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Vehicle Fuel Economy and Greenhouse Gas Standards: Frequently Asked Questions

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Summary

The Trump Administration announced on April 2, 2018, its intent to revise through rulemaking the federal standards that regulate fuel economy and greenhouse gas (GHG) emissions from new passenger cars and light trucks. These standards include the Corporate Average Fuel Economy (CAFE) standards promulgated by the U.S. Department of Transportation's National Highway Traffic Safety Administration (NHTSA) and the Light-Duty Vehicle GHG emissions standards promulgated by the U.S. Environmental Protection Agency (EPA). They are known collectively—along with California's Advanced Clean Car program—as the National Program.

NHTSA and EPA promulgated the second (current) phase of CAFE and GHG emissions standards affecting model year (MY) 2017-2025 light-duty vehicles on October 15, 2012. Like the initial phase of standards for MYs 2012-2016, the Phase 2 rulemaking was preceded by a multiparty agreement, brokered by the Obama White House. The agreement included the State of California, 13 auto manufacturers, and the United Auto Workers union. The manufacturers agreed to reduce GHG emissions from most new passenger cars, sport utility vehicles, vans, and pickup trucks by about 50% by 2025, compared to 2010, with fleet-wide fuel economy rising to nearly 50 miles per gallon.

As part of the Phase 2 rulemaking, EPA and NHTSA made a commitment to conduct a midterm evaluation for the latter half of the standards (i.e., MYs 2022-2025, for which EPA had finalized requirements and NHTSA, due to statutory limits, had proposed "augural" requirements). On November 30, 2016, the Obama Administration's EPA released a proposed determination stating that the MY 2022-2025 standards remained appropriate and that a rulemaking to change them was not warranted. On January 12, 2017, EPA finalized the determination.

After President Trump took office, however, EPA and NHTSA announced their joint intention to reconsider the Obama Administration's final determination and reopen the midterm evaluation process. EPA released a revised final determination on April 2, 2018. It stated the MY 2022-2025 standards were "not appropriate and, therefore, should be revised," and that key assumptions in the January 2017 final determination—including gasoline prices, technology costs, and consumer acceptance—"were optimistic or have significantly changed." With this revision, EPA and NHTSA announced that they would initiate a new rulemaking. Until that rulemaking is complete, the current standards would remain in force.

On August 24, 2018, EPA and NHTSA proposed amendments to the existing CAFE and GHG emission standards. The Safer Affordable Fuel-Efficient (SAFE) Vehicles Rule for MY 2021-2026 Passenger Cars and Light Trucks offers eight alternatives. The agencies' preferred alternative, if finalized, is to retain the existing standards through MY 2020 and then to freeze the standards at this level for both programs through MY 2026. A final rule has not yet been released.

In response to the proposals from the Trump Administration, California has restated its "continued support for the current National Program and California's standards." On December 12, 2018, California approved a regulatory amendment to clarify that automakers must still comply with the state's existing light-duty vehicle GHG standards through MY 2025—which includes standards in line with EPA's 2017 final determination and the 2012 rulemaking—even if EPA and NHTSA approve a rollback of the national rules. EPA granted California a Clean Air Act preemption waiver for its GHG standards on July 8, 2009.

A number of issues remain forefront regarding the CAFE and GHG emission standards, their design, purpose, and potential revision. These include (1) whether EPA has adequately justified its decision to revise the MY 2022-2025 standards and (2) whether California can continue to implement state standards that would be more stringent than the revised federal ones. These

issues are informed by analyses regarding (1) whether the standards are technically and economically feasible; (2) the impact of the standards on GHG emissions and energy conservation; and (3) whether the standards adequately address consumer choice, safety, and other vehicle policies, both domestic and international.

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This report addresses frequently asked questions about the federal and state standards that regulate fuel economy and greenhouse gas (GHG) emissions from new passenger cars and light trucks. The regulations include the Corporate Average Fuel Economy (CAFE) standards promulgated by the U.S. Department of Transportation's National Highway Traffic Safety Administration (NHTSA), the Light-Duty Vehicle GHG emissions standards promulgated by the U.S. Environmental Protection Agency (EPA), and California's Advanced Clean Car program. The agencies refer to the standards collectively as the National Program. The report looks at the origins of the standards, reviews the current and proposed future regulations, and discusses recent actions and relevant vehicle industry trends. It also examines the relationship between the California and the federal vehicle emissions programs.

What Is NHTSA's Authority to Regulate the Fuel Economy of Motor Vehicles?

NHTSA derives its authority to regulate the fuel economy of motor vehicles from the Energy Policy and Conservation Act of 1975 (EPCA; P.L. 94-163) as amended by the Energy Independence and Security Act of 2007 (EISA; P.L. 110-140).[1]

The origin of federal fuel economy standards dates to the mid-1970s. The oil embargo of 1973-1974 imposed by Arab members of the Organization of the Petroleum Exporting Countries (OPEC) and the subsequent tripling in the price of crude oil brought the fuel economy of U.S. automobiles into sharp focus. The fleet-wide fuel economy of new passenger cars had declined from 15.9 miles per gallon (mpg) in model year (MY) 1965 to 13.0 mpg in MY 1973.[2] In an effort to reduce dependence on imported oil, EPCA established CAFE standards for passenger cars beginning in MY 1978 and for light trucks[3] beginning in MY 1979. The standards required each auto manufacturer to meet a target for the sales-weighted fuel economy of its entire fleet of vehicles sold in the United States in each model year. Fuel economy—expressed in *miles per gallon* (mpg)—was defined as the average mileage traveled by a vehicle per gallon of gasoline or equivalent amount of other fuel.

EPCA required NHTSA to establish and amend the CAFE standards; promulgate regulations concerning procedures, definitions, and reports; and enforce the regulations. CAFE standards, and new-vehicle fuel economy, rose steadily through the late 1970s and early 1980s. After 1985, Congress did not revise the legislated standards for passenger cars, and they remained at 27.5 mpg until 2011. The light truck standards were increased to 20.7 mpg in 1996, where they remained until 2005.[4]

New-vehicle fuel economy began to rise again in the mid-2000s, due, in part, to a steady increase in gasoline prices that led many consumers to purchase smaller, more fuel-efficient vehicles. NHTSA promulgated two sets of standards in the mid-2000s affecting the MY 2005-2007 and MY 2008-2011 light truck fleets, increasing their average fuel economy to 24.0 mpg. Further,

[1] 49 U.S.C. §§32901-32919.

[2] NHTSA, "Historical Passenger Car Fleet Average Characteristics," https://one.nhtsa.gov/cars/rules/CAFE/HistoricalCarFleet.htm.

[3] Light trucks include most sport utility vehicles (SUVs), vans, and pickup trucks.

[4] Provisions in the Department of Transportation's annual appropriations bills between FY1996 and FY2002 prohibited the agency from changing or studying CAFE standards. As reported by National Research Council, *Effectiveness and Impact of Corporate Average Fuel Economy (CAFE) Standards*, Washington, DC: National Academy Press, 2002, p. 1.

Congress enacted EISA in 2007, which, among other provisions, revisited the CAFE standards. EISA required NHTSA to increase combined passenger car and light truck fuel economy standards to at least 35 mpg by 2020,[5] up from the combined 26.6 mpg in 2007. Along with requiring higher vehicle standards, EISA changed the structure of the program (in part due to concerns about safety and consumer choice).[6]

What Is EPA's Authority to Regulate GHG Emissions from Motor Vehicles?

EPA derives its authority to regulate GHG emissions from motor vehicles from the Clean Air Act, as amended (CAA).[7]

In 1998, during the Clinton Administration, EPA General Counsel Jonathan Cannon concluded in a memorandum to the agency's Administrator that GHGs were air pollutants within the CAA's definition of the term, and therefore could be regulated under the CAA.[8] Relying on the Cannon memorandum as well as the statute itself, a group of 19 organizations petitioned EPA on October 20, 1999, to regulate GHG emissions from new motor vehicles under CAA Section 202.[9] That section directs the EPA Administrator to develop emission standards for "any air pollutant" from new motor vehicles "which, in his judgment cause[s], or contribute[s] to air pollution which may reasonably be anticipated to endanger public health or welfare."[10] On August 28, 2003, EPA denied the petition[11] because the agency determined that the CAA does not grant EPA authority to regulate carbon dioxide (CO_2) and other GHG emissions based on their climate change impacts.[12] Massachusetts, 11 other states, and various other petitioners challenged EPA's denial of the petition in a case that ultimately reached the Supreme Court.[13]

[5] Thirty-five miles per gallon is a lower bound: the Administration is required to set standards at the "maximum feasible" fuel economy level for any model year.

[6] For more analysis, see CRS Report RL34294, *Energy Independence and Security Act of 2007: A Summary of Major Provisions*, by Fred Sissine. For further information, contact Corrie Clarke.

[7] 42 U.S.C. §§7401-7626.

[8] Memorandum from Jonathan Z. Cannon, EPA General Counsel, to Carol M. Browner, EPA Administrator, "EPA's Authority to Regulate Pollutants Emitted by Electric Power Generation Sources," April 10, 1998, at http://www.law.umaryland.edu/environment/casebook/documents/epaco2memo1.pdf.

[9] 42 U.S.C. §7521. The lead petitioner was the International Center for Technology Assessment (ICTA). The petition may be found at http://www.ciel.org/Publications/greenhouse_petition_EPA.pdf.

[10] Ibid.

[11] EPA, "Control of Emissions from New Highway Vehicles and Engines," 68 *Federal Register* 52922, September 8, 2003. The agency argued that it lacked statutory authority to regulate GHGs: Congress "was well aware of the global climate change issue" when it last comprehensively amended the CAA in 1990, according to the agency, but "it declined to adopt a proposed amendment establishing binding emissions limitations." Massachusetts v. EPA, 549 U.S. 497 (2007).

[12] Memorandum from Robert E. Fabricant, Gen. Counsel, EPA, on EPA's Authority to Impose Mandatory Controls to Address Global Climate Change Under the Clean Air Act, to Marianne L. Horinko, Acting Admin., EPA, August 28, 2003, https://go.usa.gov/xQ4mU.

[13] The U.S. Court of Appeals for the District of Columbia Circuit (D.C. Circuit), in a split decision, rejected the suit. *See* Massachusetts v. EPA, 415 F.3d 50, 56, 59-60 (D.C.C. 2005) (Randolph, J., dissenting) (holding that EPA reasonably denied the petition based on scientific uncertainty and policy considerations).

In April 2007, the Supreme Court held that EPA has the authority to regulate GHGs as "air pollutants" under the CAA.[14] In the 5-4 decision, the Court determined that GHGs fit within the CAA's "unambiguous" and "sweeping definition" of "air pollutant."[15] The Court's majority concluded that EPA must, therefore, decide whether GHG emissions from new motor vehicles contribute to air pollution that may reasonably be anticipated to endanger public health or welfare, or provide a reasonable explanation why it cannot or will not make that decision.[16] If EPA made a finding of endangerment, the CAA required the agency to establish standards for emissions of the pollutants.[17]

Following the Court's decision, the George W. Bush Administration's EPA did not respond to the original petition or make a finding regarding endangerment. Its only formal action following the Court decision was to issue a detailed information request, called an Advance Notice of Proposed Rulemaking (ANPR), on July 30, 2008.[18] The Obama Administration's EPA, however, made review of the endangerment issue a high priority. On December 15, 2009, it promulgated findings that GHGs endanger both public health and welfare, and that GHG emissions from new motor vehicles contribute to that endangerment.[19]

With these findings, the Obama Administration initiated discussions with major stakeholders in the automotive and truck industries and with states and other interested parties to develop and implement vehicle GHG standards. Because CO_2 from mobile source fuel combustion is a major source of GHG emissions, the White House directed EPA to work with NHTSA to align the GHG standards with CAFE standards. In addition, the CAA grants the state of California unique status to receive a waiver to issue motor vehicle emission standards provided that they are at least as stringent as federal ones and are necessary to meet "compelling and extraordinary conditions."

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[14] Massachusetts v. EPA, 549 U.S 497, 528-29 (2007).

[15] Massachusetts v. EPA, 549 U.S 497, 528-29 (2007), p. 532. The majority held that "[t]he Clean Air Act's sweeping definition of 'air pollutant' includes '*any* air pollution agent or combination of such agents, including *any* physical, chemical ... substance or matter which is emitted into or otherwise enters the ambient air.... ' ... Carbon dioxide, methane, nitrous oxide, and hydrofluorocarbons are without a doubt 'physical [and] chemical ... substances[s] which [are] emitted into ... the ambient air.' The statute is unambiguous." Ibid., pp. 528-29.

[16] Massachusetts v. EPA, 549 U.S 497, 528-29 (2007), p. 533.

[17] For further discussion of the Court's decision, see CRS Report R44807, *U.S. Climate Change Regulation and Litigation: Selected Legal Issues*, by Linda Tsang.

[18] EPA, "Regulating Greenhouse Gas Emissions under the Clean Air Act; Advance Notice of Proposed Rulemaking," 73 *Federal Register* 44354, July 30, 2008. The ANPR occupied 167 pages of the *Federal Register*. Besides requesting information, it took the unusual approach of presenting statements from the Office of Management and Budget, four Cabinet Departments (Agriculture, Commerce, Transportation, and Energy), the Chairman of the Council on Environmental Quality, the Director of the President's Office of Science and Technology Policy, the Chairman of the Council of Economic Advisers, and the Chief Counsel for Advocacy at the Small Business Administration, each of whom expressed their objections to regulating GHG emissions under the CAA. The OMB statement began by noting that, "The issues raised during interagency review are so significant that we have been unable to reach interagency consensus in a timely way, and as a result, this staff draft cannot be considered Administration policy or representative of the views of the Administration." 73 *Federal Register* 44356. It went on to state that "the Clean Air Act is a deeply flawed and unsuitable vehicle for reducing greenhouse gas emissions." Other letters submitted to the regulatory docket concurred.

[19] EPA, "Endangerment and Cause or Contribute Findings for Greenhouse Gases under Section 202(a) of the Clean Air Act; Final Rule," 74 *Federal Register* 66496, December 15, 2009. Although generally referred to as simply "the endangerment finding," the EPA Administrator actually finalized two separate findings: a finding that six greenhouse gases endanger public health and welfare, and a separate "cause or contribute" finding that the combined emissions of greenhouse gases from new motor vehicles and new motor vehicle engines contribute to the greenhouse gas pollution that endangers public health and welfare. Throughout the report, GHGs are quantified using a unit measurement called CO_2 equivalent (CO_2e), wherein each different GHG is indexed and aggregated against one unit of CO_2 based on their Global Warming Potential (GWP).

California had already promulgated GHG emissions standards prior to 2009, for which it had requested an EPA waiver under provisions in the CAA. EPA granted California a waiver in July 2009, and President Obama directed EPA and NHTSA to align the federal fuel economy and GHG emission standards with those developed by California. The Administration referred to the coordinated effort as the National Program.

EPA and NHTSA promulgated joint rulemakings affecting MY 2012-2016 light-duty motor vehicles on May 7, 2010. These are known as the Phase 1 standards.[20]

What Is California's Authority to Regulate GHG Emissions from Motor Vehicles?[21]

The California Air Resources Board (CARB) derives its authority to regulate GHG emissions from motor vehicles from California Assembly Bill (AB) 1493.[22]

Questions of federal preemption of state regulations can arise when state law operates in an area that may also be of concern to the federal government. Under the Supremacy Clause of the U.S. Constitution,[23] state law that conflicts with federal law must yield to the exercise of Congress's powers.[24] When it acts, Congress can preempt state laws or regulations within a field entirely, preempt only state laws or regulations that conflict with federal law, or allow states to act freely.[25]

Title II of the CAA generally preempts states from adopting their own emission standards for new motor vehicles or engines.[26] However, CAA Section 209(b) provides an exception to federal preemption of state vehicle emission standards:

> The [EPA] Administrator shall, after notice and opportunity for public hearing, waive application of this section [the preemption of State emission standards] to any State which has adopted standards (other than crankcase emission standards) for the control of emissions from new motor vehicles or new motor vehicle engines prior to March 30, 1966, if the State determines that the State standards will be, in the aggregate, at least as protective of public health and welfare as applicable Federal standards.[27]

Only California can qualify for such a preemption waiver because it is the only state that adopted motor vehicle emission standards "prior to March 30, 1966."[28] According to EPA records, since

[20] EPA, "Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards; Final Rule," 75 *Federal Register* 25324, May 7, 2010.

[21] EPCA preempts states from adopting or enforcing laws "related to" fuel economy standards for automobiles covered by federal standards. 49 U.S.C. §32919. The issue of whether EPCA could preempt state motor vehicle GHG emissions standards is beyond the scope of this report.

[22] 2002 Cal Stats. ch. 200.

[23] U.S. CONST. art. VI, cl. 2.

[24] Gade v. Nat'l Solid Wastes Mgmt. Assn., 505 U.S. 88, 108 (1992).

[25] Ibid., p. 98. Congress can disavow an intent to preempt certain categories of state law by including a "savings clause" to that effect in federal statutes, see, e.g., 29 U.S.C. §1144(b), or by allowing federal administrative agencies to grant "preemption waivers" to states in certain circumstances, see 42 U.S.C. §7543(b).

[26] CAA §209(a), 42 U.S.C. §7543(a). See also S.Rept. 91-1196, at 32 (1970).

[27] The CAA places three conditions on the grant of such waivers: The Administrator is to deny a waiver if he finds: (1) that the state's determination is arbitrary and capricious; (2) that the state does not need separate standards to meet compelling and extraordinary conditions; or (3) that the state's standards and accompanying enforcement procedures are not consistent with Section 202(a) of the act. 42 U.S.C. §7543(b)(1)(A)-(C).

[28] S.Rept. 90-403, at 33 (1990).

