ENVIRONMENTAL PROTECTION AGENCY

40 CFR Parts 86 and 600

[EPA–HQ–OAR–2021–0208; FRL 8469–02–OAR]

RIN 2060–AV13

Revised 2023 and Later Model Year Light-Duty Vehicle Greenhouse Gas Emissions Standards

AGENCY: Environmental Protection Agency (EPA).

ACTION: Proposed rule.

SUMMARY: The Environmental Protection Agency (EPA) is proposing to revise the greenhouse gas (GHG) emissions standards for light-duty vehicles for 2023 and later model years to make the standards more stringent. On January 20, 2021, President Biden issued Executive Order 13990 ''Protecting Public Health and the Environment and Restoring Science To Tackle the Climate Crisis'' directing EPA to consider whether to propose suspending, revising, or rescinding the standards previously revised under the ''The Safer Affordable Fuel-Efficient (SAFE) Vehicles Rule for Model Years 2021–2026 Passenger Cars and Light Trucks,'' promulgated in April 2020. The SAFE rule significantly weakened the standards established in 2012, which in part set GHG standards for model years 2021–25. EPA believes that in light of the significant contribution of light-duty vehicles to transportation sector GHG emissions, standards more stringent than those relaxed in the SAFE rule are appropriate under the Clean Air Act. EPA is proposing to revise the GHG standards to be more stringent than the SAFE rule standards in each model year from 2023 through 2026. EPA is also proposing to include several flexibilities to incentivize the production and sale of vehicles with zero and near-zero emissions technology to reduce compliance costs and to address the lead time of the proposed standards. In addition, EPA is proposing some technical amendments to clarify and streamline our regulations. Compliance with the proposed standards would be feasible at reasonable costs to manufacturers. The proposed revised standards would result in significant benefits for public health and welfare, primarily through substantial reductions in both GHG emissions and fuel consumption and associated fuel costs paid by drivers, and the benefits of the proposed standards would be far in excess of costs.

DATES:

Comments: Written comments must be received on or before September 27, 2021.

Public Hearing: EPA plans to hold a virtual public hearing on August 25, 2021. An additional session may be held on August 26th if necessary to accommodate the number of testifiers that sign-up to testify. Please refer to the separate **Federal Register** notice issued by EPA for public hearing details. The hearing notice is available at *https://www.epa.gov/regulations-emissions-vehicles-and-engines/proposed-rule-revise-existing-national-ghg-emissions.*

ADDRESSES: You may send comments, identified by Docket ID No. EPA–HQ–OAR–2021–0208, by any of the following methods:

- *Federal eRulemaking Portal: https://www.regulations.gov/* (our preferred method). Follow the online instructions for submitting comments.
- *Email: a-and-r-Docket@epa.gov.* Include Docket ID No. EPA–HQ–OAR–2021–0208 in the subject line of the message.
- *Mail:* U.S. Environmental Protection Agency, EPA Docket Center, OAR, Docket EPA–HQ–OAR–2021–0208, Mail Code 28221T, 1200 Pennsylvania Avenue NW, Washington, DC 20460.
- *Hand Delivery or Courier (by scheduled appointment only):* EPA Docket Center, WJC West Building, Room 3334, 1301 Constitution Avenue NW, Washington, DC 20004. The Docket Center's hours of operations are 8:30 a.m.–4:30 p.m., Monday–Friday (except Federal Holidays).

Instructions: All submissions received must include the Docket ID No. EPA–HQ–OAR–2021–0208 for this rulemaking. Comments received may be posted without change to *https://www.regulations.gov/,* including any personal information provided. For detailed instructions on sending comments and additional information on the rulemaking process, see the ''Public Participation'' heading of the **SUPPLEMENTARY INFORMATION** section of this document. Out of an abundance of caution for members of the public and our staff, the EPA Docket Center and Reading Room are closed to the public, with limited exceptions, to reduce the risk of transmitting COVID–19. Our Docket Center staff will continue to provide remote customer service via email, phone, and webform. We encourage the public to submit comments via *https://www.regulations.gov/* or email, as there may be a delay in processing mail. Hand deliveries and couriers may be received by scheduled appointment only. For further information on EPA Docket Center services and the current status, please visit us online at *https://www.epa.gov/dockets.*

EPA plans to hold a virtual public hearing for this rulemaking. Please refer to the separate **Federal Register** notice issued by EPA for public hearing details. The hearing notice is available at *https://www.epa.gov/regulations-emissions-vehicles-and-engines/proposed-rule-revise-existing-national-ghg-emissions.*

FOR FURTHER INFORMATION CONTACT: Tad Wysor, Office of Transportation and Air Quality, Assessment and Standards Division (ASD), Environmental Protection Agency, 2000 Traverwood Drive, Ann Arbor, MI 48105; telephone number: (734) 214–4332; email address: *wysor.tad@epa.gov.*

SUPPLEMENTARY INFORMATION:

