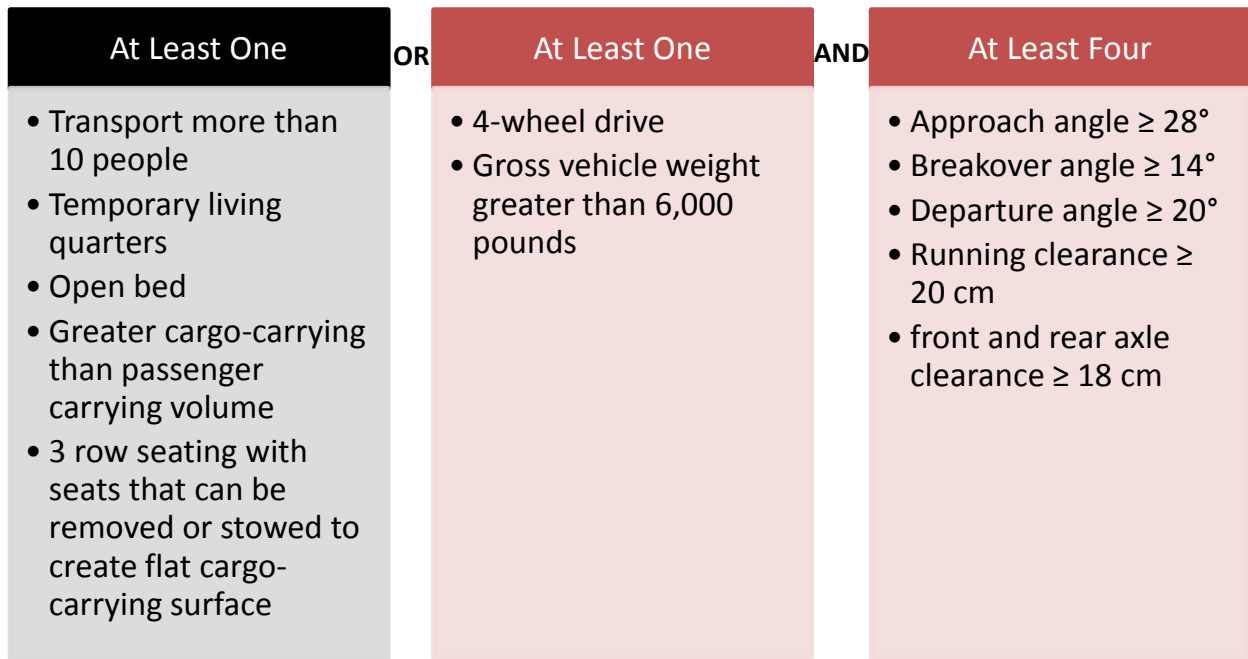
In general, a passenger car is a 4-wheeled automobile used primarily on public streets, roads, and highways, rated at less than 10,000 pounds gross vehicles weight, and transports not more than 10 individuals.

A light-duty truck is defined by the characteristics in Figure 4 and is not considered a passenger car or work truck. The non-passenger automobile must either meet one of the criteria in the first column or a combination of one criterion in the second column and four criteria in the third column. A pictorial of the approach, breakover, and departure angles are provided in the figure below (Figure 5). For some small CUVs, the 2-wheel drive version may be considered a passenger car while the 4-wheel drive vehicle would be considered a light-duty truck under the regulations.

¹⁶ "EPA and NHTSA Set Standards to Reduce Greenhouse Gases and improve Fuel Economy for Years 2017-2025 Cars and Light Trucks", U.S.E.P.A. Regulatory Announcement, EPA-420-F-12-051 August 2012 (<http://www.epa.gov/oms/climate/documents/420f12051.pdf>)