1967, CARB has submitted over 100 waiver requests for new or amended standards or "within the scope" determinations (i.e., a request that EPA rule on whether a new state regulation is within the scope of a waiver that EPA has already issued).[29]

On July 22, 2002, California became the first state to enact legislation requiring reductions of GHG emissions from motor vehicles. The legislation, AB 1493, required CARB to adopt regulations requiring the "maximum feasible and cost-effective reduction" of GHG emissions from any vehicle whose primary use is noncommercial personal transportation.[30] The reductions applied to motor vehicles manufactured in MY 2009 and thereafter. Under this authority, CARB adopted regulations on September 24, 2004, and submitted a request to EPA on December 21, 2005, for a preemption waiver.

In 2008, EPA denied California's request for a waiver.[31] As explained in its decision, EPA concluded that "California does not need its GHG standards for new motor vehicles to meet compelling and extraordinary conditions" because "the atmospheric concentrations of these greenhouse gases is [sic] basically uniform across the globe" and are not uniquely connected to California's "peculiar local conditions."[32] However, under the Obama Administration, EPA reconsidered and reversed the denial, and granted the waiver in 2009.[33] In reversing its denial, EPA determined that it is the "better approach" for the agency to evaluate whether California "needs" state standards "to meet compelling and extraordinary conditions" based on California's need for its motor vehicle program as a whole, and not solely based on GHG standards addressed in the waiver request.[34] Under this approach, EPA concluded that it cannot deny the waiver request because California has "repeatedly" demonstrated the need for its motor vehicle problem to address "serious" local and regional air pollution problems.[35]

Upon receiving the waiver, CARB joined EPA and NHTSA to develop the National Program. Three key provisions of the 2009 agreement between the Administration, the auto manufacturers, and the State of California were that EPA would grant California the waiver for MYs 2017-2025 (the agency did so on January 9, 2013),[36] that California would accept vehicles complying with

[29] See EPA, Vehicle Emissions California Waivers and Authorizations, https://www.epa.gov/state-and-local-transportation/vehicle-emissions-california-waivers-and-authorizations#state (listing *Federal Register* notices of waiver requests and decisions); Letter from Kevin de Leon, President. pro Tempore, Cal. Senate, et. al., to Xavier Becerra, Att'y Gen., Cal. Dep't of Justice, March 16, 2017.

[30] The legislation requires that CARB standards achieve "the maximum feasible and cost-effective reduction of greenhouse gas emissions from motor vehicles" while accounting for "environmental, economic, social, and technological factors."

[31] EPA, "California State Motor Vehicle Pollution Control Standards; Notice of Decision Denying a Waiver of Clean Air Act Preemption for California's 2009 and Subsequent Model Year Greenhouse Gas Emissions," 73 *Federal Register* 12156, March 6, 2008.

[32] Ibid., pp. 12159-69.

[33] EPA, "California State Motor Vehicle Pollution Control Standards; Notice of Decision Granting a Waiver of Clean Air Act Preemption for California's 2009 and Subsequent Model Year Greenhouse Gas Emission Standards for New Motor Vehicles," 74 *Federal Register* 32744, July 8, 2009.

[34] Ibid., pp. 32761-63.

[35] Ibid., pp. 32762-63.

[36] EPA, "California State Motor Vehicle Pollution Control Standards; Notice of Decision Granting a Waiver of Clean Air Act Preemption for California's Advanced Clean Car Program and a Within the Scope Confirmation for California's Zero Emission Vehicle Amendments for 2017 and Earlier Model Years," 78 *Federal Register* 2112, January 9, 2013.

the federal greenhouse standards as meeting the California standards,[37] and that the auto manufacturers would drop their suit against the California standards.

Additionally, the CAA allows other states to adopt California's motor vehicle emission standards under certain conditions.[38] Section 177 requires, among other things, that such standards be identical to the California standards for which a waiver has been granted. States are not required to seek EPA approval under the terms of Section 177. Thirteen other states have adopted California's GHG standards under these provisions, bringing approximately 35% of domestic automotive sales under the California program.[39]

What Are the Current CAFE and GHG Standards?

NHTSA and EPA promulgated the second (current) phase of CAFE and GHG emissions standards affecting MY 2017-2025 light-duty vehicles on October 15, 2012.[40] Like the Phase 1 standards, the Phase 2 standards were preceded by a multiparty agreement, brokered by the Obama White House. The Phase 2 agreement involved the State of California, 13 auto manufacturers, and the United Auto Workers union. The manufacturers agreed to reduce GHG emissions from new passenger cars and light trucks by about 50% by 2025, compared to 2010, with fleet-wide average fuel economy rising to nearly 50 miles per gallon. GHG emissions would be reduced to about 160 grams per mile by 2025 under the agreement (see **Table 1**).[41]

The standards are applicable to the fleet of new passenger cars and light trucks with gross vehicle weight rating less than or equal to 10,000 pounds sold within the United States. Fuel economy and carbon-related emissions are tested over EPA's two test cycles (the Federal Test Procedure (FTP-75), weighted at 55%; and the Highway Fuel Economy Test (HWFET), weighted at 45%).[42] In addition to the standards for fleet-average fuel economy and GHG emissions (measured and referred to as "CO_2-equivalent emissions" under the regulations),[43] the rule also includes emission

[37] Mary D. Nichols, Chairman, CARB, "Letter to Ray LaHood, Secretary U.S. Department of Transportation, and Lisa Jackson, Administrator Environmental Protection Agency," July 28, 2011, https://www.epa.gov/sites/production/files/2016-10/documents/carb-commitment-ltr.pdf. The condition set forth by CARB was that the "deemed to comply" provision was contingent upon the U.S. EPA adopting "a final rule that at a minimum preserves the greenhouse reduction benefits set forth in U.S. EPA's December 1, 2011 Notice of Proposed Rulemaking for 2017 through 2025 model year passenger vehicles." CARB Resolution 12-11, January 26, 2012, p. 20.

[38] 42 U.S.C. §7507.

[39] New York, Massachusetts, Vermont, Maine, Pennsylvania, Connecticut, Rhode Island, Washington, Maryland, Oregon, New Jersey, Delaware, and Colorado.

[40] EPA and NHTSA, "2017 and Later Model Year Light-Duty Vehicle Greenhouse Gas Emissions and Corporate Average Fuel Economy Standards; Final Rule," 77 *Federal Register* 62624, October 15, 2012.

[41] EPA and NHTSA, "2017-2025 Model Year Light-Duty Vehicle GHG Emissions and CAFE Standards: Supplemental Notice of Intent," 76 *Federal Register* 48758, August 9, 2011. The auto manufacturers' and CARB's letters of support can be found at https://www.epa.gov/regulations-emissions-vehicles-and-engines/2011-commitment-letters-2017-2025-light-duty-national.

[42] The Federal Test Procedure (FTP-75) and Highway Fuel Economy Test (HWFET) are chassis dynamometer driving schedules developed by EPA for the determination of fuel economy of light-duty vehicles during city driving and highway driving conditions, respectively (40 C.F.R. pt. 600, subpt. B). EPA also requires the US06 (high acceleration), SC03 (with air conditioning) and cold temperature FTP driving schedules for GHG emission testing.

[43] Although CO_2 is the primary GHG, other gases, such as methane (CH_4) and fluorinated gases (e.g., air conditioner refrigerants), also act as GHG. The calculations of the weighted fuel economy and carbon-related exhaust emission values are provided for in 40 C.F.R. §600.113-12, and require input of the weighted grams/mile values for CO_2, total hydrocarbons (HC), carbon monoxide (CO), and, where applicable methanol (CH_3OH), formaldehyde (HCHO), ethanol (C_2H_5OH), acetaldehyde (C_2H_4O), nitrous oxide (N_2O), and methane (CH_4). Reductions in other (i.e., non-tailpipe) GHG emissions are captured in adjustments made to the compliance standards based on the manufacturer's use of flex-fuel vehicle, air-conditioning, "off-cycle," and CH_4 and N_2O deficit credits.

caps for tailpipe nitrous oxide emissions (0.010 grams/mile) and methane emissions (0.030 grams/mile).

Table 1. MY 2017-2025 Combined Average Passenger Car and Light Truck CAFE and GHG Emission Standards

	2017	2018	2019	2020	2021	2022	2023	2024	2025
GHG Standard (grams per mile)	243	232	222	213	199	190	180	171	163
GHG-Equivalent Fuel Economy (miles per gallon equivalent)	36.6	38.3	40.0	41.7	44.7	46.8	49.4	52.0	54.5
Fuel Economy (CAFE) Standard (miles per gallon)	35.4	36.5	37.7	38.9	41.0	*43.0*	*45.1*	*47.4*	*49.7*

Source: CRS, from EPA and NHTSA, "2017 and Later Model Year Light-Duty Vehicle Greenhouse Gas Emissions and Corporate Average Fuel Economy Standards," 77 *Federal Register* 62624, October 15, 2012.

Notes: The values are based on projected sales of vehicles in different size classes. The standards are size-based, and the vehicle fleet encompasses large, medium, and small cars and light trucks. Thus if the sales mix is different from projections, the achieved CAFE and GHG levels would rise or fall. For example, CAFE numbers are based on NHTSA's projection using the MY 2008 fleet as the baseline. A different projection, based on the MY 2010 fleet, leads to somewhat lower numbers (roughly 0.3—0.6 mpg lower for MYs 2017-2020 and roughly 0.7-1.0 mpg lower for MY 2021 onward). As discussed later, types of vehicles sold domestically has changed during the past decade.

GHG-Equivalent Fuel Economy (miles per gallon equivalent) is the value returned if all of the GHG reductions were made through fuel economy improvements. However, in practice, other strategies are used to reduce GHG emissions to the actual GHG standard (for example, improved vehicle air conditioners).

CAFE standards for MYs 2022-2025 are italicized because they are non-final (or "augural"). NHTSA has authority to set CAFE standards only in five-year increments. Thus, only rules through MY 2021 have been finalized. To set standards for MY 2022 onward, NHTSA has to issue a new rule.

As with the Phase 1 standards, the agencies used the concept of a vehicle's "footprint" to set differing targets for different size vehicles.[44] These "size-based," or "attribute-based," standards were structurally different than the original CAFE program, which grouped domestic passenger cars, imported passenger cars, and light trucks into three broad categories.[45] Generally, the larger the vehicle footprint (in square feet), the lower the corresponding vehicle fuel economy target and the higher the CO_2-equivalent emissions target. This allowed auto manufacturers to produce a full range of vehicle sizes as opposed to focusing on light-weighting and downsizing[46] the entire fleet in order to meet the categorical targets.

Upon the rulemaking, the agencies expected that the technologies available for auto manufacturers to meet the MY 2017-2025 standards would include advanced gasoline engines and transmissions, vehicle weight reduction, lower tire rolling resistance, improvements in

[44] *Footprint* is defined as the product of a vehicle's wheelbase and average track width, in square feet. 40 C.F.R. §86.1803-01. The "attribute-based" standards were first introduced in the reformed CAFE program for MY 2008-2011 light trucks. NHTSA, "Average Fuel Economy Standards for Light Trucks; Model Years 2008-2011: Proposed Rule," 70 *Federal Register* 51413, August 30, 2005.

[45] The definitions of *passenger car*, *light truck*, and *import* can be found at 49 C.F.R. Part 523.

[46] *Light-weighting* refers to using lighter weight structural materials to reduce the mass of the vehicle in order to increase fuel efficiency, and *downsizing* refers to designing smaller engines that run at higher loads in order to increase fuel efficiency.

aerodynamics, diesel engines, more efficient accessories, and improvements in air conditioning systems. Some increased electrification of the fleet was also expected through the expanded use of stop/start systems, hybrid vehicles, plug-in hybrid electric vehicles, and electric vehicles.

What Does a "Standard of 54.5 MPG in MY 2025" Mean?

The 54.5 number is not a requirement for every—or for any specific—vehicle or manufacturer; it is an estimate for what the agencies deemed likely to be achieved, on average, by the sales-weighted U.S. fleet of light-duty vehicles in MY 2025. There are several caveats to this number:

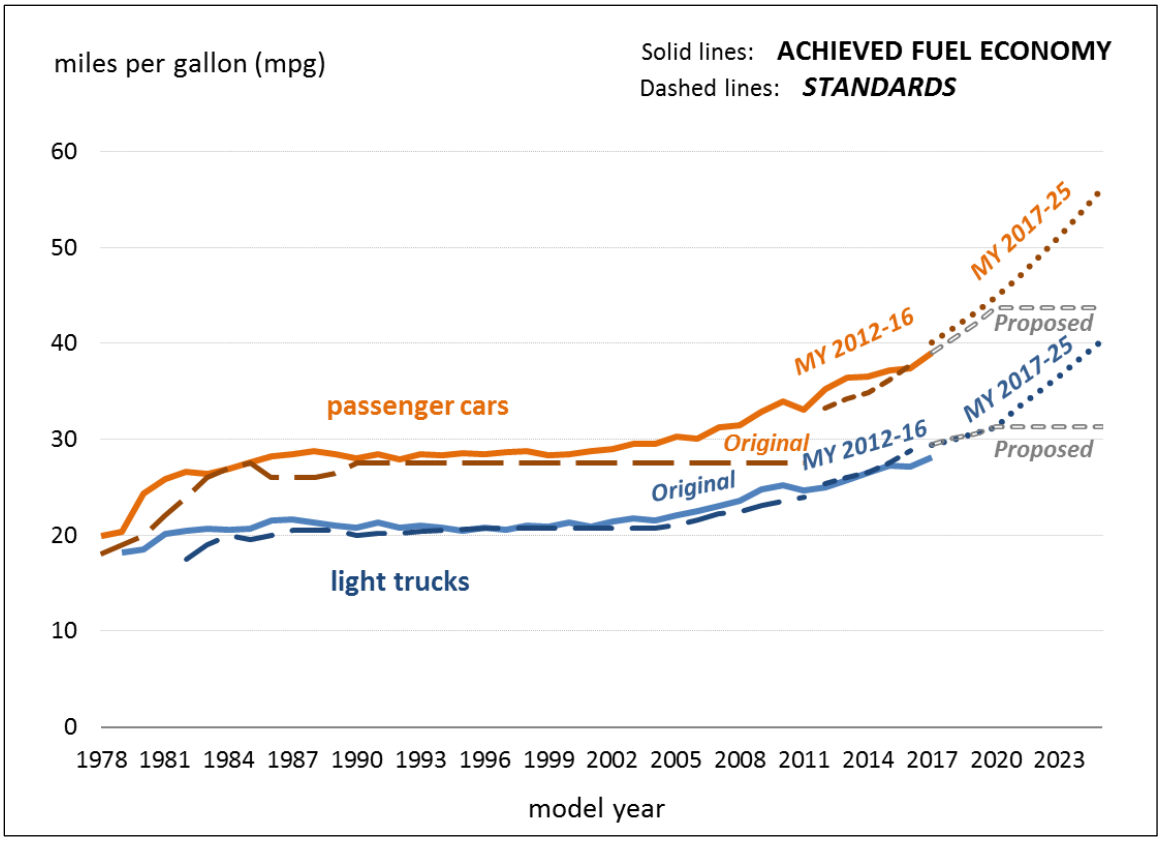
- The number is not for every—or for any specific—size or compliance category of vehicle or manufacturer. Different sizes and categories of vehicles have different mpg compliance targets. The number is an estimate of what the average fuel economy achievement would be for a sales-weighted fleet of all vehicles produced by all manufacturers under a specific scenario. This number was estimated during the Phase 2 rulemaking in 2012 using the MY 2008 fleet as the baseline. Thus, if the MY 2025 sales mix and sales volumes are different from projections, the achieved CAFE and GHG levels would be different. An analysis by EPA in 2016 adjusted this number to 50.8 mpg based on updated projections.[47]
- This number is based on the fuel economy values returned from EPA's city and highway laboratory test procedures. The number does not reflect real-world performance. Real-world adjusted fuel economy values are about 20% lower, on average, than the unadjusted fuel economy values that form the starting point for CAFE and GHG standard compliance. Hence the fuel economy stickers required on new automobiles would not show the fuel economy numbers used in the EPA analysis.
- The number is based on EPA's GHG emissions estimates, not NHTSA's fuel economy estimates. Thus, it represents the CO_2-equivalent fuel economy (in miles per gallon equivalent) for an emissions estimate of 163 grams of CO_2-equivalent per mile. While a significant portion of GHG reductions would likely come from greater fuel economy, GHG reductions can come from other sources on the vehicle (e.g., methane and nitrous oxide reductions, air-conditioning improvements). NHTSA's 2012 projection for fuel economy achievement is 49.7 mpg.
- This number, as an estimate, also includes some of the flexibilities, credits, and incentives available to manufacturers under the standards that can be used in lieu of fuel economy achievements.

How Do Manufacturers Comply with the Standards?

Manufacturers comply with the standards by reporting to EPA and NHTSA annually with information regarding their MY fleet production and sales numbers, their MY fleet characteristics, and the fuel economy and emissions results from the EPA-approved test cycles. This information allows the agencies to calculate each manufacturer's specific CAFE and GHG emissions standards given its fleet-wide sales numbers. The agencies compare the calculated standard against the manufacturer's fleet-wide adjusted test results to determine compliance. Accordingly, compliance is based on the vehicles sold, not the vehicles produced. **Figure 1** compares CAFE standards, as promulgated for both passenger cars and light trucks over MYs 1978-2025, against the U.S. fleets' adjusted performance data as reported by NHTSA for the given MYs. **Table 2** lists the most recent adjusted performance data reported by the agencies—MY 2017—for each manufacturer and its fleets.

[47] EPA, NHTSA, and CARB, "Draft Technical Assessment Report: Midterm Evaluation of Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards for Model Years 2022-2025," July 2016, p. ES-8, https://www.epa.gov/regulations-emissions-vehicles-and-engines/midterm-evaluation-light-duty-vehicle-greenhouse-gas#TAR.

Figure 1. CAFE Standards and Achieved Fuel Economy, MYs 1978-2026



Source: CRS, from EPA, "Light-Duty Automotive Technology, Carbon Dioxide Emissions, and Fuel Economy Trends: 1975 through 2017," January 2018; and NHTSA, "Manufacturer Projected Fuel Economy Performance Report," April 30, 2018, Table 2.