A. Public Participation

Written Comments

EPA will keep the comment period open until September 27, 2021. All information will be available for inspection at the EPA Air Docket No. EPA–HQ–OAR–2021–0208. Submit your comments, identified by Docket ID No. EPA–HQ–OAR–2021–0208, at *https://www.regulations.gov* (our preferred method), or the other methods identified in the **ADDRESSES** section. Once submitted, comments cannot be edited or removed from the docket. EPA may publish any comment received to its public docket. Do not submit to EPA's docket at *https://www.regulations.gov* any information you consider to be Confidential Business Information (CBI) or other information whose disclosure is restricted by statute. Multimedia submissions (audio, video, etc.) must be accompanied by a written comment. The written comment is considered the official comment and should include discussion of all points you wish to make. EPA will generally not consider comments or comment contents located outside of the primary submission (*i.e.,* on the web, cloud, or other file sharing system). For additional submission methods, the full EPA public comment policy, information about CBI or multimedia submissions, and general guidance on making effective comments, please visit *https://www.epa.gov/dockets/commenting-epa-dockets.*

EPA is temporarily suspending its Docket Center and Reading Room for public visitors, with limited exceptions, to reduce the risk of transmitting COVID–19. Our Docket Center staff will continue to provide remote customer service via email, phone, and webform. We encourage the public to submit comments via *https://www.regulations.gov/* as there may be a delay in processing mail. Hand deliveries or couriers will be received by scheduled appointment only. For further information and updates on EPA Docket Center services, please visit us online at *https://www.epa.gov/dockets.*

EPA continues to carefully and continuously monitor information from the Centers for Disease Control and Prevention (CDC), local area health departments, and our Federal partners so that we can respond rapidly as conditions change regarding COVID–19.

Virtual Public Hearing

EPA plans to hold a virtual public hearing on August 25, 2021. An additional session will be held on August 26th if necessary, to accommodate the number of testifiers that sign-up to testify. Please refer to the separate **Federal Register** notice issued by EPA for public hearing details. The hearing notice is available at *https://www.epa.gov/regulations-emissions-vehicles-and-engines/proposed-rule-revise-existing-national-ghg-emissions.* Please also refer to this website for any updates regarding the hearings. EPA does not intend to publish additional documents in the **Federal Register** announcing updates.

B. Does this action apply to me?

This action affects companies that manufacture or sell passenger automobiles (passenger cars) and non-passenger automobiles (light trucks) as defined in 49 CFR part 523. Regulated categories and entities include:

Category	NAICS codes [A]	Examples of potentially regulated entities
Industry	336111 336112	Motor Vehicle Manufacturers.
Industry	811111 811112 811198 423110	Commercial Importers of Vehicles and Vehicle Components.
Industry	335312 811198	Alternative Fuel Vehicle Converters.

[A] North American Industry Classification System (NAICS).

This list is not intended to be exhaustive, but rather provides a guide regarding entities likely to be regulated by this action. To determine whether particular activities may be regulated by this action, you should carefully examine the regulations. You may direct questions regarding the applicability of this action to the person listed in **FOR FURTHER INFORMATION CONTACT**.

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I. Executive Summary

A. Purpose of This Proposed Rule and Legal Authority

1. Proposal for Near-Term Standards Through Model Year 2026

The Environmental Protection Agency (EPA) is proposing to revise existing national greenhouse gas (GHG) emissions standards for passenger cars and light trucks under section 202(a) of the Clean Air Act (CAA), 42 U.S.C. 7521(a). Section 202(a) requires EPA to establish standards for emissions of air pollutants from new motor vehicles which, in the Administrator's judgment, cause or contribute to air pollution which may reasonably be anticipated to endanger public health or welfare.

This proposal also responds to Executive Order (E.O.) 13990, ‘‘Protecting Public Health and the Environment and Restoring Science To Tackle the Climate Crisis’’ (Jan. 20, 2021), which directs EPA to consider taking the action proposed in this notice:[1]

> ‘‘[T]he head of the relevant agency, as appropriate and consistent with applicable law, shall consider publishing for notice and comment a proposed rule suspending, revising, or rescinding the agency action[s set forth below] within the time frame specified.’’
>
> ‘‘Establishing Ambitious, Job-Creating Fuel Economy Standards: . . . ‘The Safer Affordable Fuel-Efficient (SAFE) Vehicles Rule for Model Years 2021–2026 Passenger Cars and Light Trucks,’ 85 FR 24174 (April 30, 2020), by July 2021. . . . In considering whether to propose suspending, revising, or rescinding the latter rule, the agency should consider the views of representatives from labor unions, States, and industry.’’

The proposed program would revise the light-duty vehicle GHG standards previously revised by the SAFE rule and would build upon earlier EPA actions and supporting analyses that established or maintained stringent light-duty vehicle GHG emissions standards. For example, in 2012, EPA issued a final rule establishing light-duty vehicle GHG standards for model years (MYs) 2017–2025,[2] which were supported in analyses accounting for compliance costs, lead time and other relevant factors.[3] That rule and its analyses also accounted for the development and availability of advanced GHG emission-reducing technologies for gasoline-fueled vehicles, which demonstrated that the standards were appropriate under section 202(a) of the CAA.[4] This proposed rule provides additional analysis that takes into consideration updated data and recent developments. Auto manufacturers are currently implementing an increasing array of advanced gasoline vehicle GHG emission-reducing technologies at a rapid pace throughout their vehicle fleets. Vehicle electrification technologies are also advancing rapidly, as battery costs have continued to decline, and automakers have announced an increasing diversity and volume of zero-emission vehicle models. Meanwhile, in 2019, several auto manufacturers voluntarily entered into agreements with the State of California to comply with GHG emission reduction targets through MY 2026 across their national vehicle fleets (the ‘‘California Framework Agreements’’) that are more stringent than the EPA standards as revised by the SAFE rule. These developments further support EPA's decision to reconsider and propose revising the existing EPA standards to be more stringent, particularly in light of factors indicating that more stringent near-term standards are feasible at reasonable cost and would achieve significantly greater GHG emissions reductions and public health and welfare benefits than the existing program. In developing this proposal, EPA has conducted outreach with a wide range of interested stakeholders, including labor unions, States, and industry as provided in E.O. 13990, and we will continue to engage with these and other stakeholders as part of our regulatory development process.