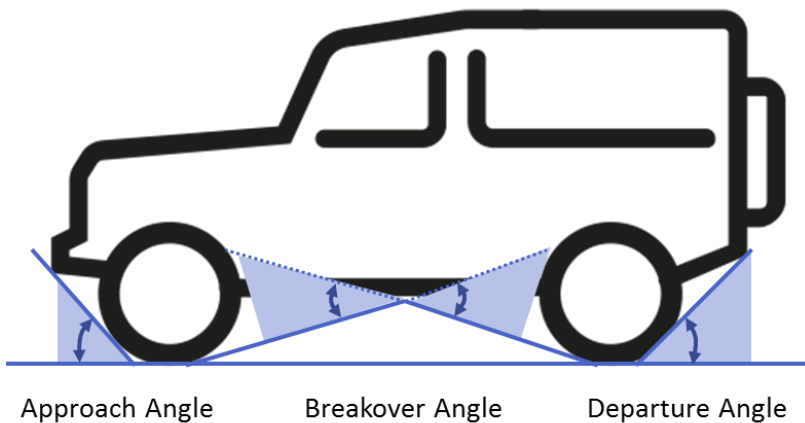
¹⁷ <http://www.gpo.gov/fdsys/granule/CFR-2011-title49-vol6/CFR-2011-title49-vol6-part523>

Figure 4. Defining characteristics of automobiles defined as a Light-Duty Truck



Source: United States Code of Federal Regulations Title 49 CFR 523

Figure 5. Illustration of vehicle dimensions measured for the determination of a passenger car or light-duty truck



Source: CAR 2015

2.2 Test cycles: The different tests to measure fuel economy

The determination of greenhouse gas emissions and fuel economy for a vehicle is made through a series of laboratory tests. These tests are used for both regulatory compliance and estimating real world fuel economy. Testing is conducted on a dynamometer to simulate the load that is applied to the vehicle

when driving on road. For regulatory purposes, two test profiles using different speed and acceleration are used to simulate driving in cities and on highways. These two test profiles are referred to as a 2-cycle test. For real world fuel economy estimates, manufacturers base their estimates from a series of five different tests (5-cycle) or, if certain criteria are met, they may adjust the results from the 2-cycle test.

The 2-cycle test procedures are the Federal Test Procedure (FTP) and the Highway Fuel Economy Test (HFET) and are designed to represent city and highway driving patterns, respectively. These tests have essentially remained unchanged since 1984 and are no longer directly used for real world fuel economy measurements. Results of these tests are often referred to as the unadjusted fuel economy since it does not apply to real world fuel economy. Today, these tests are used to determine compliance of a manufacturer’s fleet relative to CAFE and GHG targets set by the regulators.

Due to changes in driving patterns and vehicle technology, the 2-cycle test is no longer an accurate representation of real world conditions. In general, the results of the 2-cycle test can be reduced by approximately 20 percent for real world fuel economy. In 2006, due to these inaccuracies, the EPA introduced three more test procedures for the estimation of real world fuel economy. The new tests are US06 for high speed driving, SC03 for air conditioner operation and Cold FTP for cold weather driving. When combined with the 2-cycle test, these five tests are believed to achieve a representation of real world fuel economy according to current driving styles and vehicle technology.

Table 3. Summary of test procedure specifications

Test Procedure	FTP	HFET	US06	SC03	Cold FTP
Trip Type	Low speeds in stop-and-go urban traffic	Free-flow traffic at highway speeds	Higher speeds; harder acceleration & braking	A/C use under hot ambient conditions	City test w/ colder outside temp.
Top Speed	56 mph	60 mph	80 mph	54.8 mph	56 mph
Average Speed	21.2 mph	48.3 mph	48.4 mph	21.2 mph	21.2 mph
Max. Acceleration	3.3 mph/sec	3.2 mph/sec	8.46 mph/sec	5.1 mph/sec	3.3 mph/sec
Stops	23	None	4	5	23
Idling time	18% of time	None	7% of time	19% of time	18% of time
Lab temperature	68°F–86°F	68°F–86°F	68°F–86°F	95°F	20°F
Vehicle air conditioning	Off	Off	Off	On	Off