Notes: "CAFE Achieved" mpg are the values reported under "NHTSA CAFE (mpg)" in Table 9.1 of EPA's 2018 Trends report and Table 2 of NHTSA's 2018 Manufacturer Projected Fuel Economy Performance Report. "CAFE Standards" are as they were projected at the publication of the respective final rules, including "Original" (NHTSA's CAFE program); "MY 2012-2016" (75 *Federal Register* 25324, May 7, 2010); MY 2017-2025 (77 *Federal Register* 62624, October 15, 2012); and "Proposed" (83 *Federal Register* 42986, August 24, 2018).

Because of the "attribute-based" standards, compliance targets are different for each manufacturer depending on the vehicles it produces. As stated by NHTSA: "Manufacturers are not compelled to build light-duty vehicles of any particular size or type, and each manufacturer will have its own standard which reflects the vehicles it chooses to produce."[48] The agencies contend: "Under the National Program automobile manufacturers will be able to continue building a single light-duty national fleet that satisfies all requirements under both programs while ensuring that consumers still have a full range of vehicle choices that are available today."[49]

To facilitate compliance, the agencies provide manufacturers various flexibilities under the standards. A manufacturer's fleet-wide performance (as measured on EPA's test cycles) can be

[48] NHTSA, "Fact Sheet: NHTSA and EPA Propose to Extend the National Program to Improve Fuel Economy and Greenhouse Gases for Passenger Cars and Light Trucks," p. 3, https://morningconsult.com/wp-content/uploads/2017/06/2017-25_CAFE_NPRM_Factsheet.pdf.

[49] EPA and NHTSA, "2017 and Later Model Year Light-Duty Vehicle Greenhouse Gas Emissions and Corporate Average Fuel Economy Standards; Final Rule," 77 *Federal Register* 62624, October 15, 2012.

adjusted through the use of flex-fuel vehicles, air-conditioning efficiency improvements, and other "off-cycle" technologies (e.g., active aerodynamics, thermal controls, and idle reduction).[50] Further, manufacturers can generate credits for overcompliance with the standards in a given year. They can bank, borrow, trade, and transfer these credits, both within their own fleets and among other manufacturers, to facilitate current compliance. They can also offset current deficits using future credits (either generated or acquired within three years) to determine final compliance.[51] A CAFE credit is earned for each 0.1 mpg in excess of the fleet's standard mpg. A GHG credit is earned for each megagram (Mg, or metric ton) of CO_2-equivalent saved relative to the standard as calculated for the projected lifetime of the vehicle. **Table 3** summarizes GHG credits that are available to each manufacturer after MY 2017, reflecting all completed trades and transfers, as reported by EPA. (NHTSA's CAFE credit balances for MY 2017 have not been reported.)

The auto manufactures completed MY 2017 compliance with approximately 250 million metric tons of GHG credits under EPA's program. Many manufacturers chose to use credits for MY 2017 compliance. It was the second consecutive model year that the manufacturers depleted total industry credits after four years of the industry accumulating credits (see **Figure 2**). In addition to the industry-wide credit balance, factors that may affect future compliance include credit expiration and distribution. Credits earned by manufacturers in MY 2017 or beyond have a five-year lifespan, while all prior credits (92% of the total) are to expire at the end of MY 2021. Additionally, three manufacturers hold more than half of the current balance.[52]

Under the CAFE program, manufacturers can comply with the standards by paying a civil penalty. The CAFE penalty is currently $5.50 per 0.1 mpg over the standard, per vehicle.[53] Historically, some manufacturers have opted to comply with the standards in this way, especially low volume, luxury imported vehicles.[54] Beginning with MY 2019, NHTSA was scheduled to assess a civil penalty of $14 per 0.1 mpg over the standard as provided by the Federal Civil Penalties Inflation Adjustment Act Improvements Act of 2015 within the Bipartisan Budget Act of 2015 (P.L. 114-74) and subsequent rulemaking.[55] On August 26, 2019, NHTSA finalized a rule to retain the existing penalty rate of $5.50 applicable to automobile manufacturers that fail to meet CAFE standards, having proposed that increasing the CAFE civil penalty rate would have a negative economic impact. The rule is to be effective as of September 24, 2019.[56]

Under the CAA, manufacturers that fail to comply with the GHG emissions standards are also subject to civil enforcement. The EPA Administer and the U.S. Attorney General determine the amount of the civil penalty based on numerous factors, but it could be as high as $37,500 per vehicle per violation.[57] As of MY 2015, EPA has not determined any manufacturer to be out of compliance with the light-duty vehicle GHG emissions standards.

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[50] "Off-cycle" refers to technologies that result in real-world emissions and fuel economy benefits, but where the benefits are not adequately captured on the test procedures used by manufacturers to demonstrate compliance.

[51] Both NHTSA and EPA consider total vehicle miles traveled (VMT) for the different vehicle compliance categories (DPC, IPC, LT) when calculating credit values. EPA incorporates this calculation prior to awarding credits. NHTSA employs an adjustment factor during the trading or transferring of credits across compliance categories.

[52] EPA, "The 2018 EPA Automotive Trends Report: Greenhouse Gas Emissions, Fuel Economy, and Technology since 1975," March 2019.

[53] 49 U.S.C. §32912.

[54] NHTSA reports annually the amounts paid in civil penalties by manufacturer. See https://one.nhtsa.gov/cafe_pic/CAFE_PIC_Fines_LIVE.html.

[55] The goal of the 2015 law is to adjust federal penalties for inflation in line with the original intent of underlying statutes. NHTSA, "Civil Penalties: Final Rule," 81 *Federal Register* 95489, December 28, 2016.

[56] NHTSA, "Civil Penalties: Final Rule," 84 *Federal Register* 36007, August 26, 2019.

[57] 42 U.S.C. §7524.

Table 2. MY 2017 Manufacturer Fuel Economy and GHG Values

(Data are projected. Italicized values show performance data that do not meet the standards after the two-cycle test and adjustments but before the manufacturer's use of compliance flexibilities.)

Manufacturer	Fleet	CAFE Standard (mpg)	CAFE Performance (mpg)	GHG Standard (g/m)	GHG Performance (g/m)
BMW	IPC	38.5	*35.1*	221	*223*
	LT	30.6	*28.9*	284	278
Daimler/Mercedes	DPC	38.1	*36.9*	229	*255*
	IPC	36.8	*32.4*		
	LT	29.9	*26.4*	290	*326*
Fiat Chrysler *	DPC	37.3	*32.0*	225	*267*
	IPC	40.0	*33.5*		
	LT	29.1	*27.6*	297	*315*
Ford	DPC	38.5	*36.2*	222	*237*
	IPC	40.8	75.8		
	LT	28.2	*27.1*	308	*322*
GM	DPC	38.1	*37.8*	221	213
	IPC	41.9	43.7		
	LT	27.5	*25.8*	315	*333*
Honda	DPC	39.1	43.1	217	196
	IPC	41.2	46.4		
	LT	30.9	32.8	279	253
Hyundai	IPC	38.9	*38.8*	219	*230*
	LT	31.2	*27.1*	278	*327*
Jaguar Land Rover	IPC	37.0	*31.7*	244	*267*
	LT	30.4	*27.5*	287	*310*
Kia	DPC	39.5	44.7	218	*219*
	IPC	38.9	*37.6*		
	LT	31.0	*28.5*	281	*308*
Mazda	DPC	39.8	42.7	216	*222*
	IPC	39.1	*39.0*		
	LT	32.3	33.9	268	263
Mitsubishi	IPC	42.4	44.4	217	214
	LT	34.2	34.6	286	*294*
Nissan	DPC	39.2	40.8	217	214
	IPC	39.0	*36.3*		
	LT	30.1	*29.1*	286	*294*

Manufacturer	Fleet	CAFE Standard (mpg)	CAFE Performance (mpg)	GHG Standard (g/m)	GHG Performance (g/m)
Subaru	IPC	39.7	*38.2*	213	*236*
	LT	33.6	36.8	258	230
Tesla	DPC	33.4	370.5	252	-266
Toyota	DPC	38.6	*38.3*	216	208
	IPC	40.0	42.5		
	LT	29.9	*28.8*	290	*305*
Volkswagen *	DPC	38.5	*36.7*	213	*234*
	IPC	38.2	*36.8*		
	LT	27.3	27.6	282	*301*
Volvo	IPC	37.4	*35.9*	241	236
	LT	30.2	30.9	288	265

Source: CRS, from NHTSA, "Manufacturer Projected Fuel Economy Performance Report," April 30, 2018, Table 1; EPA, "The 2018 EPA Automotive Trends Report: Greenhouse Gas Emissions, Fuel Economy, and Technology Since 1975," March 2019, Tables 5.1, 5.7, and 5.9.

Notes: CAFE values in miles per gallon (mpg); GHG values in grams per mile (g/m). CAFE compliance is divided into three fleets: domestic passenger cars (DPC), import passenger cars (IPC), and light trucks (LT); GHG compliance is divided into two fleets: passenger cars and light trucks. CAFE and GHG performance values are after fleet adjustments but before credit banking, borrowing, trading, or transferring by manufacturer. A higher CAFE performance value than CAFE standard value is in compliance; a lower GHG performance value than GHG standard value is in compliance. Values listed in *italics* show performance data that do not meet the standards after the 2-cycle test and adjustments, but before the manufacturer's use of compliance flexibilities. Manufacturers may be in compliance for one program but out of compliance for the other due to the classification of fleets and the differences in the programs' adjustments.

Nissan and Mitsubishi are listed as separate companies in NHTSA's report and a single company in EPA's report.

* Fiat Chrysler and Volkswagen are under ongoing investigations and/or corrective actions. Investigations and corrective actions may yield different final data.

Table 3. GHG Credit Balances after MY 2017

Manufacturer	Total Credits Carried Forward to MY 2018 (Metric Tons)
Toyota	71,407,230
Honda	37,813,391
Nissan/Mitsubishi	28,069,044
Fiat Chrysler *	20,307,365
Hyundai	18,086,030
Subaru	16,865,474
Ford	16,263,750
GM	15,082,239
Mazda	9,294,662
BMW	5,276,410
Kia	4,942,038
Volkswagen *	2,776,936
Tesla	2,385,617
Daimler/Mercedes	573,455
Suzuki	428,242
Volvo	264,235
Karma Automotive	58,852
BYD Motors	5,401
Jaguar Land Rover	-575,167

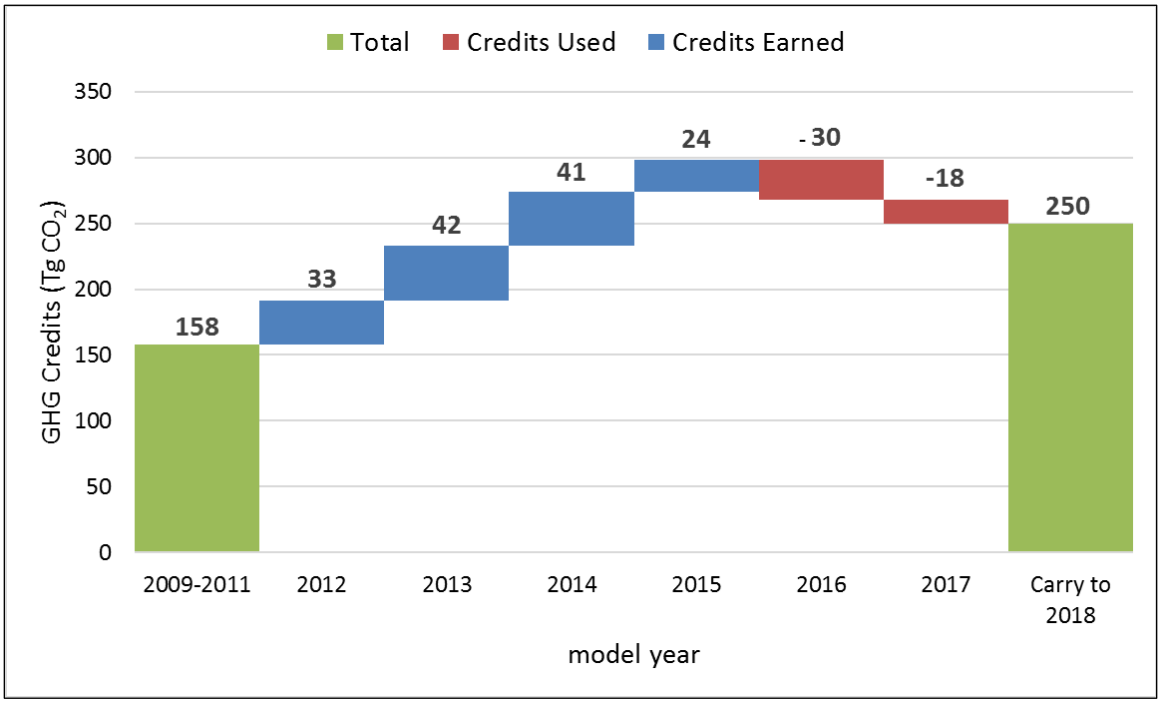
Source: CRS, from EPA, "The 2018 EPA Automotive Trends Report: Greenhouse Gas Emissions, Fuel Economy, and Technology Since 1975," March 2019, Table 5.17.

Notes: A GHG credit is earned for each megagram (Mg, or metric ton) of CO_2-equivalent saved relative to the standard as calculated for the projected lifetime of the vehicle. EPA estimates the lifetime of a passenger car to be 14 years and the lifetime of a light truck to be 16 years. Accordingly, outstanding credits for all manufacturers carried forward to MY2018 are equivalent to 249 million metric tons CO_2-equivalent saved. For comparison, CO_2-equivalent emissions from all on-road passenger cars and light trucks in the United States in 2017 were 1,054 million metric tons (EPA, "Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990-2017," April 11, 2019, Table 3-13).

Some companies on the list produced no vehicles for the U.S. market in the most recent model year, but the credits generated in previous model years continue to be available. Manufacturers can offset current deficits using future credits (either generated or acquired within three years) to determine final compliance.

* Fiat Chrysler and Volkswagen are under ongoing investigations and/or corrective actions. Investigations and corrective actions may yield different final data.

Figure 2. Industry GHG Credit Generation and Use after MY 2017



Source: CRS, from EPA, "The 2018 EPA Automotive Trends Report: Greenhouse Gas Emissions, Fuel Economy, and Technology Since 1975," March 2019, Table 5.1.

Notes: One teragram carbon dioxide (Tg CO_2) is equivalent to one million metric tons (MMT).

What Is the Midterm Evaluation?

As part of the Phase 2 rulemaking, EPA and NHTSA made a commitment to conduct a midterm evaluation (MTE) for the latter half of the standards, MYs 2022-2025.[58] The agencies deemed an MTE appropriate given the long time frame during which the standards were to apply and the uncertainty about how motor vehicle technologies would evolve. EPA, NHTSA, and California also have differing statutory obligations. That is, EPA, California, and some other states—through their authorities under the CAA, California AB 1493, and other state statutes—have finalized GHG emissions standards through MY 2025. Under the MTE, EPA and CARB were to decide whether to revise their standards. NHTSA, through its authorities under EPCA, has finalized standards only through MY 2021, and would require new rulemaking for the period MYs 2022-2025.

Through the MTE, the EPA Administrator was to determine whether EPA's standards for MYs 2022-2025 were still appropriate given the latest available data and information.[59] A final determination could result in strengthening, weakening, or retaining the current standards. If EPA determined that the standards were appropriate, the agency would "announce that final decision and the basis for that decision." If EPA determined that the standards should be changed, EPA and NHTSA would be required to "initiate a rulemaking to adopt standards that are appropriate."

[58] 40 C.F.R. §86.1818-12(h).

[59] The rulemaking specified EPA as the agency to determine whether the standards established for MYs 2022-2025 are appropriate. See 40 C.F.R. §86.1818-12(h).

Throughout the process, the MY 2022-2025 standards were to "remain in effect unless and until EPA changes them by rulemaking."

The Phase 2 rulemaking laid out several formal steps in the MTE process, including

- a Draft Technical Assessment Report issued jointly by EPA, NHTSA, and CARB with opportunity for public comment no later than November 15, 2017;
- a Proposed Determination on the MTE, with opportunity for public comment; and
- a Final Determination, no later than April 1, 2018.

EPA, NHTSA, and CARB jointly issued the Draft Technical Assessment Report for public comment on July 27, 2016.[60] This was a technical report, not a decision document, and examined a wide range of technology, marketplace, and economic issues relevant to the MY 2022-2025 standards. It found

- auto manufacturers are innovating in a time of record sales and fuel economy levels;
- the MY 2022-2025 standards could be met largely with more efficient gasoline-powered cars and with only modest penetration of hybrids and electric vehicles; and
- the "attribute-based" standards preserve consumer choice, even as they protect the environment and reduce fuel consumption.

On November 30, 2016, the Obama Administration's EPA released a proposed determination stating that the MY 2022-2025 standards remained appropriate and that a rulemaking to change them was not warranted.[61] The agency based its findings on a Technical Support Document,[62] the previously released Draft Technical Assessment Report, and input from the auto industry and other stakeholders. On January 12, 2017, then-EPA Administrator Gina McCarthy finalized the determination, stating that "the standards adopted in 2012 by the EPA remain feasible, practical and appropriate."[63]

The final action arguably accelerated the timeline for the MTE, and EPA announced it separately from any NHTSA or CARB announcement. EPA noted its "discretion" in issuing a final determination, saying that the agency "recognizes that long-term regulatory certainty and stability

[60] EPA and NHTSA, "Notice of Availability of Midterm Evaluation Draft Technical Assessment Report for Model Year 2022-2025 Light-Duty Vehicle GHG Emissions and CAFE Standards," 81 *Federal Register* 49217, July 27, 2016. EPA, NHTSA, and CARB, "Draft Technical Assessment Report: Midterm Evaluation of Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards for Model Years 2022-2025," EPA-420-D-16-900, July 2016.