This proposal is limited to MYs 2023–2026, given lead time considerations under the CAA, which is consistent with E.O. 13990's direction to review the SAFE rule standards. We have designed the proposed program based on our assessment that the proposed standards are reasonable and appropriate and will achieve a significant level of GHG reductions for MYs 2023–2026 vehicles, with the expectation that a future, longer-term program for MYs 2027 and later will build upon these near-term standards.

EPA has set previous light-duty vehicle GHG emission standards in joint rulemakings where NHTSA also established CAFE standards. EPA has concluded that it is not necessary at this time for this EPA proposal to be done in a joint action with NHTSA. EPA has coordinated with NHTSA, both on a bilateral level as well as through the interagency review of the EPA proposal led by the Office of Management and Budget.

2. Why does EPA believe the proposed standards are appropriate under the CAA?

EPA is proposing to revise GHG emissions standards for passenger cars and light trucks under its authority in section 202(a) of the CAA. Section 202(a) requires EPA to establish standards for emissions of pollutants from new motor vehicles which, in the Administrator's judgment, cause or contribute to air pollution which may reasonably be anticipated to endanger public health or welfare. Standards under section 202(a) take effect ‘‘after 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.’’ Thus, in establishing or revising section 202(a) standards designed to reduce air pollution that endangers public health and welfare, EPA also must consider issues of technological feasibility, compliance cost, and lead time. EPA also may consider other factors and in previous light-duty vehicle GHG standards rulemakings has considered the impacts of potential GHG standards

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[1] 86 FR 7037, January 25, 2021.

[2] EPA's model year emission standards also apply in subsequent model years, unless revised, *e.g.,* MY 2025 standards issued in the 2012 rule also applied to MY 2026 and beyond.

[3] 77 FR 62624, October 15, 2012.

[4] *Id.*

on the auto industry, fuel savings by consumers, oil conservation, energy security and other energy impacts, as well as other relevant considerations such as safety.

As we describe in greater detail below, EPA has carefully considered the technological feasibility and cost of the proposed standards and the available lead time for manufacturers to comply with them, including existing and proposed flexibilities designed to facilitate compliance during the MYs 2023–2026 timeframe. Based on our analysis, we believe that the proposed standards, combined with proposed flexibilities that address lead time considerations resulting from relaxations in standards revised in the SAFE rule, are appropriate and justified under section 202(a) of the CAA. Our updated analysis for this proposal, as well as our earlier analyses of similar standards, supports the conclusion that the proposed standards are technologically feasible for the model years covered (MYs 2023–2026) and that the costs of compliance for manufacturers would be reasonable. The proposed standards would result in greater reductions in GHG emissions, as well as reductions in emissions of some criteria pollutants and air toxics, resulting in significant benefits for public health and welfare. We also show that the proposal would result in reduced vehicle operating costs for consumers and that the benefits of the proposed program would significantly exceed the costs.

EPA has significantly updated its analysis for this rule. As discussed further below, we have updated a number of key inputs, such as, for example, certain technology costs and penetrations, to ensure they are up to date. Notably, the results of this updated analysis are generally in agreement with prior analyses, including those conducted for the SAFE rule. In particular, the costs that have been estimated for manufacturers to meet standards of a similar stringency to the proposed standards have been roughly consistent since EPA first estimated them in 2012. That is, although manufacturers have less lead time before these standards would be implemented than with previous rulemakings, the significant progress that has been made in implementing advanced gasoline technologies in the fleet (as well as advances in electric and hybrid vehicle technology) since 2012 means the proposed standards can be achieved at roughly the same cost as previous estimates, and additional lead time is unnecessary.

When considering similar cost estimates in the SAFE rule, EPA identified some factors, primarily costs to manufacturers and upfront costs to consumers, as favoring reductions in stringency of the then-existing standards, and other factors, such as reduced emissions that endanger public health and welfare and reduced operating costs for consumers, as favoring increased stringency (or a lower degree of reduced stringency). In balancing these factors in the SAFE rule, EPA placed greater weight on the former factors, and thereby decided to make EPA's GHG standards significantly less stringent. But the purpose of adopting standards under CAA section 202 is to address air pollution that may reasonably be anticipated to endanger public health and welfare. Indeed, reducing air pollution has traditionally been the focus of such standards. EPA has reconsidered how costs, lead time and other factors were weighed in the SAFE rule and is reaching a different conclusion as to the appropriate stringency of GHG standards. In light of the statutory purpose of section 202, the Administrator is placing greater weight on the emission reductions and resulting public health and welfare benefits, as well as the savings in vehicle operating costs for consumers, and proposing significantly more stringent standards for MYs 2023–2026 compared to the standards established by the SAFE rule. As discussed in Section III.A, the proposed standards take into consideration both the updated analysis for this rule and past EPA analyses conducted for similar GHG standards. We are revising decisions made in the SAFE final rule in accordance with Supreme Court decisions affirming that agencies are free to reconsider and revise their prior decisions where they provide a reasonable explanation for their revised decisions.[5] In this rulemaking, the agency is changing its 2020 position and restoring its previous approach by proposing to find, in light of the statutory purposes of the Clean Air Act and in particular of section 202(a), that it is more appropriate to place greater weight on the magnitude and benefits of reducing emissions that endanger public health and welfare, while continuing to consider compliance costs, lead time and other relevant factors.