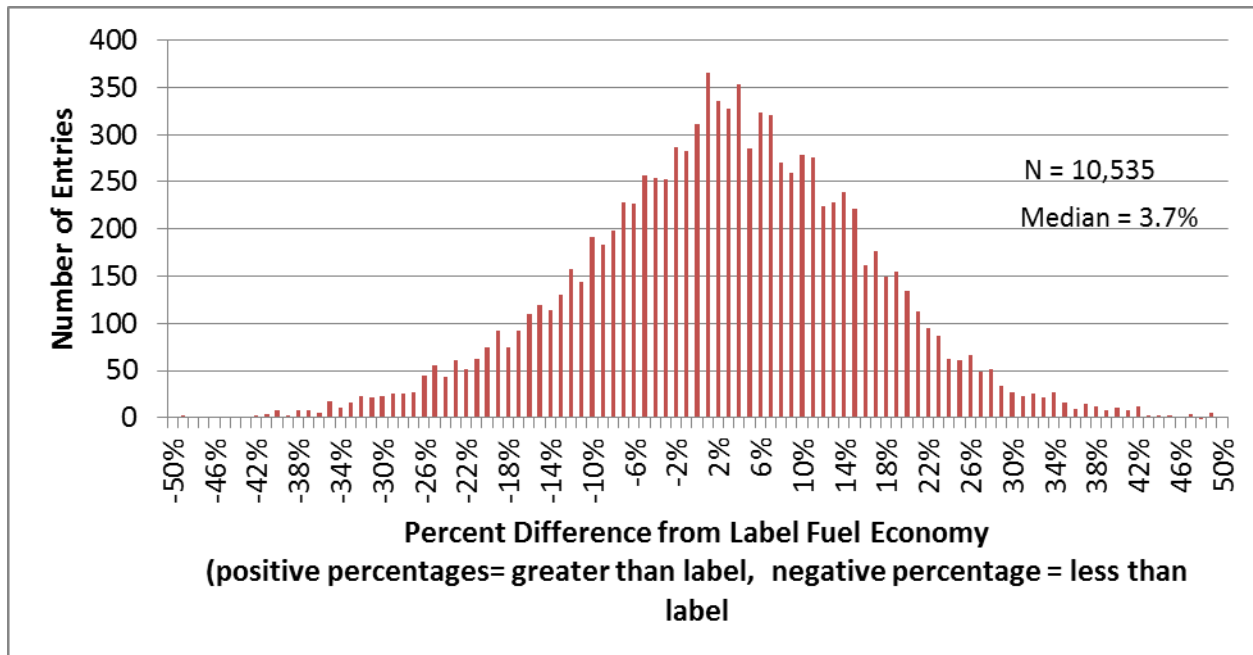
Source: *Fueleconomy.gov*

The 5-cycle test can cause additional burden to vehicle manufacturers by requiring a significant increase to the number of tests for each vehicle. To compensate for this, the EPA allows manufacturers to estimate real world fuel economy by adjusting the results of the 2-cycle test. Manufacturers may elect to estimate real world fuel economy if they meet certain criteria. For emissions testing, vehicles are placed into test groups with vehicles that have similar engines and emissions technologies. Within this

test group one vehicle deemed the worst-case emitting vehicle must complete the 5-cycle emissions test. If standard adjustment of the 2-cycle test closely matches the results of the 5-cycle test, the remaining vehicles within the test group may estimate fuel economy through the 2-cycle test. The 5-cycle test results must not be lower than four percent less than the estimated 2-cycle city fuel economy and five percent less than the estimated 2-cycle highway fuel economy, respectively. Measurement of fuel economy through the 2-cycle method is often called the modified 5-cycle test or MPG based fuel economy.

Concerns over the accuracy of fuel economy testing have resurfaced within the past few years as new fuel efficient vehicles with advanced technology have come into the market. Several manufacturers have been required to relabel their vehicles to match the results that are experienced in the real world. To date, most of these inaccuracies appear to be the result of minor errors during testing. The most likely source of errors appears to be due to the estimation forces exerted on the vehicle during operation (i.e., road loads). The EPA issued a statement to manufacturers clarifying procedures required for determining loads on vehicles. It should be noted that due to simple mathematical reasons, sensitivity to testing errors increase with increased fuel efficiency. In addition, larger swings in fuel economy should be expected with increasingly fuel efficient vehicles. The potential influence of these swings will be discussed in a paper on the influence of consumer acceptance. However, based on user reported results on the fueleconomy.gov website, the average for MY 2008 to current MY vehicles experience at or a slightly better fuel economy than what is on the label.