[61] EPA, "Proposed Determination on the Appropriateness of the Model Year 2022-2025 Light-Duty Vehicle Greenhouse Gas Emissions Standards under the Midterm Evaluation," 81 *Federal Register* 87928, December 6, 2016.

[62] EPA, Assessment and Standards Division, Office of Transportation and Air Quality, "Proposed Determination on the Appropriateness of the Model Year 2022-2025 Light-Duty Vehicle Greenhouse Gas Emissions Standards under the Midterm Evaluation: Technical Support Document," EPA-420-R-16-021, November 2016, https://19january2017snapshot.epa.gov/sites/production/files/2016-11/documents/420r16021.pdf.

[63] EPA, "Final Determination on the Appropriateness of the Model Year 2022-2025 Light-Duty Vehicle Greenhouse Gas Emissions Standards under the Midterm Evaluation," EPA-420-R-17-001, January 2017, https://nepis.epa.gov/Exe/ZyPURL.cgi?Dockey=P100QQ91.txt.

are important for the automotive industry and will contribute to the continued success of the national program."[64]

Some auto manufacturer associations and other industry groups criticized the results of EPA's review and reportedly vowed to work with the Trump Administration to revisit EPA's determination. These groups sought actions such as easing the MY 2022-2025 requirements and/or better aligning NHTSA's and EPA's standards.

What Is the Status of CAFE and GHG Standards Under the Trump Administration?

The Revised Final Determination

On March 15, 2017, after President Trump took office, EPA and NHTSA announced their joint intention to reconsider the Obama Administration's final determination and reopen the midterm evaluation process. EPA announced a 45-day public comment period on August 21, 2017, and held a public hearing on September 6, 2017, receiving more than 290,000 comments.[65]

On April 2, 2018, EPA released a revised final determination, stating that the MY 2022-2025 standards are "not appropriate and, therefore, should be revised."[66] The notice states that the January 2017 final determination is based on "outdated information, and that more recent information suggests that the current standards may be too stringent." In making the revised determination, EPA Administrator Scott Pruitt cited and provided comment on several factors from the Phase 2 rulemaking that governed analysis for the midterm evaluation process. These factors include[67]

- the availability and effectiveness of technology, and the appropriate lead time for introduction of technology;
- the cost to the producers or purchasers of new motor vehicles or new motor vehicle engines;
- the feasibility and practicability of the standards;
- the impact of the standards on emissions reduction, oil conservation, energy security, and fuel savings by consumers;
- the impact of the standards on the automobile industry;
- the impact of the standards on automobile safety;
- the impact of the GHG emissions standards on the CAFE standards and a national harmonized program; and
- the impact of the standards on other relevant factors.

[64] EPA, "Letter to Stakeholders," November 30, 2016, https://www.epa.gov/sites/production/files/2016-11/documents/ld-pd-stkhldr-ltr-2016-11-30.pdf.

[65] EPA, "News Release: EPA to Reexamine Emission Standards for Cars and Light-Duty Trucks—Model Years 2022-2025," March 15, 2017, https://www.epa.gov/newsreleases/epa-reexamine-emission-standards-cars-and-light-duty-trucks-model-years-2022-2025.

[66] EPA, "Mid-Term Evaluation of Greenhouse Gas Emissions Standards for Model Year 2022-2025 Light-Duty Vehicles: Notice; Withdrawal," 83 *Federal Register* 16077, Friday, April 13, 2018.

[67] These factors are listed at 40 C.F.R. §86.1818-12(h)(1).

The revised final determination states that EPA and NHTSA would initiate a new rulemaking to consider revised standards for MY 2022-2025 vehicles.[68] Until that new rulemaking is completed, the current standards remain in effect.

The Proposed SAFE Rule

On August 24, 2018, EPA and NHTSA proposed amendments to the existing CAFE and GHG emission standards. The Safer Affordable Fuel-Efficient Vehicles Rule for MY 2021-2026 Passenger Cars and Light Trucks (SAFE Vehicles Rule) offers eight alternatives (see **Table 4**).[69] The agencies' preferred alternative, if finalized, is to retain the existing standards through MY 2020 and then to freeze the standards at this level for both programs through MY 2026. The preferred alternative also removes CO_2 equivalent air conditioning refrigerant leakage, nitrous oxide, and methane requirements after MY 2020.

Further, EPA proposes to withdraw California's CAA preemption waiver for its vehicle GHG standards applicable to MYs 2021-2025. Separately, NHTSA contends that EPCA preempts California's standards because the statute preempts state laws related to federal fuel economy standards. NHTSA argues that state laws regulating or prohibiting tailpipe CO_2 emissions are related to fuel economy and can therefore be preempted regardless of California's CAA preemption waiver.

Observers have had difficulty comparing the costs and benefits reported under the proposed SAFE Vehicles Rule to those reported under the existing standards because each set of standards employs different compliance timelines, modeling, inputs, and underlying assumptions. For example, the primary focus of the analysis changed (i.e., from GHG emission impacts under the existing standards to fuel use, vehicle miles traveled, and highway accidents under the proposal), and the primary computer model and the modeling agency have changed (i.e., from the ALPHA and OMEGA models at EPA to the VOLPE model at NHTSA).[70] Further, certain modeling assumptions have been amended (e.g., the social cost of carbon, new technology costs) and others have been added (e.g., a dynamic stock model to estimate the effects of new vehicle sales and existing vehicle scrappage). These changes and their impacts may likely shape the debate during the proposal's comment period and beyond.

[68] EPA has declared that the MTE determination "is not a final agency action," explaining that "a determination that the standards are not appropriate would lead to the initiation of a rulemaking to adopt new standards, and it is the conclusion of that rulemaking that would constitute a final agency action and be judicially reviewable as such." EPA, "Mid-Term Evaluation of Greenhouse Gas Emissions Standards for Model Year 2022-2025 Light-Duty Vehicles: Notice; Withdrawal," 83 *Federal Register* 16078, Friday, April 13, 2018. However, several states and stakeholders have filed petitions in the D.C. Circuit seeking judicial review of the revised MTE determination. *See, e.g.*, Petition for Review, California v. EPA, No. 18-1114 (D.C. Cir. May 1, 2018); Petition for Review, Nat'l Coalition for Advanced Transp. v. EPA, No. 18-1118 (D.C. Cir. May 3, 2018); Petition for Review, Center for Biological Diversity v. EPA, No. 18-1139 (D.C. Cir. May 15, 2018).

[69] EPA and NHTSA, "The Safer Affordable Fuel-Efficient (SAFE) Vehicles Rule for Model Years 2021-2026 Passenger Cars and Light Trucks; Proposed Rule," 83 *Federal Register* 42986, August 24, 2018.

[70] For a discussion of the agencies' modeling systems, see EPA's OMEGA model at https://www.epa.gov/regulations-emissions-vehicles-and-engines/optimization-model-reducing-emissions-greenhouse-gases and NHTSA's VOLPE model at https://www.nhtsa.gov/corporate-average-fuel-economy/compliance-and-effects-modeling-system.

Table 4. SAFE Vehicles Rule Regulatory Alternatives

Alternative	Change in Stringency	Air Conditioning and Other Off-Cycle Adjustments	Retention of Provisions for Other GHGs
Baseline/No-Action	MY 2021 standards remain in place; MYs 2022-2025 augural CAFE standards are finalized and GHG standards remain unchanged; MY 2026 standards are set at MY 2025 levels	No change	Yes, for all MYs
1 (Proposed)	Existing standards through MY 2020, then 0%/year increases for both passenger cars and light trucks, for MYs 2021-2026	No change	No, beginning in MY 2021
2	Existing standards through MY 2020, then 0.5%/year increases for both passenger cars and light trucks, for MYs 2021-2026	No change	No, beginning in MY 2021
3	Existing standards through MY 2020, then 0.5%/year increases for both passenger cars and light trucks, for MYs 2021-2026	Phase out these adjustments over MYs 2022-2026	No, beginning in MY 2021
4	Existing standards through MY 2020, then 1%/year increases for passenger cars and 2%/year increases for light trucks, for MYs 2021-2026	No change	No, beginning in MY 2021
5	Existing standards through MY 2021, then 1%/year increases for passenger cars and 2%/year increases for light trucks, for MYs 2022-2026	No change	No, beginning in MY 2022
6	Existing standards through MY 2020, then 2%/year increases for passenger cars and 3%/year increases for light trucks, for MYs 2021-2026	No change	No, beginning in MY 2021
7	Existing standards through MY 2020, then 2%/year increases for passenger cars and 3%/year increases for light trucks, for MYs 2021-2026	Phase out these adjustments over MYs 2022-2026	No, beginning in MY 2021
8	Existing standards through MY 2021, then 2%/year increases for passenger cars and 3%/year increases for light trucks, for MYs 2022-2026	No change	No, beginning in MY 2022

Source: EPA and NHTSA, "The Safer Affordable Fuel-Efficient (SAFE) Vehicles Rule for Model Years 2021–2026 Passenger Cars and Light Trucks; Proposed Rule," 83 *Federal Register* 42986, August 24, 2018.

Notes: Per the proposed rule: "Carbon dioxide equivalent of air conditioning refrigerant leakage, nitrous oxide and methane emissions are included for compliance with the EPA standards for all MYs under the baseline/no action alternative. Carbon dioxide equivalent is calculated using the Global Warming Potential (GWP) [see footnote 19] of each of the emissions. Beginning in MY 2021, the proposal provides that the GWP equivalents of air conditioning refrigerant leakage, nitrous oxide and methane emissions would no longer be able to be included with the tailpipe CO_2 for compliance with tailpipe CO_2 standards."

California's Actions

EPA and NHTSA have met with California to discuss the MTE, the MY 2022-2025 GHG standards, and post-2025 GHG standards, on which CARB officials have said they are already working. Efforts have focused on establishing a single national standard for fuel economy and GHG emissions in order to avoid a situation in which manufacturers must deal with a patchwork of competing state regulations.[71]

California has restated its continued support for the current National Program and the state's standards. On March 24, 2017, CARB passed a resolution to accept its staff's midterm evaluation of the state's Advanced Clean Car program—which includes MY 2017-2025 vehicle GHG standards in line with EPA's 2017 final determination and the 2012 rulemaking.[72] Effective December 12, 2018, CARB adopted a regulatory amendment to clarify that automakers must still comply with the state's existing light-duty vehicle GHG standards through MY 2025 even if EPA and NHTSA approve a rollback of the equivalent national rules.[73]

Under the proposed SAFE Vehicles Rule for MY 2021-2026 Passenger Cars and Light Trucks, EPA has proposed withdrawing the California CAA preemption waiver for its vehicle GHG standards applicable to MYs 2021-2025.[74] In addition, under the EPCA authority, NHTSA proposes to preempt state GHG standards (including Section 177 states adopting the California GHG standards) that are "related" to federal fuel economy standards regardless of California's CAA preemption waiver.[75]

Premised on an expectation that CARB and the White House do not reach an accord on these proposals, California announced on July 25, 2019, that the state reached an agreement with four major automakers to implement voluntary fuel economy and GHG limits through MY 2026 that fall roughly midway between the current standards and the Trump Administration's proposal.[76] The companies were Ford, Honda, Volkswagen, and BMW, which represent approximately one-third of the U.S. new vehicle market. The terms of the agreement are as follows:

- "Revised Greenhouse Gas Standards: GHG standards, beginning in the 2022 model year (MY) and extending through the 2026 MY, with increasing stringency at a nationwide average annual rate of 3.7% (year-over-year). Of the 3.7% annual stringency, 1% can be achieved using the advanced technology multiplier credits, below.

[71] In response to questions about the CAFE/GHG standards and California's waiver status, then-EPA Administrator Scott Pruitt stated that "there are ongoing discussions with CARB in California, the agency that oversees these matters. It is our hope that we can come to a resolution as we visit about these standards in April of this year. Senator, federalism doesn't mean that one State can dictate to the rest of the Country, that we recognize California's special status on the statute. And we are working with them to find consensus around these issues." U.S. Congress, Senate Committee on Environment and Public Works, *Oversight Hearing to Receive Testimony from Environmental Protection Agency Administrator Scott Pruitt*, 115th Cong., January 30, 2018, p. 72.

[72] CARB, "2017 Midterm Review Report," at https://ww2.arb.ca.gov/resources/documents/2017-midterm-review-report.

[73] See documents related to CARB's amendments at "CARB: Proposed Amendments to the Low- Emission Vehicle III Greenhouse Gas Emission Regulation," https://ww2.arb.ca.gov/rulemaking/2018/proposed-amendments-low-emission-vehicle-iii-greenhouse-gas-emission-regulation.

[74] EPA and NHTSA, "The Safer Affordable Fuel-Efficient (SAFE) Vehicles Rule for Model Years 2021-2026 Passenger Cars and Light Trucks; Proposed Rule," 83 *Federal Register* 42986, 43240, August 24, 2018.

[75] Ibid., p. 43232.

[76] Office of the Governor, "California and Major Automakers Reach Groundbreaking Framework Agreement on Clean Emission Standards," July 25, 2019, https://www.gov.ca.gov/2019/07/25/california-and-major-automakers-reach-groundbreaking-framework-agreement-on-clean-emission-standards/. CRS inserts in square brackets.

- "Appropriate Flexibilities to Promote Zero Emission Technology: Continue current advanced technology multipliers that now expire after MY 2021, extending them through MY 2024 at the current 2.0x for Battery Electric and Fuel Cell Electric Vehicles (BEV/FCEV), and 1.6x for Plug-in Hybrid Electric Vehicles (PHEV), tapering off at the current MY 2020 and MY 2021 levels in MY 2025 and MY 2026, respectively.
- "Simplify Accounting: Remove the requirement to account for upstream emissions of fuels, as these can be addressed by other programs.
- "Increase Innovation: Raise the current cap on off-cycle menu credits, which account for actions taken outside the formal test cycle framework, from 10 grams [CO_2e] per mile to 15 grams per mile starting in MY 2020.
- "Streamlining and Process Improvements: Improve the off-cycle credit program to facilitate timely review and decision-making regarding the approval of new off-cycle technologies.
- "Recognize California's Authority: Participating companies are choosing to pursue a voluntary agreement in which California accepts these terms as compliance with its program, given its authority, rather than challenge California's GHG and ZEV programs."

At this time, it is unclear whether other auto manufacturers or other CAA Section 177 states would join the agreement or whether the agreement would spur EPA and NHTSA to reconsider their proposal. Further, it is uncertain how California would incorporate the new agreement into its current regulations and CAA waiver requirements.

What Is Meant by "Harmonizing" or "Aligning" the Standards?

Many auto manufacturers and industry stakeholders have argued that the CAFE and GHG emission standards are intended to be a joint set of rules that would allow auto manufacturers to comply with both programs through a single unified fleet. In practice, however, differences in the test procedures, flexibilities, and credit systems used by NHTSA and EPA have created the possibility that a manufacturer's fleet may be in compliance with one agency's program but not the other's. Although the agencies have acted to integrate the standards, differences remain. Some stakeholders argue for statutory or regulatory changes to further integrate—or what they refer to as "harmonize" or "align"—the standards.

Table 5 outlines a selection of the differences between the federal programs. Many of NHTSA's requirements are statutory; and thus, many potential adjustments to NHTSA's CAFE program would require legislation.

Lawmakers introduced bills in the 114th, 115th, and 116th Congresses to address some of the statutory limitations of the CAFE program vis-à-vis the GHG program. These included:

- H.R. 431 (116th) would have repealed Title 49, Chapter 329, of the *United States Code*.
- S. 1273/H.R. 4011 (115th) would have amended Chapter 329 to extend NHTSA's credit banking period, ease the limits on credit trading and transferring between fleets, and allow for Phase 1 off-cycle credits.

- S.Amdt. 3251 to S. 2012 (114th) would have modified the calculation of fuel economy for gaseous fuel, dual-fueled automobiles under Chapter 329.