3. Future Longer-Term Action To Further Reduce Light-Duty Vehicle Emissions in 2027 and Beyond

Addressing the climate crisis will require substantial reductions in GHG emissions from the transportation sector. The transportation sector is the largest U.S. source of GHG emissions, representing 29 percent of total GHG emissions.[6] Within the transportation sector, light-duty vehicles are the largest contributor, at 58 percent, and thus comprise 17 percent of total U.S. GHG emissions.[7] GHG emissions have significant impacts on public health and welfare as evidenced by the well-documented scientific record and as set forth in EPA's Endangerment and Cause or Contribute Findings under Section 202(a) of the CAA.[8] Additionally, major scientific assessments continue to be released that further advance our understanding of the climate system and the impacts that GHGs have on public health and welfare both for current and future generations, as discussed in Section IV.B, making it clear that continued emission reductions in the light-duty vehicle sector are needed beyond the model years covered by the standards proposed today.

This proposed action therefore serves as a critical building block for a comprehensive, multipollutant longer-term regulatory program implementing EPA's statutory authority under the CAA. We are at a pivotal moment in the history of the light-duty transportation sector—a shift to zero-emission vehicle technologies is already underway, and it presents a strong potential for dramatic reductions in GHG and criteria pollutant emissions over the longer term. Major automakers as well as many global jurisdictions and U.S. states have announced plans to shift the light-duty fleet toward zero-emissions technology, as detailed below. EPA anticipates that the design of a future, longer-term program beyond 2026 will incorporate accelerating advances in zero-emission technologies.

A proliferation of recent announcements from automakers signals a rapidly growing shift in investment away from internal-combustion technologies and toward high levels of electrification. These automaker announcements are supported by continued advances in automotive electrification technologies, and further driven by the need to

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[5] *See, e.g., Encino Motorcars, LLC* v. *Navarro,* 136 S. Ct. 2117, 2125 (2016); *FCC* v. *Fox Television Stations, Inc.,* 556 U.S. 502, 515 (2009).

[6] *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2019* (EPA–430–R–21–005, published April 2021).

[7] 7 *Ibid.*

[8] 74 FR 66496, December 15, 2009; 81 FR 54422, August 15, 2016.

compete in a global market as other countries implement aggressive zero-emission transportation policies. For example, in January 2021, General Motors announced plans to become carbon neutral by 2040, including an effort to shift its light-duty vehicles entirely to zero-emissions by 2035.[9] In March 2021, Volvo announced plans to make only electric cars by 2030,[10] and Volkswagen announced that it expects half of its U.S. sales will be all-electric by 2030.[11] In April 2021, Honda announced a full electrification plan to take effect by 2040, with 40 percent of North American sales expected to be fully electric or fuel cell vehicles by 2030, 80 percent by 2035 and 100 percent by 2040.[12] In May 2021, Ford announced that they expect 40 percent of their global sales will be all-electric by 2030.[13] In June 2021, Fiat announced a move to all electric vehicles by 2030, and in July 2021 its parent corporation Stellantis announced an intensified focus on electrification across all of its brands.[14] [15] Also in July 2021, Mercedes-Benz announced that all of its new architectures would be electric-only from 2025, with plans to become ready to go all-electric by 2030 where possible.[16]

These announcements and others like them continue a pattern over the past several years of many manufacturers taking steps to aggressively pursue zero-emission technologies, introduce a wide range of zero-emission vehicle models, and reduce their reliance on the internal-combustion engine in various markets around the globe.[17] [18] These goals and investments have been coupled with a rapidly increasing availability of plug-in vehicle models in the U.S.[19] For example, the number of all-electric vehicle (EV) and plug-in hybrid electric vehicle (PHEV) models available for sale in the U.S. more than doubled from about 24 in MY 2015 to about 60 in MY 2021, with offerings in a growing range of vehicle segments.[20] Recent model announcements indicate that this number will increase to more than 80 models by MY 2023, with many more expected to reach production before the end of the decade.[21] Many of the zero-emission vehicles already on the market today cost less to drive than conventional vehicles,[22] [23] offer improved performance and handling,[24] and can be charged at a growing network of public chargers[25] as well as at home.