Figure 6 Percentage Difference: User Reported vs. Label Fuel Economy All vehicles MY2008 and Later



Source: fueleconomy.gov, CAR analysis

2.3 Credit trading/transfers A few paragraphs

Under the regulations, manufacturers may earn credits which may be transferred and traded within the automaker's own fleet or with another manufacturer. These credits may be earned by over-complying with the CAFE or GHG target for a given MY, implementing air conditioning and off-cycle technologies that improve fuel efficiency, selling of advanced powertrain vehicles such as EVs, and using alternative fuels.¹⁸ The EPA and NHTSA both offer programs that allow manufacturers to transfer credits between fleets and MYs. In addition, manufacturers may sell and buy credits from other manufacturers as needed.

Both the EPA and NHTSA allow credits from a MY to be carried forward to compensate for deficits that might occur in future MYs. For the CAFE standard, manufacturers may carry credits forward up to five MYs. The carry forward allowance under the GHG standard varies depending on MY. For GHG credits, MY 2009 credits cannot carry forward and cannot be traded to other manufacturers. For GHG credits earned through MY 2010-2016, the credits may be carried forward up to MY 2021. GHG credits earned for MY 2017 and beyond may be carried forward five years.

Credits may be carried back if a manufacturer needs to compensate for deficits accrued in previous years. NHTSA and the EPA both allow credits to be carried back for a total of three years. This also implies that a manufacturer has three years before any penalties are levied to the manufacturer if they are unable to cover the deficits from prior years.

The EPA and NHTSA both allow for the trading (selling and buying of credits) between manufacturers. The cost and amount of credits to be exchanged are negotiated between the individual companies and are not dictated by the regulators. As was mentioned previously, credits earned by manufacturers in MY 2009 under the GHG program cannot be traded among companies. Some manufacturers have already taken advantage of this process and have begun buying and selling credits based on their business needs.

Finally, the GHG program allows small and intermediate volume manufacturers to earn what is referred to a Temporary Lead Time Allowance Alternative Standards (TLAAS) credits for a portion of their vehicles based on a less stringent standard. These credits can be transferred just as any other credit, but may not be traded to other manufacturers.

A summary of these similarities and difference are described in Table 4.

¹⁸ A more detailed description of available credits will be addressed in a separate document.

Table 4. Summary of GHG and CAFE credit transfer and trading options available to manufacturers

	EPA GHG Standard	NHTSA CAFE Standard
Carry Forward	<ul style="list-style-type: none"> • MY 2009 credits: no transfers • MY 2010 - 2016 can be carried forward to MY 2021 • MY 2017 and beyond carried forward 5 years 	<ul style="list-style-type: none"> • 5 years
Carry Back	<ul style="list-style-type: none"> • 3 years 	<ul style="list-style-type: none"> • 3 years
Credit transfer cap between fleets (e.g., passenger car to truck)	<ul style="list-style-type: none"> • None 	<ul style="list-style-type: none"> • MY 2011 – 2013: 1 MPG • MY 2014-2017: 1.5 MPG • MY 2018 and beyond: 2 MPG
Credit trading (e.g., from one manufacturer to another)	<ul style="list-style-type: none"> • Allowed except for credits earned for MY 2009 	<ul style="list-style-type: none"> • Allowed
Credit Transfers and Trading of TLAAS	<ul style="list-style-type: none"> • Transfers: Same as above • Trading: Not allowed 	<ul style="list-style-type: none"> • Not covered in CAFE program

Source: U.S. Federal Register Vol. 77 Num. 199

2.4 Regulatory Penalties for non-compliance

The penalties for non-compliance differ between the EPA and NHTSA. The Energy Independence and Security Act (EISA) and EPCA allows NHTSA to take into account civil penalties in place of achieving the CAFE standard for a manufacturer. Currently the penalty for non-compliance under the CAFE standard is \$55 per mile per gallon multiplied by the total number of vehicles in that fleet for that MY. The EPA, according to the Clean Air Act, does not allow for the payment of civil penalties in lieu of achieving the GHG standards. Although the EPA does not allow payment in place of non-compliance, they may penalize manufacturers up to \$37,500 per vehicle based on a variety of factors. Those factors are described in Section 205(b) of the CAA as:

“In determining the amount of any civil penalty to be assessed [in a civil judicial action] the court shall take into account the gravity of the violation, the economic benefit or savings (if any) resulting from the violation, the size of the violator's business, the violator's history of compliance with [Title I1 of the Act], action taken to remedy the violation, the effect of the penalty on the violator's ability to continue in business, and such other matters as justice may require.”