Table 5. Selected Differences between NHTSA's CAFE and EPA's GHG Programs

(citations to the U.S.C. and C.F.R. are provided where appropriate)

Item	NHTSA CAFE Program	EPA GHG Program
Authority	EPCA, EISA	CAA
Citations	49 U.S.C. §§32901-32919; 49 C.F.R. Parts 523, 531, 533, and 600	42 U.S.C. §§7521-7554; 40 C.F.R. Parts 85, 86, and 600
Stated Purpose	"To increase domestic energy supplies and availability; to restrain energy demand; [and] to prepare for energy emergencies" EPCA 1975	To prevent the "emission of any air pollutant from any class or classes of new motor vehicles or new motor vehicle engines, which … cause, or contribute to ... air pollution which may reasonably be anticipated to endanger public health or welfare" CAA 1970
Considerations	EPCA requires that NHTSA establish separate passenger car and light truck standards (49 U.S.C. §32902(b)(1)) at "the maximum feasible average fuel economy level that it decides the manufacturers can achieve in that model year" (49 U.S.C. §32902(a)), based on the agency's consideration of four statutory factors: "technological feasibility, economic practicability, the effect of other motor vehicle standards of the Government on fuel economy, and the need of the United States to conserve energy" (49 U.S.C. §32902(f))	CAA requires that EPA consider issues of technical feasibility, cost, and available lead time. Standards under section CAA 202 (a) take effect only "after providing such period as the Administrator finds necessary to permit the development and application of the requisite technology, giving appropriate consideration to the cost of compliance within such period" (42 U.S.C. §7512 (a)(2))
Compliance Categories	"Passenger car" and "light truck" as defined in 49 C.F.R. Part 523	"Light-duty vehicle," "light-duty truck," and "medium-duty passenger vehicle" as defined in 40 C.F.R. §86.1803-01
Control	Fleet average fuel economy as measured by vehicle miles per gallon (49 U.S.C. §32901(11))	Fleet average CO_2-equivalent[a] emissions as measured by grams per mile
Duration	5 years; MYs 2017-2021 (49 U.S.C. §32902(b)(3)(B)); and the proposal of non-final "augural" standards for MYs 2022-2025	MYs 2017-2025 (EPA's duration is unlimited under the CAA)

Item	NHTSA CAFE Program	EPA GHG Program
Minimum Standard	Minimum Fleet Standard: 35 mpg by MY 2020 (49 U.S.C. §32902(b)(2)(A)); Minimum Domestic Passenger Car Standard: 27.5 mpg or 92 percent of the average fuel economy of the combined domestic and import passenger car fleets in that model year, whichever is greater (49 U.S.C. §32902(b)(4))	None
Cost of Non-compliance	Fines can be paid to satisfy compliance. Fee of $5.50 per 0.1 mpg over the standard, per vehicle (49 U.S.C. §32912); starting 2019, $14 per 0.1 mpg over the standard (NHTSA, "Civil Penalties: Final Rule," 81 *Federal Register* 95489, December 28, 2016)	Civil enforcement; unknown penalty, but could be as high as $37,500 per vehicle per violation of the CAA (42 U.S.C. §7524)
Credits		
Definition of Credit	0.1 mpg above manufacturer's required mpg standard for fleet (49 U.S.C. §32903(d))	1.0 megagram (or metric ton) of CO_2-equivalent as estimated over the lifetime of the vehicle below the manufacturer's standard
Compliance Categories	Domestic Passenger Cars, Import Passenger Cars, and Light Trucks (49 U.S.C. §32903(g)(6)(b))	Passenger Cars and Light Trucks
Credit Banking	5-year banking period (49 U.S.C. §32903(a)(2))	5-year banking period with the exception that credits earned between MYs 2010-2016 can be carried forward through MY 2021
Credit Borrowing	3-year carryback period (49 U.S.C. §32903(a)(1))	3-year carryback period
Limits	Limits on credits that can be transferred between compliance fleet categories; adjustment factors placed on traded or transferred credits to preserve "fuel savings" over the vehicle miles traveled (VMT) of the vehicle (49 U.S.C. §32903(f-g))	No limits on credits transferred between compliance categories; VMT calculation incorporated into definition of credit
Provisions for Alternative-Fueled Vehicles	Credits for ethanol and methanol fuels; electricity use in electric vehicles is converted to "equivalent gallons of gasoline" and only 15% of that is counted for compliance (49 U.S.C. §§32905-32906)	Allows manufacturers to count each alternative-fueled vehicle as more than a single vehicle—multipliers range from 1.3 to 2.0 depending on the extent of alternative fuel used and the MY; emissions from battery electric vehicles assumed to be zero

Item	NHTSA CAFE Program	EPA GHG Program
Exemptions	Secretary of Transportation's decision on exemptions for manufacturers with limited production lines of fewer than 10,000 passenger automobiles in the model year 2 years before the model year for which the application is made (49 U.S.C. §32902(d)); generally, fines can be paid to satisfy compliance	Temporary Lead-time Allowance Alternative Standards for manufacturers with limited product lines through MY 2015

Source: CRS, from EPA and NHTSA, "2017 and Later Model Year Light-Duty Vehicle Greenhouse Gas Emissions and Corporate Average Fuel Economy Standards; Final Rule," 77 *Federal Register* 62624, October 15, 2012; 49 U.S.C. §§32901-32919; 42 U.S.C. §§7401-7671q; 49 C.F.R. Parts 523, 531, 533, and 600; and 40 C.F.R. Parts 85, 86, and 600.

Notes: (a) Although CO_2 is the primary GHG, other gases, such as methane (CH_4) and fluorinated gases (e.g., air conditioner refrigerants), also act as greenhouse gases. The calculations of the weighted fuel economy and carbon-related exhaust emission values are provided for in 40 C.F.R. §600.113-12, and require input of the weighted grams/mile values for CO_2, total hydrocarbons (HC), carbon monoxide (CO), and, where applicable methanol (CH_3OH), formaldehyde (HCHO), ethanol (C_2H_5OH), acetaldehyde (C_2H_4O), nitrous oxide (N_2O), and methane (CH_4). Reductions in other (i.e., non-tailpipe) GHG emissions are captured in adjustments made to the compliance standards based on the manufacturer's use of flex-fuel vehicle, air-conditioning, "off-cycle," and CH_4 and N_2O deficit credits.

Other differences between NHTSA's CAFE and EPA's GHG standards stem from the agencies' regulatory interpretations. These differences could potentially be addressed through new rulemaking. In June of 2016, the Alliance of Automobile Manufacturers and the Association of Global Automakers submitted to EPA and NHTSA a Petition for a Direct Final Rule.[77] The petition asked the agencies to address some of the regulatory differences between the two programs, such as the calculations and applicability of off-cycle credits, air-conditioning efficiency credits, fuel savings adjustment factors, vehicle miles traveled (VMT) estimates, and alternative-fueled vehicle multipliers.

NHTSA partially granted the petition for rulemaking on December 21, 2016, agreeing "to address the changes requested in the petition in the course of the rulemaking proceeding, in accordance with statutory criteria."[78] Under the Trump Administration, both NHTSA and EPA have reportedly engaged with stakeholders in discussions of regulatory alignment.[79] Most of these discussions have reportedly focused on loosening the stringency of NHTSA's statutory and regulatory requirements so that they more closely match the flexibilities under EPA's standards. In the near term, this could serve the purpose of allowing many auto manufacturers to avoid

[77] Alliance of Automobile Manufacturers and Global Automakers, "Re: Petition for Direct Final Rule with Regard to Various Aspects of the Corporate Average Fuel Economy Program and the Greenhouse Gas Program," June 20, 2016, https://www.epa.gov/sites/production/files/2016-09/documents/petition_to_epa_from_auto_alliance_and_global_automakers.pdf. Specifically, the petition asked the agency to consider the following: (1) Include off-cycle credits in NHTSA's CAFE calculation for MYs 2010-2016; (2) Include air-conditioning efficiency credits in NHTSA's CAFE calculation for MYs 2010-2016; (3) Apply the fuel savings adjustment factor across model years within a compliance category; (4) Apply the harmonized VMT estimates from MYs 2017-2025 to MYs 2011-2016; (5) Revise NHTSA credit transfer definition to be more consistent with EPA; (6) Revise other restrictions on the use of credits ; (7) Revise the CAFE minimum domestic passenger car standard to reflect the final standard applicable to each model year; (8) Revise the multiplier for battery electric, plug-in hybrid electric, fuel cell, and compressed natural gas vehicles; and (9) Revise the off-cycle credit approval process.

[78] NHTSA, "Corporate Average Fuel Economy Standards; Credits: Proposed Rule," 81 *Federal Register* 95553, December 21, 2016.

[79] CRS correspondence with stakeholders.

paying compliance penalties under NHTSA's CAFE program, as they would be allowed to account for more credits in a revised system. Greater alignment, however, could also be achieved through tightening some of EPA's flexibilities so that they more closely adhere to NHTSA's requirements.

The proposed SAFE Vehicles Rule addresses harmonization in a few general ways—depending upon the alternative finalized—with many of EPA's GHG-specific provisions being removed. However, many of the details regarding categories, definitions, durations, credit systems, and compliance costs remain unchanged.

What Are Some of the Issues That Are Informing the Discussion on the Standards?

Below is a selected list of broader policy issues regarding the CAFE and GHG emission standards, their design, purpose, and potential revision. The issues are organized according to the specific factors listed in the requirements for the midterm evaluation.[80]

(1) The Availability and Effectiveness of Technology

The CAFE and GHG emissions standards are technology-forcing standards (i.e., they are standards that Congress authorized to set performance levels that, while not achievable immediately, are demonstrated to be achievable in the future based on information available today). Such policies date to the 1970s in environmental law and are now commonplace among health, safety, and environmental statutes. In the case of automotive controls, Congress enacted the Motor Vehicle Air Pollution Control Act (P.L. 89-272) in 1965, authorizing the Secretary of Health, Education, and Welfare to establish motor vehicle standards to reduce tailpipe emissions. Dissatisfied with the agency's lack of progress in the years following the law's enactment, Congress amended the statute to specify not only emission limits, but also deadlines for meeting the standards, and an enforcement program to ensure compliance. These changes became a major part of the Clean Air Act of 1970 (P.L. 91-604) and its subsequent amendments. Lawmakers recognized that the technology needed to meet the standards they enacted did not yet exist, and the schedule for compliance was ambitious; however most agreed that the only way to motivate the vehicle manufacturers to develop the necessary technology was to create the incentive to force such development.

The MY 2017-2025 CAFE and GHG emissions standards are based on EPA's and NHTSA's technology analysis from the 2012 rulemaking. In a 2015 report by the National Research Council, the council "found the analysis conducted by NHTSA and EPA in their development of the [MY] 2017-2025 standards to be thorough and of high caliber on the whole" and "concurred with the Agencies' costs and effectiveness values for many technologies."[81] But the council, as well as various stakeholders, expressed some concern that technologies may not be in place or achievable to attain the most stringent MY 2025 standards.

According to EPA's most recent Manufacturers' Report (MY 2017), the industry achieved record low new vehicle CO_2 emissions and record high fuel economy. Average estimated real-world CO_2

[80] 40 C.F.R. §86.1818-12(h)(1).

[81] National Research Council, *Cost, Effectiveness, and Deployment of Fuel Economy Technologies for Light-Duty Vehicles*, National Academies Press: Washington, DC, 2015, pp. 2-3.

tailpipe emissions fell by 3 g/mi to 357 g/mi, while estimated real-world fuel economy increased 0.2 mpg to 24.9 mpg compared to the previous year. Over the past 13 years, CO_2 emissions and fuel economy have improved 11 times and worsened twice. Further, seven of the 13 manufacturers increased fuel economy and decreased CO_2 between MY 2016 and MY 2017. The preliminary MY 2018 data project a similar trend, with seven of 13 manufacturers improving.[82] Some stakeholders have noted that many new product lines are scheduled to be introduced over the next few MYs that may further facilitate manufacturers' compliance with the standards. EPA will not have final MY 2018 data until 2020.

According to EPA's analysis, 26% of the MY 2017 vehicles already meet or exceed the MY 2020 emissions targets, with the addition of expected air conditioning improvements and off-cycle credits. The number of vehicles meeting or exceeding the MY 2020 standards has steadily increased with each model year (e.g., fewer than 5% of MY 2012 vehicles met or exceeded the MY 2020 standards): About 5% of MY 2017 vehicles could meet the MY 2025 emissions targets. These vehicles are currently comprised solely of hybrids (HEV), plug-in hybrids (PHEV), electric vehicles (EV), and hydrogen fuel cell vehicles (FCV).[83]

EPA's Draft Technical Assessment Report released in July 2016 states that the technology needed to meet the MY 2025 standards would likely include "advanced gasoline vehicle technologies ... with modest levels of strong hybridization and very low levels of full electrification (plug-in vehicles)."[84] Technologies considered in the report include more efficient engines and transmissions, aerodynamics, light-weighting, improved accessories, low rolling resistance tires, improved air conditioning systems, and others. Beyond the technologies the agencies considered in the 2012 final rule, several others have emerged, such as higher compression ratio, naturally aspirated gasoline engines, and an increased use of continuously variable transmissions. Further, the agencies expect other new technologies that are under active development to be in the fleet before MY 2025 (e.g., 48-volt mild hybrid systems). Stakeholders have disagreed about the levels of advanced gasoline, hybrid, and/or electric penetration that could be needed to meet the MY 2025 standards.

Table 6 shows fleet-wide penetration rates for a subset of the technologies that could be utilized to comply with the MY 2025 standards, as assessed by each agency's separate evaluation in the Draft Technical Assessment Report.

[82] EPA, "The 2018 EPA Automotive Trends Report: Greenhouse Gas Emissions, Fuel Economy, and Technology since 1975," March 2019, pp. 5-8.

[83] EPA, "Light-Duty Automotive Technology, Carbon Dioxide Emissions, and Fuel Economy Trends: 1975 through 2017," January 2018, p. ES-10.

[84] EPA, NHTSA, and CARB, "Draft Technical Assessment Report: Midterm Evaluation of Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards for Model Years 2022-2025," July 2016, p. ES-2.

Table 6. Selected Technology Penetrations to Meet the MY 2025 Standards

Technology	EPA	NHTSA
Turbocharged and downsized gasoline engines	33%	54%
Higher compression ratio, naturally aspirated gasoline engines	44%	<1%
8-speed and other advanced transmissions	90%	70%
Mass reduction	7%	6%
Stop-start	20%	38%
Mild Hybrid	18%	14%
Full Hybrid	<3%	14%
Plug-in hybrid electric vehicle	<2%	<1%
Electric vehicle	<3%	<2%

Source: CRS, from EPA, NHTSA, and CARB, "Draft Technical Assessment Report: Midterm Evaluation of Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards for Model Years 2022-2025," EPA-420-D-16-900, July 2016, Table ES-3.

Notes: Percentages shown are absolute rather than incremental. These values reflect both EPA and NHTSA's primary analyses; both agencies present additional sensitivity analyses in the Draft TAR at Chapter 12 (EPA) and Chapter 13 (NHTSA).

The 2018 revised final determination, however, reports that the Draft Technical Assessment Report's analysis "was optimistic in its assumptions and projections with respect to the availability and effectiveness of technology and the feasibility and practicability of the standards."[85] It calls into question the prior assumptions regarding electrification and notes an overreliance on future and/or proprietary technologies. Similarly, the supplementary information portion of the proposed SAFE Vehicles Rule refers to "significant doubts on EPA's [prior] predictions for future and timely availability of emerging technologies for compliance with Federal GHG standards for MY 2021–2025 … [and] highlights in particular challenges for ZEV-type technologies, such as BEVs and PHEVs."[86]

(2) The Cost on the Producers or Purchasers of New Motor Vehicles

The addition of fuel efficiency technologies in the U.S. fleet of passenger cars and light trucks incurs an initial set of costs on manufacturers and, by extension, consumers. However, these initial, incremental costs may be recouped by consumers through fuel savings over the lifetime of the vehicles. Both EPCA and CAA contain provisions that require the agencies to consider costs when promulgating standards.[87] The agencies are also subject to executive orders—such as E.O.

[85] EPA, "Mid-Term Evaluation of Greenhouse Gas Emissions Standards for Model Year 2022-2025 Light-Duty Vehicles: Notice; Withdrawal," 83 *Federal Register* 16077, Friday, April 13, 2018, p. 16079.

[86] The proposed SAFE Vehicles Rule projects that high penetrations of hybridized vehicles would be required to achieve the previously-issued EPA MYs 2021-2025 standards, specifically 37% mild hybrid penetration and 21% strong hybrids for the new vehicle fleet in MY 2030. EPA and NHTSA, "The Safer Affordable Fuel-Efficient (SAFE) Vehicles Rule for Model Years 2021-2026 Passenger Cars and Light Trucks; Proposed Rule," 83 *Federal Register* 42986, August 24, 2018, pp. 43230 and 43251-52.

[87] For an analysis of the CAA's requirements, see CRS Report R44840, *Cost and Benefit Considerations in Clean Air Act Regulations*, by James E. McCarthy and Richard K. Lattanzio.

12866, "Regulatory Planning and Review"—that require the estimation of costs and benefits any time they develop "economically significant" regulations.[88] E.O. 12866 further states that, "Each agency shall assess both the costs and the benefits of the intended regulation and, recognizing that some costs and benefits are difficult to quantify, propose or adopt a regulation only upon a reasoned determination that the benefits of the intended regulation justify its costs."

Based on the updated assessments provided in the Draft Technical Assessment Report, the projections for the average, initial costs of meeting the MY 2025 standards (incremental to the costs already incurred to meet the MY2021 standards) are approximately $1,100 per vehicle. Total industry-wide costs of meeting the MY 2022-2025 GHG standards are estimated at approximately $36 billion (at a 3% discount rate).

According to the 2016 Draft Technical Assessment Report, benefits of the CAFE and GHG emission standards include impacts such as climate-related economic benefits from reducing emissions of CO_2, reductions in energy security externalities caused by U.S. petroleum consumption and imports, the value of certain particulate matter-related health benefits (including premature mortality), the value of additional driving attributed to the VMT rebound effect, and the value of reduced refueling time needed to fill up a more fuel-efficient vehicle.

According to the 2016 Draft Technical Assessment Report, EPA estimates that GHG emissions would be reduced by about 540 million metric tons (MMT) and oil consumption would be reduced by 1.2 billion barrels over the lifetimes of MY 2022-2025 vehicles. Consumer pretax fuel savings are estimated to be $89 billion over the lifetime of vehicles meeting the MY 2022-2025 standards. Net benefits (inclusive of fuel savings) are estimated at $92 billion. EPA's analysis indicates that, compared to the MY 2021 standards, the MY 2025 standards will result in a net lifetime consumer savings of approximately $1,500 per vehicle with a payback period of about 5 years.[89]

The 2018 revised determination, however, states that the Draft Technical Assessment Report may underestimate costs and overstate benefits. Referencing analyses provided by the Alliance of Automobile Manufacturers and Global Automakers, it identifies direct technology costs, indirect cost multipliers, and cost learning curves as areas that need further assessment. It also contends that the Draft Technical Assessment Report does not give appropriate consideration to the effect

[88] Executive Order 12866 defines an "economically significant" regulation as any rule that may "have an annual effect on the economy of $100 million or more or adversely affect in a material way the economy, a sector of the economy, productivity, competition, jobs, the environment, public health or safety, or State, local, or tribal governments or communities." "Regulatory Planning and Review," Executive Order 12866, 58 *Federal Register* 51735, October 4, 1993.