At the same time, an increasing number of global jurisdictions and U.S. states plan to take actions to shift the light-duty fleet toward zero-emissions technology. In 2020, California announced an intention to require increasing volumes of zero-emission vehicles to meet the goal that, by 2035, all new light-duty vehicles sold in the state be zero-emission vehicles.[26] Massachusetts[27] and New York[28] are also poised to adopt similar targets and requirements to take effect by 2035. Several other states may adopt similar provisions by 2050 as members of the International Zero-Emission Vehicle Alliance.[29] Globally, at least 12 countries, as well as numerous local jurisdictions, have announced similar goals to shift all new passenger car sales to zero-emission vehicles in the coming years, including Norway (2025); the Netherlands, Denmark, Iceland, Ireland, Sweden, and Slovenia (2030); Canada and the United Kingdom (2035); France and Spain (2040); and Costa Rica (2050).[30] [31] Together, these countries represent approximately 13 percent of the global market for passenger cars,[32] in addition to that represented by the aforementioned U.S. states and other global jurisdictions.

EPA recognizes that in addition to substantially reducing GHG emissions, a longer-term rulemaking could also address criteria pollutant and air toxics emissions from the new light-duty vehicle fleet—especially important considerations during the transition to zero-emission vehicles. EPA expects that a future longer-term rulemaking will take critical steps to continue the trajectory of transportation emission reductions needed to protect public health and welfare. Achieving this trajectory with the help of increased fleet penetration of zero-emission vehicles would bring with it other advantages as well, such as potentially large reductions in roadway pollution and noise in overburdened communities, and potentially support for the future development of vehicle-to-grid services that could become a key enabler for increased utilization of

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[9] General Motors, ''General Motors, the Largest U.S. Automaker, Plans to be Carbon Neutral by 2040,'' Press Release, January 28, 2021.

[10] Volvo Car Group, ''Volvo Cars to be fully electric by 2030,'' Press Release, March 2, 2021.

[11] Volkswagen Newsroom, ''Strategy update at Volkswagen: The transformation to electromobility was only the beginning,'' March 5, 2021. Accessed June 15, 2021 at *https://www.volkswagen-newsroom.com/en/stories/strategy-update-at-volkswagen-the-transformation-to-electromobility-was-only-the-beginning-6875.*

[12] Honda News Room, ''Summary of Honda Global CEO Inaugural Press Conference,'' April 23, 2021. Accessed June 15, 2021 at *https://global.honda/newsroom/news/2021/c210423eng.html.*

[13] Ford Motor Company, ''Superior Value From EVs, Commercial Business, Connected Services is Strategic Focus of Today's 'Delivering Ford+' Capital Markets Day,'' Press Release, May 26, 2021.

[14] Stellantis, ''World Environment Day 2021—Comparing Visions: Olivier Francois and Stefano Boeri, in Conversation to Rewrite the Future of Cities,'' Press Release, June 4, 2021.

[15] Stellantis, ''Stellantis Intensifies Electrification While Targeting Sustainable Double-Digit Adjusted Operating Income Margins in the Mid-Term,'' Press Release, July 8, 2021.

[16] Mercedes-Benz, ''Mercedes-Benz prepares to go all-electric,'' Press Release, July 22, 2021.

[17] Environmental Defense Fund and M.J. Bradley & Associates, ''Electric Vehicle Market Status—Update, Manufacturer Commitments to Future Electric Mobility in the U.S. and Worldwide,'' April 2021.

[18] International Council on Clean Transportation, ''The end of the road? An overview of combustion-engine car phase-out announcements across Europe,'' May 10, 2020.

[19] Muratori et al., ''The rise of electric vehicles—2020 status and future expectations,'' Progress in Energy v3n2 (2021), March 25, 2021. Accessed July 15, 2021 at *https://iopscience.iop.org/article/10.1088/2516–1083/abe0ad.*

[20] *Fueleconomy.gov,* 2015 Fuel Economy Guide and 2021 Fuel Economy Guide.

[21] Environmental Defense Fund and M.J. Bradley & Associates, ''Electric Vehicle Market Status—Update, Manufacturer Commitments to Future Electric Mobility in the U.S. and Worldwide,'' April 2021.

[22] Department of Energy Vehicle Technologies Office, Transportation Analysis Fact of the Week #1186, ''The National Average Cost of Fuel for an Electric Vehicle is about 60% Less than for a Gasoline Vehicle,'' May 17, 2021.

[23] Department of Energy Vehicle Technologies Office, Transportation Analysis Fact of the Week #1190, ''Battery-Electric Vehicles Have Lower Scheduled Maintenance Costs than Other Light-Duty Vehicles,'' June 14, 2021.

[24] Consumer Reports, ''Electric Cars 101: The Answers to All Your EV Questions,'' November 5, 2020. Accessed June 8, 2021 at *https://www.consumerreports.org/hybrids-evs/electric-cars-101-the-answers-to-all-your-ev-questions/.*

[25] Department of Energy Alternative Fuels Data Center, Electric Vehicle Charging Station Locations. Accessed on May 19, 2021 at *https://afdc.energy.gov/fuels/electricity_locations.html#/find/nearest?fuel=ELEC.*

[26] State of California Office of the Governor, ''Governor Newsom Announces California Will Phase Out Gasoline-Powered Cars & Drastically Reduce Demand for Fossil Fuel in California's Fight Against Climate Change,'' Press Release, September 23, 2020.

[27] Commonwealth of Massachusetts, ''Request for Comment on Clean Energy and Climate Plan for 2030,'' December 30, 2020.