In addition to civil penalties, the EPA may revoke certificates of conformity, which are required for sale in the United States, for non-compliant vehicles.

Future Whitepapers

The preceding document was meant as a primer of the regulations and to outline some important similarities and differences of the EPA GHG and NHTSA CAFE standards. CAR intends to release additional papers that delve into specific details of the regulations and the effect the regulations have on the industry. Some topics that are expected to be released are:

- Effect of regulations on the use of alternative fuels
- Accumulation of credits and the burn rate based on increasingly stringent standards
- Detailed description of credits available to the industry
- Influence of consumer acceptance
- Influence of Zero Emission Vehicle (ZEV) requirements

References

- CARB. (2007). "Fact Sheet: Climate Change Emissions Standards for Vehicles." California Air Resources Board, California Environmental Protection Agency. May 30, 2007.
<<http://www.arb.ca.gov/cc/ccms/factsheets/ccfaq.pdf>>.
- EPA. (2009). "EPA Grants California GHG Waiver." U.S. Environmental Protection Agency. June 30, 2009.
<<http://yosemite.epa.gov/opa/admpress.nsf/6427a6b7538955c585257359003f0230/5e448236de5fb369852575e500568e1b!OpenDocument>>.
- EPA (2012) "EPA and NHTSA Set Standards to Reduce Greenhouse Gases and improve Fuel Economy for Years 2017-2025 Cars and Light Trucks", U.S.E.P.A. Regulatory Announcement, EPA-420-F-12-051 August 2012 (<http://www.epa.gov/oms/climate/documents/420f12051.pdf>)
- EPA/NHTSA (2009.) Final Rule Making to Establish Light –Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards Regulatory Impact Analysis, Environmental Protection Agency (EPA), p. 2-4 (<http://www.epa.gov/otaq/climate/regulations/420r10009.pdf>)
- Federal Register. (2009). "Endangerment and Cause or Contribute Findings for Greenhouse Gases Under Section 202(a) of the Clean Air Act." Federal Register, National Archives and Records Administration, 77(239): 66496-66546. December 15, 2009.
<http://www.epa.gov/climatechange/Downloads/endangerment/Federal_Register-EPA-HQ-OAR-2009-0171-Dec.15-09.pdf>.
- Klier, Thomas and Joshua Linn. (2011). "Corporate Average Fuel Economy Standards and the Market for New Vehicles." Federal Reserve Bank of Chicago. January 2011.
<<https://www.chicagofed.org/~media/publications/working-papers/2011/wp2011-01-pdf.pdf>>.
- Knittel, Christopher R. (2011). "Automobiles on Steroids: Product Attribute Trade-Offs and Technological Progress in the Automobile Sector." American Economic Review, 101(7): 3368-3399. December 2011.
<<http://pubs.aeaweb.org/doi/pdfplus/10.1257/aer.101.7.3368>>.
- Nichols, Mary D. (2009). Letter to The Honorable Lisa P. Jackson, Administrator of the United States Environmental Protection Agency and The Honorable Ray LaHood, Secretary of the United States Department of Transportation. California Air Resources Board, California Environmental Protection Agency. May 18, 2009. <<http://www.epa.gov/otaq/climate/regulations/air-resources-board.pdf>>.
- NHTSA. (2014). "Summary of Fuel Economy Performance (Public Version)." National Highway Traffic Safety Administration, U.S. Department of Transportation. June 26, 2014.
<http://www.nhtsa.gov/staticfiles/rulemaking/pdf/cafe/June_2014_Summary_Report.pdf>.

Supreme Court. (2007). "Supreme Court of the United States: Massachusetts et al. V. Environmental Protection Agency et al." Legal Information Institute, Cornell University Law School. April 2, 2007. <<https://www.law.cornell.edu/supct/html/05-1120.ZS.html>>.

Yacobucci, Brent D. and Robert Bamberger. (2007). "Automobile and Light Truck Fuel Economy: The CAFE Standards." Congressional Research Service. January 19, 2007. <<http://www.cnie.org/NLE/CRSreports/07Jan/RL33413.pdf>>.