[89] In more detail, projections in the Draft TAR for the average per-vehicle costs of meeting the MY 2025 standards (incremental to the costs already incurred to meet the MY2021 standards) are, for EPA's analysis of the GHG program, $894 to $1,017, and, for NHTSA's analysis of the CAFE program, $1,128 to $1,245. Total industry-wide costs of meeting the MY 2022-2025 GHG standards are estimated at $34 to $38 billion at a 3% discount rate (and $24 to $27 billion at a 7% discount rate). Over the lifetimes of MY 2021-2025 vehicles, EPA estimates that under the GHG standards, GHG emissions would be reduced by about 540 million metric tons (MMT) and oil consumption would be reduced by 1.2 billion barrels. Thus, societal monetized benefits of the MY 2022-2025 standards (exclusive of fuel savings to consumers) range from $40 to $41 billion at a 3% discount rate ($30 billion at a 7% discount rate). Consumer pretax fuel savings are estimated to be $89 billion at a 3% discount rate ($49 billion at a 7% discount rate) over the lifetime of vehicles meeting the MY 2022-2025 standards. Net benefits (inclusive of fuel savings) are estimated at $90 to $94 billion at a 3% discount rate ($51 to $54 billion at a 7% discount rate). EPA's analysis indicates that, compared to the MY 2021 standards, the MY 2025 standards will result in a net lifetime consumer savings of $1,460 to $1,620 and a payback of about 5 to 5 ½ years. NHTSA's analysis indicates that net lifetime consumer savings could average $680 to $800 per vehicle and a payback of about 6 to 6 ½ years. EPA, "Draft Technical Assessment Report," pp. ES-6 and ES-11.

of the standards on low-income consumers.[90] The average cost of a new 2019 light vehicle is $37,185, which, according to the Trump Administration's argument, could serve as a barrier to a new car purchase among middle- and lower-income car buyers, who instead may purchase a used vehicle.[91]

Correspondingly, the proposed SAFE Vehicles Rule estimates combined light-duty CAFE compliance impacts for the industry to be a savings of $252.6 billion in technology costs through MY 2029 compared to the baseline standards.[92] For the average consumer, the proposal states that "if the preferred alternative is finalized, buyers of new cars and light trucks will benefit from their lower purchase prices and financing costs."[93] The proposal estimates a $2,340 reduction in overall average vehicle ownership costs for new vehicles; a $1,850 reduction in the average required technology costs; and a $490 reduction in ownership costs for financing, insurance, and taxes.[94] However, the proposal also states that

> new cars and light trucks will offer lower fuel economy with more lenient standards in place, and this imposes various costs on their buyers and users. Drivers will experience higher costs as a consequence of new vehicles' increased fuel consumption, and from the added inconvenience of more frequent refueling stops required by their reduced driving range. They will also forego some mobility benefits as they use newly-purchased cars and light trucks less in response to their higher fueling costs, although this loss will be almost fully offset by the fuel and other costs they save by driving less.[95]

On balance, the proposed rule estimates a $390 net benefit to the average consumer.[96]

(3) The Feasibility and Practicability of the Standards

In both the 2017 and 2018 final determinations, EPA interpreted an analysis of the feasibility and practicability of the standards to include an analysis of consumer choice. Many factors drive consumer buying decisions, including vehicle costs, the price of gas, and business and family needs. The CAFE and GHG emissions standards are designed with the intention that consumers can continue to buy the differing types of vehicles they need, from compact cars, to SUVs, to larger trucks suitable for towing and carrying heavy loads. Under the "attribute-based" standards, owners of every type of new vehicle are potentially afforded gasoline savings and improved fuel economy with a reduced environmental impact. Notwithstanding, the agencies continue to research consumer issues, including an assessment of vehicle affordability, a study of willingness-to-pay for various vehicle attributes, and the content analysis of auto reviews.[97] During Phase 1 of

[90] EPA, "Mid-Term Evaluation of Greenhouse Gas Emissions Standards for Model Year 2022-2025 Light-Duty Vehicles: Notice; Withdrawal," 83 *Federal Register* 16077, Friday, April 13, 2018, p. 16084.

[91] Kelley Blue Book, "Average New-Car Prices Up Nearly 4 Percent Year-Over-Year for May 2019, According to Kelley Blue Book," press release, June 3, 2019, https://mediaroom.kbb.com/2019-06-03-Average-New-Car-Prices-Up-Nearly-4-Percent-Year-Over-Year-for-May-2019-According-to-Kelley-Blue-Book.

[92] EPA and NHTSA, "The Safer Affordable Fuel-Efficient (SAFE) Vehicles Rule for Model Years 2021-2026 Passenger Cars and Light Trucks; Proposed Rule," 83 *Federal Register* 42986, August 24, 2018, Table VII-45, p. 43310.

[93] Ibid., pp. 43066-67.

[94] Ibid., Table VII-71, p. 43323.

[95] Ibid., p. 43067.

[96] Ibid., Table VII-71, p. 43323.

[97] EPA, NHTSA, and CARB, "Draft Technical Assessment Report: Midterm Evaluation of Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards for Model Years 2022-2025," EPA-420-D-16-900, July 2016, pp. 6-1 to 6-27.

the standards, vehicle sales were close to record levels; fuel efficiency, vehicle footprint, and horsepower had increased slightly; and the weight and the inflation-adjusted price of a new vehicle stayed relatively constant, with the price of new passenger cars decreasing slightly and the price of new light trucks increasing slightly (see **Figure 3** for the changes in some of these attributes since 1990). Leading up to the Draft Technical Assessment Report, the agencies did not find evidence that the standards have posed significant obstacles to consumer acceptance.[98]

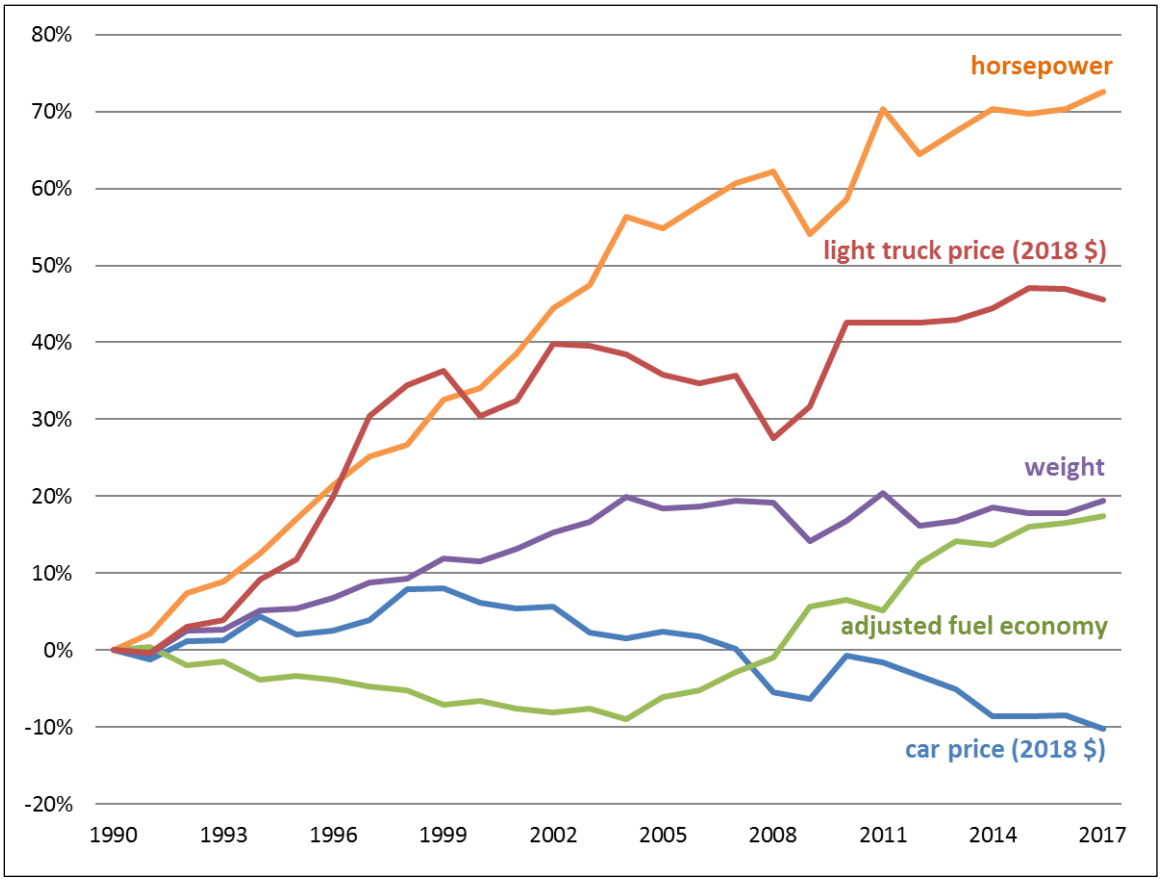
However, economic conditions change. The market has seen a sustained drop in fuel prices as a result of increased oil supply and/or reduced global demand since the origin of CAFE and GHG emission standards. Under these conditions, manufacturers are more challenged to design and sell advanced-technology, fuel-efficient vehicles at costs above the value of fuel savings captured by the new vehicle buyer. Research has shown a relationship between gasoline prices and the demand for fuel efficient vehicles.[99] Accordingly, lower gasoline prices tend to incentivize consumers to purchase new vehicles with lower fuel economy. Under these conditions, consumers focus less on fuel efficiency and more on increased horsepower, size, safety, comfort, and other features. Additionally, consumers are less likely to consider alternative-fueled vehicles, such as hybrid and electric vehicles. Thus, while manufacturers may be able to engineer vehicles that meet the more stringent CAFE and GHG emission standards, the choice of consumers to focus less on fuel efficiency has presented challenges to some manufacturers' sales-weighted fleet-wide conformity.

Further, as the standards become more stringent, uncertainties may arise as to which technologies will be necessary to achieve them. While the agencies have projected that the standards could be met primarily with gasoline vehicles, alternative-fueled vehicles may gain greater penetration in the years ahead. For gasoline vehicles, consumer acceptance would likely depend on the costs, effectiveness, and potential tradeoffs or synergies of those technologies with other vehicle attributes. For alternative-fueled vehicles, the higher standards could raise the possibility of new and additional challenges to consumer acceptance (e.g., availability, incentives, infrastructure, and the complexities of understanding cost, consumption, range, and recharging patterns).

[98] Ibid., p. 6-13.

[99] See, for example, Congressional Budget Office, "Effects of Gasoline Prices on Driving Behavior and Vehicle Markets," January 14, 2008; Shanjun Li, Roger von Haefen, and Christopher Timmins, "How Do Gasoline Prices Affect Fleet Fuel Economy?" National Bureau of Economic Research Working Paper No. 14450, October 2008; and Benjamin Leard, Joshua Linn, and Virginia McConnell, "Fuel Prices, New Vehicle Fuel Economy, and Implications for Attribute-Based Standards," Resources for the Future Working Paper, DP 16-04, February 3, 2016.

Figure 3. Percentage Change in Selected Vehicle Attributes, MYs 1990-2017



Source: CRS, from EPA, "Light-Duty Automotive Technology, Carbon Dioxide Emissions, and Fuel Economy Trends: 1975 through 2017," January 2018; EPA, "The 2018 EPA Automotive Trends Report: Greenhouse Gas Emissions, Fuel Economy, and Technology Since 1975," March 2019; and U.S. Department of Energy, Oak Ridge National Labs, "Transportation Energy Data Book: Edition 37.1—2019," Tables 10.13 and 10.14.

Notes: Percentage change from a baseline of 1990. "Horsepower," "weight," and "adjusted fuel economy" are averaged across all vehicle types; "price (2018$)" is split between "cars" and "light trucks." DOE did not report light truck price data before 1990. DOE defines *light trucks* as "pickups, vans, or sport utility vehicles … 14,000 lb and less," which may differ from NHTSA and EPA definitions.

Finally, the 2018 revised final determination and the proposed SAFE Vehicles Rule argue that increased prices for new motor vehicles due to advanced fuel-efficient technologies may have the unintended consequence of taking some consumers out of the market for new motor vehicles. The Administration contends that higher costs could delay fleet turnover, slow new vehicle sales, and keep less efficient vehicles on U.S. roads. In this case, fewer benefits in fuel economy and GHG emissions would be realized, as many consumers would retain their current vehicles or purchase used ones.[100]

[100] The modelling used for the proposed SAFE Vehicles Rule finds that "higher vehicle prices, which result from more stringent fuel economy standards, have an effect on consumer purchasing decisions. As prices increase, the market-wide incentive to extract additional travel from used vehicles increases. The average age of the in service fleet has been increasing, and when fleet turnover slows, not only does it take longer for fleet-wide fuel economy and CO_2 emissions to improve, but also safety improvements, criteria pollutant emissions improvements, many other vehicle attributes that also provide societal benefits take longer to be reflected in the overall U.S. fleet as well because of reduced turnover." EPA and NHTSA, "The Safer Affordable Fuel-Efficient (SAFE) Vehicles Rule for Model Years 2021-2026 Passenger Cars and Light Trucks; Proposed Rule," 83 *Federal Register* 42986, August 24, 2018, p. 42993.

(4) The Impact of the Standards on Reduction of Emissions, Oil Conservation, Energy Security, and Fuel Savings by Consumers

In the final Phase 2 rulemaking, EPA and NHTSA estimated that the standards would save approximately 4 billion barrels of oil and reduce GHG emissions by the equivalent of approximately 2 billion metric tons over the lifetimes of those light-duty vehicles produced in MYs 2017-2025. Based on the updated assessments provided in the Draft Technical Assessment Report, EPA estimates that over the lifetime of vehicles meeting the second half of the standards (MYs 2022-2025), GHG emissions would be reduced by about 540 MMT and oil consumption would be reduced by 1.2 billion barrels. Consumer pretax fuel savings are estimated to be $89 billion over the lifetime of vehicles meeting the MY 2022-2025 standards.

In the proposed SAFE Vehicles Rule, however, the agencies project that CO_2 emissions would increase by 873 MMT, methane emissions would increase by 1.5 MMT, and fuel consumption would increase by 78.9 billion gallons (equivalent to 1.9 billion barrels) over the lifetimes of those light-duty vehicles produced under the preferred alternative and in comparison to the baseline standards.[101]

GHG Emissions and the Transportation Sector

The statement of purpose in the CAA includes protecting against "air pollution which may reasonably be anticipated to endanger public health or welfare."[102] EPA's 2009 endangerment finding determined that "the combined emissions of ... greenhouse gases from new motor vehicles and new motor vehicle engines contribute to the greenhouse gas air pollution that endangers public health and welfare under CAA section 202(a)."[103] This finding formed the basis of EPA's GHG emission regulations on new motor vehicles.

Various trends from the mid-1990s through today have informed the discussion on GHG emissions in the transportation sector. Transportation is one of the largest contributors to man-made GHG emissions in the United States. According to EPA's "Inventory of U.S. Greenhouse Gas Emissions and Sinks," sources in the transportation sector represented 29% of total U.S. GHG emissions in 2017 (up from 24% in 1990), and light-duty vehicles contributed 60% of the sector's total emissions (thus, passenger cars and light trucks represented one-sixth of all U.S. GHG emissions).[104] According to EIA, emissions from the transportation sector surpassed those from the electric-power sector for the first time in 2015. This transition was as much the product of the electric-power sector's increased efficiency (due to the substitution of renewables and natural gas for coal-fired power generation) as it was the transportation sector's continued

[101] Calculations based on an analysis of the cumulative changes in fuel consumption and GHG emissions for MYs 1977-2029 under the preferred alternative to the GHG program against the baseline standards. 83 *Federal Register* 42986, August 24, 2018, Table VII-78, p. 43329.

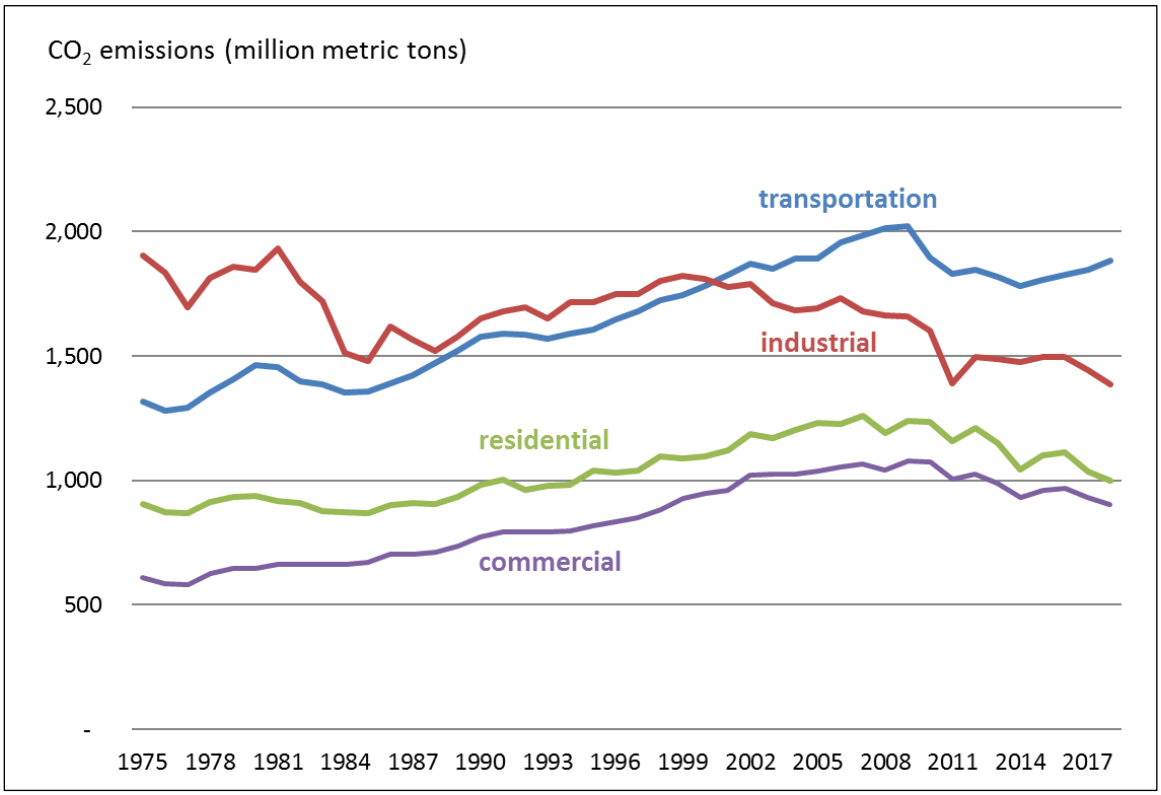
[102] 42 U.S.C. §7521(a)(1).