[28] New York State Senate, Senate Bill S2758, 2021–2022 Legislative Session. January 25, 2021.

[29] ZEV Alliance, ''International ZEV Alliance Announcement,'' Dec. 3, 2015. Accessed on July 16, 2021 at *http://www.zevalliance.org/international-zev-alliance-announcement/.*

[30] International Council on Clean Transportation, ''Update on the global transition to electric vehicles through 2019,'' July 2020.

[31] Reuters, ''Canada to ban sale of new fuel-powered cars and light trucks from 2035,'' June 29, 2021. Accessed July 1, 2021 from *https://www.reuters.com/world/americas/canada-ban-sale-new-fuel-powered-cars-light-trucks-2035-2021-06-29/.*

[32] International Council on Clean Transportation, ''Growing momentum: Global overview of government targets for phasing out new internal combustion engine vehicles,'' posted 11 November 2020, accessed April 28, 2021 at *https://theicct.org/blog/staff/global-ice-phaseout-nov2020.*

variable renewable energy sources, such as wind and solar, across the grid.[33]

B. Summary of Proposed Light-Duty Vehicle GHG Program

EPA is proposing revised GHG standards that would begin in MY 2023 and increase in stringency year over year through MY 2026. EPA proposes to increase the stringency of the standards from the average roughly 1.5 percent year-over-year stringency increase of the relaxed SAFE standards to a nearly 10 percent proposed stringency increase in MY 2023, followed by a nearly 5 percent proposed stringency increase in each MY from 2024 through 2026. EPA believes the 10 percent proposed increase in stringency in MY 2023 is appropriate given the technological investments industry has continued to make beyond what would be required to meet the SAFE rule revised standards, such as improvements being made in response to the California Framework Agreements, as well as the compliance flexibilities built into the program. Also, as discussed in Section I.G below, EPA requests comment on standards for MY 2026 that would result in fleet average target levels that are in the range of 5–10 g/mile lower (i.e., more stringent) than the levels proposed. This request for comments is in keeping with the additional lead time available for this out-year compared to MYs 2023–2025, and because EPA may determine that it is appropriate, particularly in light of the accelerating transition to electrified vehicles, to require additional reductions in this time frame. The proposed standards would achieve significant GHG and other emission reductions and related public health and welfare benefits, while providing consumers with lower operating costs resulting from significant fuel savings. Our analysis described in this notice demonstrates that the proposed standards are appropriate under section 202(a) of the CAA, considering costs, technological feasibility, available lead time, and other factors. The proposed trajectory of increasing stringency from MYs 2023 to 2026 takes into account the credit-based emissions averaging, banking and trading flexibilities of the current program as well as additional flexibility provisions that we are proposing to ease the transition to more stringent standards. EPA also took into account manufacturers' ability to generate credits against the existing standards relaxed in the SAFE rule for MYs 2021 and 2022, which we are not proposing to revise.

In our design and analyses of the proposed program and our overall updated assessment of feasibility, EPA also took into account the decade-long light-duty vehicle GHG emission reduction program in which the auto industry has introduced a wide lineup of ever more fuel-efficient, GHG-reducing technologies. The technological achievements already developed and applied to vehicles within the current new vehicle fleet will enable the industry to achieve the proposed standards even without the development of new technologies beyond those already widely available. Furthermore, in light of the design cycle timing for vehicles, EPA has basis to expect that the vehicles that automakers will be selling during the first years of the proposed MY 2023–26 program were already designed before the less stringent SAFE standards were recently adopted. Further support that the technologies needed to meet the proposed standards do not need to be developed, but are already widely available and in use on vehicles, can be found in the fact that five vehicle manufacturers, representing about a third of U.S. auto sales, agreed in 2019 with the State of California that their nationwide fleets would meet GHG emission reduction targets more stringent than the applicable EPA standards beginning in model year 2021. The fact that five automakers voluntarily entered into the California Framework Agreements also supports the feasibility of meeting standards at least as stringent as the emission reduction targets under the California Framework, which we describe in detail later in this preamble. We describe additional details of the proposal below and in later sections of the preamble as well as in the Draft Regulatory Impact Analysis (DRIA). We also describe and analyze both less stringent and more stringent alternatives, consistent with OMB Circular A–4.

Although most automakers have launched ambitious plans to develop and produce increasing numbers of zero- and near-zero-emission vehicles, EPA recognizes that during the near-term timeframe of the proposed standards through MY 2026, the new vehicle fleet likely will continue to consist primarily of gasoline-fueled vehicles. In this preamble and in the DRIA, we provide our analyses supporting our assessment that the proposed standards for MYs 2023 through 2026 would be achievable primarily through the application of advanced gasoline vehicle technologies. We project that during the four-year ramping up of the stringency of the CO_2 standards, the proposed standards could be met with gradually increasing sales of plug-in electric vehicles in the U.S., up to about 8 percent market share (including both electric vehicles (EVs) and plug-in hybrid electric vehicles (PHEVs)) by MY 2026. Given that EVs and PHEVs represented about 2 percent of the new vehicle market in MY 2019,[34] this would represent a significant increase in penetration of these vehicles but one that we believe is reasonable given automaker announcements on increasing EV and PHEV production. We note later in this preamble in the discussion of the alternative levels of stringency that EPA is considering, that there may be the potential for higher levels of EV penetration by MY 2026, which could enable EPA to consider a more stringent standard for MY 2026. As described elsewhere in this preamble, we believe that, in conjunction with the proposed standards, the limited but focused incentives and flexibilities that we are proposing would support automakers' acceleration of their introduction and sales of advanced technologies, including zero and near-zero-emission technologies.