[103] EPA, "Endangerment and Cause or Contribute Findings for Greenhouse Gases under Section 202(a) of the Clean Air Act; Final Rule," 74 *Federal Register* 66496, December 15, 2009.

[104] EPA, "Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990-2017," EPA 430-R-19-001, April 11, 2019. See Tables 3-13, 3-14, and 3-15 on pages 3-23 to 3-27 for GHG emissions from mobile sources. Four greenhouse gases are emitted by motor vehicles: CO_2, methane, nitrous oxide, and hydrofluorocarbons. Two other commonly mentioned greenhouse gases, sulfur hexafluoride (SF_6) and perfluorocarbons, are not emitted by motor vehicles.

growth. Nevertheless, transportation remains the only broad category of the economy in which emissions have risen in recent years (see **Figure 4**).[105]

Figure 4. Energy-Related CO_2 Emissions by End-Use Sectors (1975-2018)



Source: CRS, from EIA, "Carbon Dioxide Emissions From Energy Consumption," Monthly Energy Review, July 2019, p. 193.

Energy Conservation and the Transportation Sector

The statement of purpose in EPCA includes requirements "to conserve energy supplies through energy conservation programs, and, where necessary, the regulation of certain energy uses ... and to provide for improved energy efficiency of motor vehicles."[106] Further, in regard to NHTSA's specific requirement to set "the maximum feasible average fuel economy level that it decides the manufacturers can achieve in that model year," EPCA requires NHTSA to consider four factors: "technological feasibility, economic practicability, the effect of other motor vehicle standards of the Government on fuel economy, and the need of the United States to conserve energy."[107] The United States Court of Appeals for the Ninth Circuit has stated that "EPCA clearly requires the agency to consider these four factors, but it gives NHTSA discretion to decide how to balance the statutory factors—as long as NHTSA's balancing does not undermine the fundamental purpose of the EPCA: *energy conservation*."[108]

[105] EIA, "Power sector carbon dioxide emissions fall below transportation sector emissions," January 19, 2017, https://www.eia.gov/todayinenergy/detail.php?id=29612.

[106] 42 U.S.C. §6201.

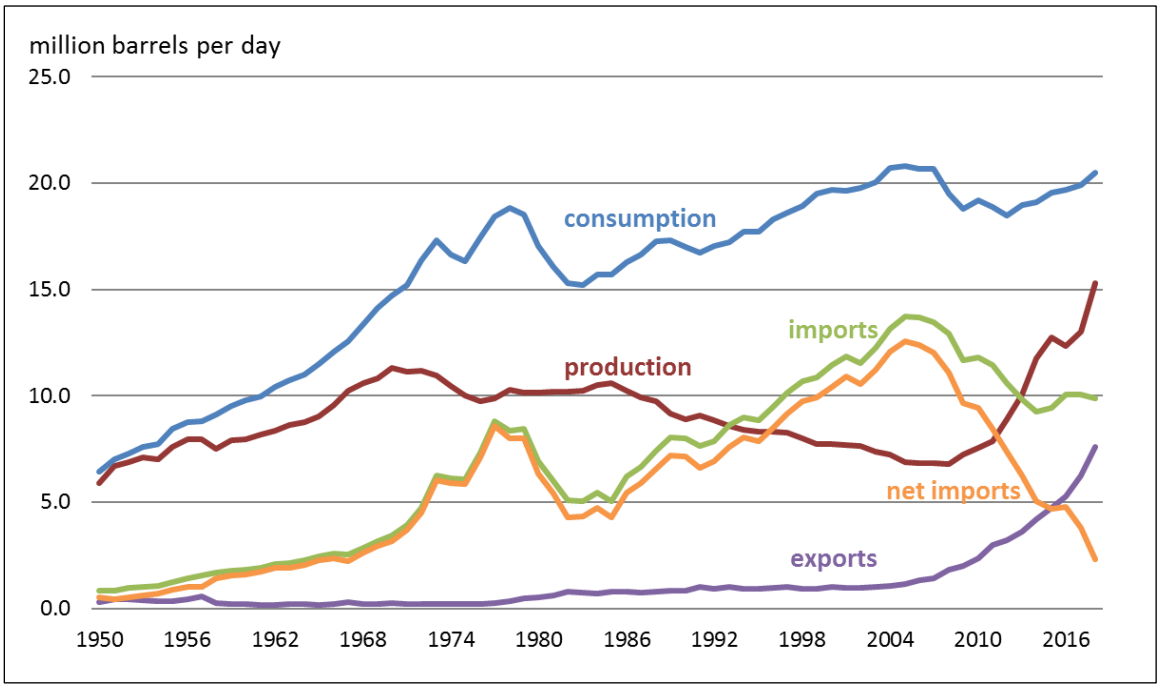
[107] 49 U.S.C. §32902(f).

[108] Center for Biological Diversity v. NHTSA, 538 F.3d. 1172, 1195 (9th Cir. 2008) (emphasis added).

Various trends from the mid-1970s through today have informed the discussion on energy conservation in the transportation sector. As some of these trends highlight an increase in available petroleum products for the United States, various stakeholders have argued that more stringent fuel economy standards for vehicles are unnecessary. However, other trends show a movement away from energy conservation, and, arguably, a greater need to ensure fuel economy benefits in order to conserve oil.

For example, in 1975, U.S. net imports (imports minus exports) of petroleum from foreign countries were equal to about 36% of U.S. petroleum consumption, according to the Energy Information Administration (EIA).[109] However, in 2018, U.S. production of petroleum (including crude oil and natural gas liquids) reached a level not seen in decades; and net imports of petroleum dropped to 11% of consumption. Nonetheless, net imports averaged 2.3 million barrels per day in 2018, and petroleum consumption has increased steadily since 2011 (see **Figure 5**).

Figure 5. U.S. Petroleum Statistics (1950-2018)



Source: CRS, from EIA, "Petroleum Overview," Monthly Energy Review, July 2019, Table 3.1, p. 57.

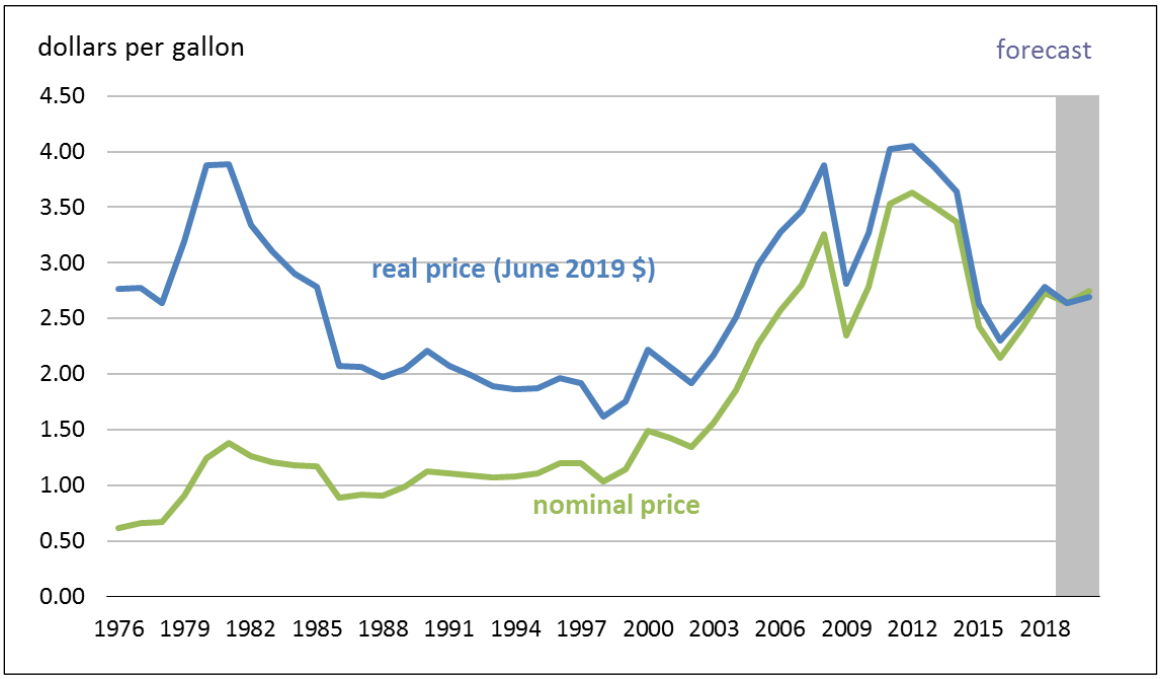
Notes: All categories include both crude oil and natural gas liquids. Production includes total petroleum field production, renewable fuels and oxygenate plant net production, and refinery processing gain. Consumption is all petroleum products supplied, including renewable fuels and oxygenates.

The price of gasoline at the pump has likewise seen fluctuations since 1975 (see **Figure 6**). The second half of the 1970s saw a doubling in the nominal price of gasoline. As recently as 2010-2014, the inflation-adjusted price of a gallon of regular grade gasoline had hovered over $3.50 per gallon (in constant 2019$). Lately, however, that price has returned to levels comparable to 1975

[109] These statistics and the others in this section are provided by EIA, "Monthly Energy Review, July 2019," https://www.eia.gov/totalenergy/data/monthly/pdf/mer.pdf.

(approximately $2.75 per gallon in constant 2019$). EIA projects that gasoline will remain below $3.00 a gallon through 2020. Gasoline prices were $2.69 on August 5, 2019.[110]

Figure 6. Annual Motor Gasoline Regular Grade Retail Price (1975-2018)



Source: CRS, from EIA, "Retail Motor Gasoline and On-Highway Diesel Fuel Prices," Monthly Energy Review, July 2019, Table 9.4, p. 156, including EIA price forecasts through 2020.

Recent trends in the vehicle sector also affect the discussion on energy conservation. For nearly 25 years, the U.S. vehicle fleet has seen a decline in passenger car sales in favor of larger pickup trucks, SUVs, and crossover vehicles, a trend that has accelerated since the end of the 2008-2009 recession (see **Figure 7**). In 2000, 49% of U.S. light-duty vehicles sales were pickups and SUVs; by 2017 the share of that segment rose to 65%. The changing U.S. fleet mix is driven by several factors; newer SUVs and crossovers

- have more fuel-efficient engines that make them more attractive to car buyers than previous models with lower gas mileage; and
- offer more space and greater versatility of use than a standard passenger car.

Further, some automakers reportedly have a low profit margin on their passenger cars, prompting the manufacturers to shift away from these vehicles.[111]

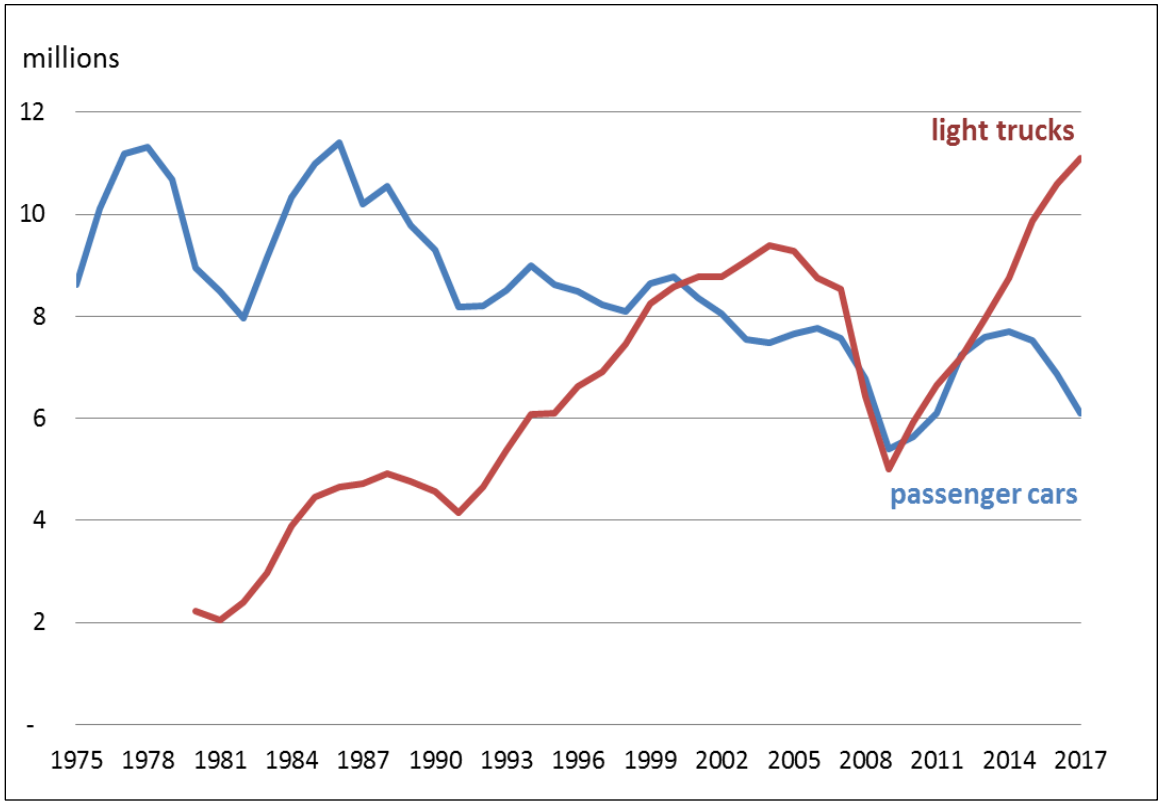
[110] Inflation-adjusted retail price of regular grade gasoline indexed to June 2019 U.S. dollar. See EIA, "Short-term Energy Outlook," June 2019, https://www.eia.gov/outlooks/steo/archives/Jun19.pdf; and EIA, "Gasoline and Diesel Fuel Update," May 21, 2018, https://www.eia.gov/petroleum/gasdiesel/.

[111] For example, Ford Motor Company announced on April 25, 2018, that it would eliminate some of its passenger car options, stating "Given declining consumer demand and product profitability, the company will not invest in next generations of traditional Ford sedans for North America." Ford Motor Company, "Ford Delivers First Quarter $1.7B Net Income, $2.2B Adj. EBIT; Fitness Actions Improve 2020 Outlook," https://media.ford.com/content/dam/fordmedia/North%20America/US/2018/04/25/1q18-financials.pdf.

For compliance purposes, the CAFE and GHG emissions standards define vehicle categories slightly differently than industry. Nevertheless, the trend toward light trucks over passenger cars is similar, although not as pronounced (see **Figure 8**).

Finally, another measure relevant to motor vehicle analysis is the total vehicle miles traveled (VMT) by on-road motor vehicles in the United States. Between 1975 and 2017, VMT increased nearly 150%, from approximately 1.3 trillion miles to 3.2 trillion miles.[112]

Figure 7. U.S. Vehicles Sold, as Defined by Industry Categories (1975-2017)

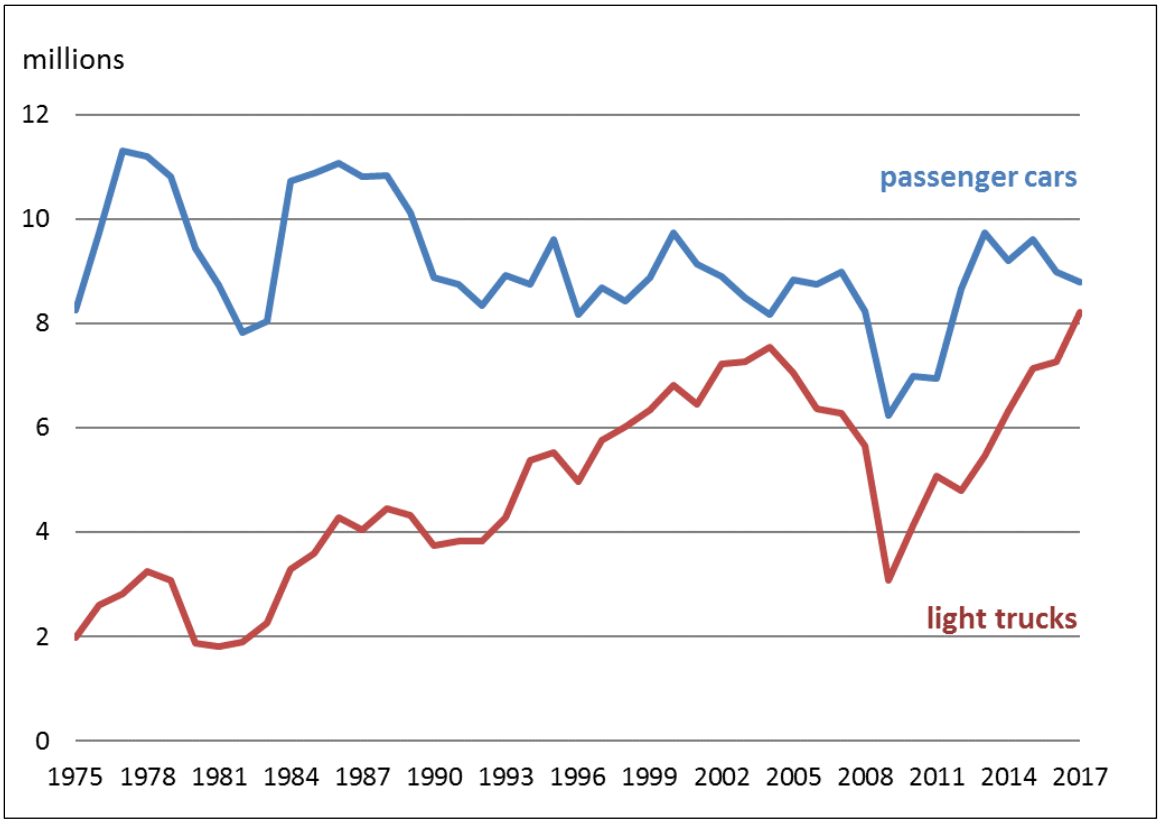


Source: CRS, from Ward's Auto Database.

Notes: "Passenger cars" and "light trucks" as defined by Ward's Auto Database.

[112] U.S. Federal Highway Administration (FHWA), "Moving 12-Month Total Vehicle Miles Traveled," Travel Volume Trends, https://www.fhwa.dot.gov/policyinformation/travel_monitoring/tvt.cfm.

Figure 8. U.S. Vehicles Regulated Under the Standards, as Defined by Agency Compliance Categories (1975-2017)



Source: CRS, from EPA, "Light-Duty Automotive Technology, Carbon Dioxide Emissions, and Fuel Economy Trends: 1975 through 2017," January 2018; and EPA, "The 2018 EPA Automotive Trends Report: Greenhouse Gas Emissions, Fuel Economy, and Technology Since 1975," March 2019.

Notes: "Passenger cars" and "light trucks" as defined by 49 C.F.R. Part 523.

(5) The Impact of the Standards on the Automobile Industry

In both the 2017 and 2018 final determinations, EPA interpreted an analysis of the impacts of the standards on the automotive industry to include an analysis of industry costs, vehicle sales, and automotive sector employment. While the 2017 final determination finds that the standards would impose a reasonable per vehicle cost to manufacturers, it returns no evidence in support of adverse impacts on vehicle sales or on other vehicle attributes, or on employment in the automotive industry sector.[113]

The 2018 final determination, however, finds that the standards potentially impose unreasonable per-vehicle costs resulting in decreased sales and potentially significant impacts to both automakers and auto dealers. Further, it states recognition of significant unresolved concerns regarding the impact of the current standards on U.S. auto industry employment.[114]

[113] EPA, "Final Determination on the Appropriateness of the Model Year 2022-2025 Light-Duty Vehicle Greenhouse Gas Emissions Standards under the Midterm Evaluation," EPA-420-R-17-001, January 2017, pp. 24-26.

[114] EPA, "Mid-Term Evaluation of Greenhouse Gas Emissions Standards for Model Year 2022-2025 Light-Duty Vehicles: Notice; Withdrawal," 83 *Federal Register* 16077, Friday, April 13, 2018, p. 16085.

Analysis in the proposed SAFE Vehicles Rule finds that compared to the baseline standards, the proposed alternative and the other regulatory alternatives under the agencies' consideration all involve reduced regulatory costs expected to lead to reduced average vehicle prices and, in turn, increased sales. However, the proposal states that "while the increased sales slightly increase estimated U.S. auto sector labor, because producing and selling more vehicles uses additional U.S. labor, the reduced outlays for fuel-saving technology slightly reduce estimated U.S. auto sector labor, because manufacturing, integrating, and selling less technology means using less labor to do so."[115] Overall, the proposed rule estimates a loss of 60,000 jobs in 2030 under the preferred alternative compared to the baseline standards.[116] Thus, both rulemakings comment on the potential for the baseline standards to lead to macroeconomic and employment benefits through their effects on innovation, investment in key technologies, and a competitive advantage for U.S. companies in the global marketplace.

(6) The Impacts of the Standards on Automobile Safety

The primary goals of the CAFE and GHG emission standards are to reduce fuel consumption and GHG emissions from the on-road light-duty vehicle fleet. But in addition to these intended effects, the agencies also consider the potential of the standards to affect vehicle safety. As a safety agency, NHTSA has long considered the potential for adverse safety consequences when establishing CAFE standards. Similarly, under the CAA, EPA considers factors related to public health and welfare, including safety, in regulating emissions of air pollutants from mobile sources.

Research has shown that safety trade-offs associated with fuel economy increases have occurred in the past, particularly before NHTSA switched its CAFE program to an "attribute-based" standard. In a 2002 report, the National Research Council concluded that "the preponderance of evidence indicates that this downsizing of the vehicle fleet [in response to original CAFE program] resulted in a hidden safety cost, namely, travel safety would have improved even more had vehicles not been downsized."[117] These past safety trade-offs occurred, in part, because manufacturers chose at the time to build smaller and lighter vehicles rather than adding more expensive fuel-saving technologies. The regulatory decision to move to an "attribute-based" standard in NHTSA's MY 2008-2011 light truck proposal—as well as in Phase 1 of the rulemaking—was due, in part, to these concerns over safety.

Debate over the hidden safety cost of the CAFE and GHG emission standards has continued. Vehicles have gotten safer—vehicle fatalities per mile traveled are significantly lower than they were in the 1970s. However, some argue that fatalities would be even lower in the absence of the standards. Total fatalities and fatalities per mile traveled have declined by 17% and 65%, respectively, between 1975 and 2017 (see **Figure 9**). However, fatality rates through the years have seen periods of increase. These trends may be due to many factors, including less use of restraints, alcohol impairment, speed, and distraction (e.g., cell phones and texting), as well as the downsizing and light-weighting of vehicles. The fatality rates also include the increased count of pedestrian fatalities. Nevertheless, vehicle design remains a concern, and the agencies continue to investigate the amount of mass reduction that is affordable and feasible while maintaining overall

[115] EPA and NHTSA, "The Safer Affordable Fuel-Efficient (SAFE) Vehicles Rule for Model Years 2021–2026 Passenger Cars and Light Trucks; Proposed Rule," 83 *Federal Register* 42986, August 24, 2018, p. 43436.

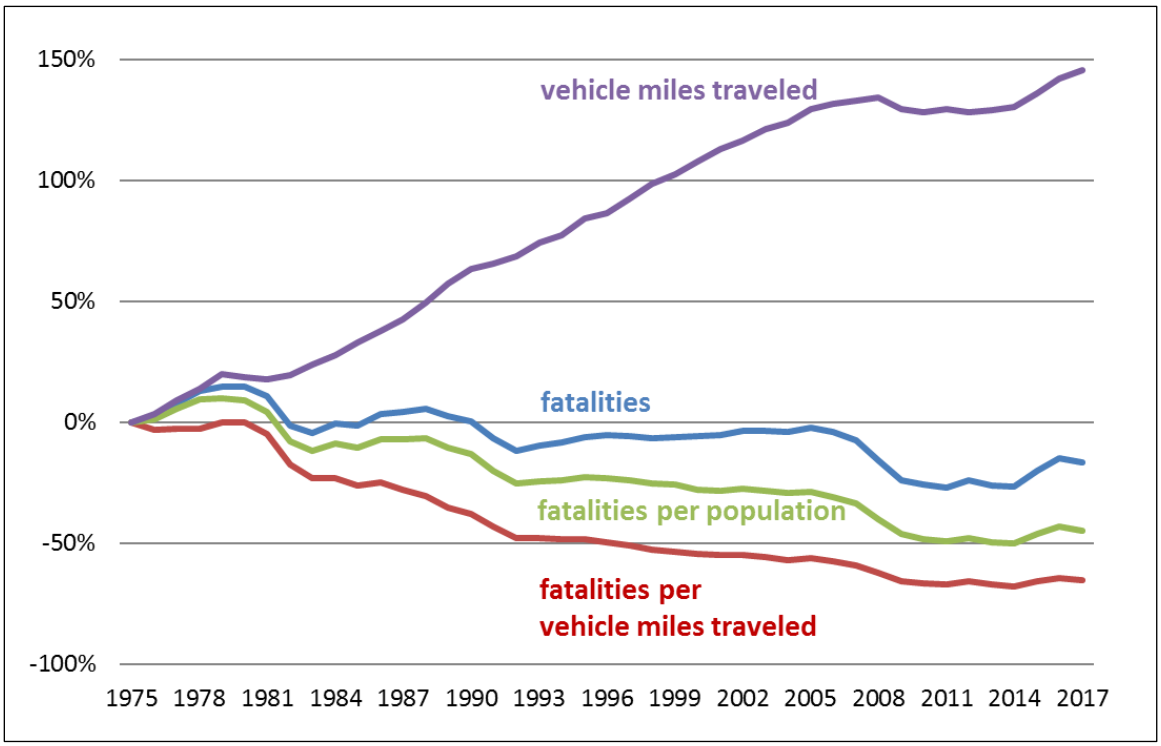
[116] Ibid., Table VII-5, p. 43265.

[117] National Research Council, "Effectiveness and Impact of Corporate Average Fuel Economy (CAFE) Standards," Washington, D.C., 2002, p. 70.

fleet safety and functionality, such as durability, drivability, noise, handling, and acceleration performance.

Safety may be evaluated with other metrics, such as the health and welfare impacts of reduced air pollution. In addition to reducing the emissions of GHGs, the Phase 2 standards influence "non-GHG" pollutants, that is, "criteria" air pollutants, their precursors, and air toxics, which may lead to the reduction in the respiratory health effects of air pollution (e.g., the exacerbation of asthma symptoms, diminished lung function, adverse birth outcomes, and incidences of cancer).[118]

Figure 9. Percentage Change in Selected Traffic Statistics (1975-2017)



Source: CRS, from NHTSA, "Fatality Analysis Reporting System (FARS)," 2017 data based on FARS data publication, 1st release.

Notes: Percentage change from a baseline of 1975.

The proposed SAFE Vehicles Rule emphasizes safety benefits related to the changes from prior rules. The proposal estimates the benefits of the preferred alternative as compared to the baseline standards to be 12,700 fewer crash fatalities over the lifetimes of all vehicles built through MY 2029, with up to 1,000 lives saved annually. The proposal estimates that a small portion of the benefits would be attributed to changes in the vehicle's mass (160 out of 12,700). The proposal states that "a large portion of these safety benefits [6,180 out of 12,700] will come from improved fleet turnover as more consumers will be able to afford newer and safer vehicles."[119] The

[118] For an analysis of the health impacts criteria and air toxic pollutants from the 2012 rulemaking, see EPA and NHTSA, "2017 and Later Model Year Light-Duty Vehicle Greenhouse Gas Emissions and Corporate Average Fuel Economy Standards; Final Rule," 77 *Federal Register* 62624, October 15, 2012, Table III-92.

[119] EPA and NHTSA, "The Safer Affordable Fuel-Efficient (SAFE) Vehicles Rule for Model Years 2021-2026 Passenger Cars and Light Trucks; Proposed Rule," 83 *Federal Register* 42986, August 24, 2018, Table II-73, p. 43152 and p. 42995. CRS inserts in square brackets.

remainder of the reported safety benefits would arise from reductions in VMT modeled under the preferred alternative, which estimates that VMT of the U.S. fleet of passenger cars and light trucks would be reduced under the proposed rule. NHTSA's modeling assumptions for sales, scrappage rates, and VMT in the proposed rule have been critiqued by a variety of sources and stakeholders.[120]

(7) The Impact of the GHG Emission Standards on the CAFE Standards and a National Harmonized Program

The CAFE and GHG emission standards are a set of performance standards, based on an evaluation of future technological and economic feasibility. While fuel economy, rated in miles per gallon achieved, has risen from 13 mpg to 25 mpg under the CAFE standards (i.e., since 1978), the program is only one of many possible policy options that could conserve fuel and reduce GHG emissions. Some have argued that market-based approaches such as a gasoline tax, a GHG emissions fee on motor vehicles, or an economy-wide policy to constrain GHG emissions, could be more efficient and cost-effective. Similarly, in lieu of or in addition to a federally mandated performance standard, some state and local governments have proposed or promulgated policies to serve similar ends. These include—but are not limited to—mandates or incentives for the sale or use of alternative-fueled vehicles, access limits for petroleum-fueled vehicles in cities or on state highways, and congestion charges and other efforts to limit vehicle use. Further, other transportation-related policies are being fashioned that will have significant—albeit uncertain—impacts on fuel economy and GHG emissions. These include connected and autonomous vehicle technologies, ride-sharing services, and investments in mass transit and bicycle infrastructure, among others. As more city, state, and national governments investigate options to conserve fuel and reduce emissions, these and other policies are likely to become more common, potentially impacting the design and purpose of vehicle performance standards.

The CAFE and GHG emission standards are a federal program, and both EPCA and CAA generally preempt state and local governments from regulating fuel economy and air pollution emissions from mobile sources. Auto manufacturers have been supportive of the regulatory certainty provided by a single national standard with a long lead time, partly because of concerns that states could implement divergent standards in the absence of a uniform federal standard. This regulatory certainty was a principal component of the agreement brokered between the auto manufacturers, EPA, NHTSA, and the State of California at the inception of the National Program. Revising the federal standards could reintroduce divergence if California and the Section 177 states choose to maintain higher standards unless EPCA preempts the state standards or EPA withdraws the CAA preemption waiver for California.

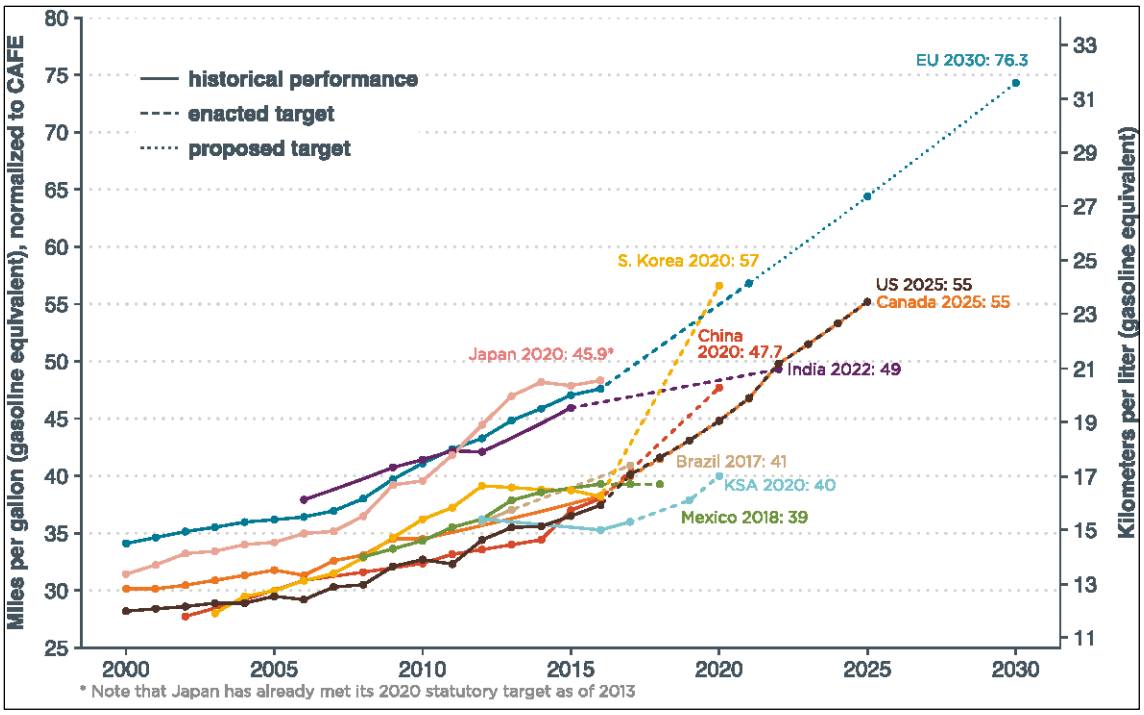
Finally, discussion of regulatory alignment also extends to the global marketplace. Auto manufacturers produce and sell vehicles in all major international markets and they increasingly see the benefit of aligning vehicle safety and emission standards in North America, Europe, and Asia. As the United States reconsiders its vehicle fuel economy and GHG emissions standards through MY 2025, the major auto manufacturers remain attuned to the standards being adopted

[120] For examples, see Email from William Charmley, Director, Assessment and Standards Division, Office of Transportation and Air Quality, EPA, to Chad Whiteman, Deputy Chief, Natural Resource and Environment Branch, Office of Management and Budget, June 18, 2018 (as submitted to Docket ID: NHTSA-2018-0067); Antonio M. Bento, et al., "Flawed analyses of U.S. auto fuel economy standards," *Science*, vol. 362, no. 6419 (December 7, 2018), pp. 1119-1121; and Alan J. Krupnick et al., "Critiquing the Trump Administration's Analysis of Consumer Behavior in the Proposed CAFE Standards," *Resources*, September 17, 2018.

by other countries. For example, Canada's vehicle standards closely align with the current CAFE and GHG emission standards; Canada has not announced that they are under review. China, India, Japan, South Korea, and many European nations have announced GHG emissions standards and alternative-fueled vehicle mandates that would be more stringent than the existing U.S. program (see **Figure 10**). As more foreign governments move to increase their standards, auto manufacturer may potentially pursue these developments in their product planning to stay competitive globally.[121]

Figure 10. Selection of International Vehicle Standards

Historical fleet CO_2 emissions performance and current standards for passenger cars



Source: The figure is provided courtesy of Zifei Yang and Anup Bandivadekar, "2017 Global Update: Light-Duty Vehicle Greenhouse Gas and Fuel Economy Standards," International Council on Clean Transportation, 2017, figure 4, p. 11. As per ICCT's terms of use, all materials are available under the Share Alike license of Creative Commons, https://creativecommons.org.

Notes: The ICCT analysis converts all international fuel economy and GHG emissions standards to mpg targets normalized to U.S. CAFE test cycles.

[121] Automakers in the United States and the European Union placed harmonization of vehicle safety regulations as a major industry goal in the Transatlantic Trade and Investment Partnership (TTIP) negotiations, held from 2013-2016, and some argued for inclusion of emissions standards in the talks. Although alignment of emissions standards was not the focus of these discussions, some automakers and prominent academic studies have pointed to the economic benefits of regulatory convergence in both safety and emissions standards. For example, see Caroline Freund and Sarah Oliver, *Gains from Convergence in U.S. and E.U. Auto Regulations under the Transatlantic Trade and Investment Partnership*, European University Institute, EUI Working Paper RSCAS 2015/59, 2015, https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2663554&download=yes. In addition, the Trump Administration's recently renegotiated free trade agreement with South Korea includes commitments by the South Korean government to evaluate closer alignment of its emissions standards with U.S. standards in the future.

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