1. Proposed Revised GHG Emissions Standards

i. Proposed Revised CO_2 Targets

As with EPA's previous light-duty GHG programs, EPA is proposing footprint-based standards curves for both passenger cars and trucks. Each manufacturer would have a unique standard for the passenger cars category and another for the truck category[35] for each MY based on the sales-weighted footprint-based CO_2 targets[36] of the vehicles produced in that MY. Figure 1 shows EPA's proposed standards, expressed as average fleetwide GHG emissions targets (cars and trucks combined), projected through MY 2026. For comparison, the figure also shows the corresponding targets for the SAFE final rulemaking (FRM) and the 2012 FRM. The projected fleet targets for this proposed rule increase in stringency in

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[33] Department of Energy Electricity Advisory Committee, "Enhancing Grid Resilience with Integrated Storage from Electric Vehicles: Recommendations for the U.S. Department of Energy," June 25, 2018.

[34] "The 2020 EPA Automotive Trends Report, Greenhouse Gas Emissions, Fuel Economy, and Technology since 1975," EPA–420–R–21–003, January 2021, p. 52.

[35] Passenger cars include cars and smaller cross-overs and SUVs, while the truck category includes larger cross-overs and SUVs, minivans, and pickup trucks.

[36] Because compliance is based on the full range of vehicles in a manufacturer's car and truck fleets, with lower-emitting vehicles compensating for higher-emitting vehicles, the emission levels of specific vehicles within the fleet are referred to as targets, rather than standards.

MY 2023 by about 10 percent (from the existing SAFE rule standards in MY 2022), followed by stringency increases thereafter of nearly 5 percent year over year from MY 2024 through MY 2026. Also, as discussed in Section I.G, EPA requests comment on standards for MY 2026 that would result in fleet average target levels that are in the range of 5–10 g/mile lower (*i.e.*, more stringent) than the levels proposed. As with all EPA vehicle emissions standards, the proposed MY 2026 standards would then remain in place for all subsequent MYs, unless and until they are revised in a subsequent rulemaking. Table 1 presents the estimates of EPA's proposed standards presented in Figure 1, again in terms of the projected overall industry fleetwide CO_2-equivalent emission compliance target levels. The industry fleet-wide estimates in Table 1 are projections based on modeling that EPA conducted for the proposed rule, taking into consideration projected fleet mix and footprints for each manufacturer's fleet in each model year. Table 2 presents projected industry fleet average year-over-year percent reductions comparing the existing standards under the SAFE rule and the proposed revised standards. See Section II.A below for a full discussion of the proposed standards and presentations of the footprint standards curves.

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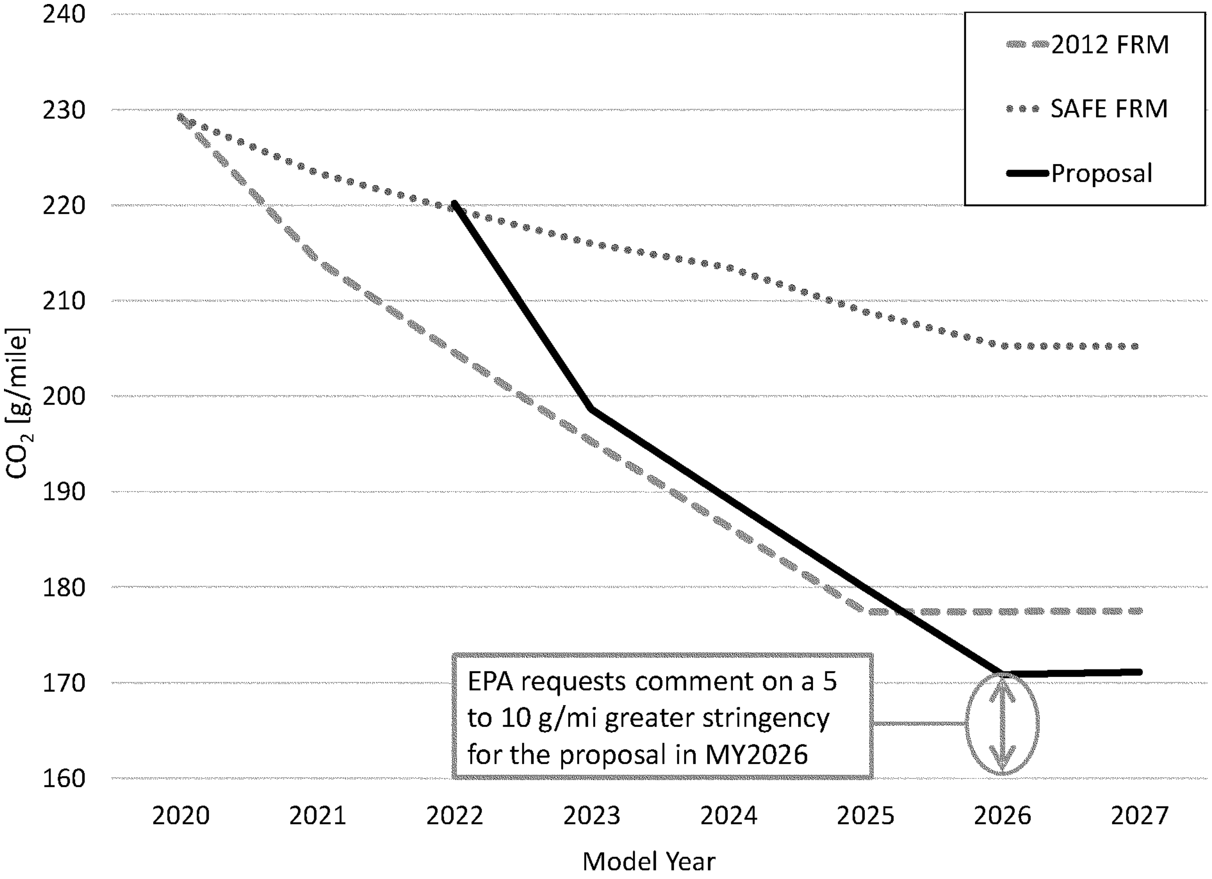

Figure 1 EPA Proposed Industry Fleet-Wide CO_2 Compliance Targets, Compared to 2012 and SAFE Rules, grams/mile, MYs 2021-2026

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TABLE 1—PROJECTED INDUSTRY FLEET-WIDE CO_2 COMPLIANCE TARGETS FOR MYS 2023–2026

[grams/mi]

	2022 *	2023	2024	2025	2026 **
Cars	180	165	157	149	142
Trucks	260	232	221	210	199
Combined Cars and Trucks	220	199	189	180	171

* SAFE rule targets included for reference.

** EPA is also requesting comment on MY 2026 standards that would result in fleet average levels that are 5–10 g/mile more stringent than the levels shown.

The combined car/truck CO2 targets are a function of assumed car/truck shares. For this illustration, we assume an approximately 50/50% split in MYs 2023–2026. See DRIA Chapter 2 for detail.

TABLE 2—PROJECTED INDUSTRY FLEET AVERAGE TARGET YEAR-OVER-YEAR PERCENT REDUCTIONS

	SAFE rule			Proposal		
	Cars %	Trucks %	Combined %	Cars %	Trucks %	Combined %
2023	1.7	1.5	1.6	8.3	10.8	9.8
2024	1.1	1.2	1.2	4.8	4.7	4.7
2025	2.3	2.0	2.2	5.1	5.0	4.9
2026*	1.8	1.6	1.7	4.7	5.2	5.0

*The percentages shown do not include EPA's request for comments on MY 2026 standards that are 5–10 g/mile more stringent than proposed.

2. Proposed Compliance Incentives and Flexibilities

The existing GHG program established in the 2010 and 2012 rules included several key flexibilities, such as credit programs and technology incentives that are discussed further in this proposal where EPA is requesting comment or proposing modifications.[37] These include:

- Credit Averaging, Banking, and Trading (ABT) including credit carry-forward, credit carry-back, transferring credits between a manufacturer's car and truck fleets, and credit trading between manufacturers (MY 2012 and later)
- Off-cycle credits for GHG emissions reductions not captured on the test procedures used for fleet average compliance with the footprint-based standards (MY 2012 and later)
- Air conditioning credits for system efficiency improvements and reduced refrigerant leakage or use of low global warming potential refrigerants (MY 2012 and later)
- Multiplier incentives for advanced technology vehicles including electric vehicles, fuel cell vehicles, plug-in hybrids (ending after MY 2021)
- Multiplier incentives for natural gas fueled vehicles (MY 2021–2026)
- Full-size pick-up incentives for hybridization or performance improvements equivalent to hybridization (ending after MY 2021)

EPA is proposing a targeted set of extended or additional compliance flexibilities and incentives that we believe are appropriate given the stringency and lead time of the proposed standards. We are proposing four types of flexibilities/incentives, in addition to flexibilities/incentives that already will be available for these MYs under EPA's existing regulations: (1) A limited extension of carry-forward credits generated in MYs 2016 through 2020; (2) an extension of the advanced technology vehicle multiplier credits for MYs 2022 through 2025 with a cumulative credit cap; (3) restoration of the 2012 rule's full-size pickup truck incentives for strong hybrids or similar performance-based credit for MYs 2022 through 2025 (provisions which were removed in the SAFE rule); and (4) an increase of the off-cycle credits menu cap from 10 g/mile to 15 g/mile. EPA is also proposing to remove the multiplier incentives for natural gas fueled vehicles for MYs 2023–2026. We summarize these proposals below and provide details in Sections II.B and II.C below.

The GHG program includes existing provisions initially established in the 2010 rule, which set the MY 2012–2016 GHG standards, for how credits may be used within the program. These averaging, banking, and trading (ABT) provisions include credit carry-forward, credit carry-back (also called deficit carry-forward), credit transfers (within a manufacturer), and credit trading (across manufacturers). These ABT provisions define how credits may be used and are integral to the program. The current program limits credit carry-forward to 5 years. EPA is proposing a limited extension of credit carry-forward for credits generated in MYs 2016 through 2020. The proposal would change the credit carry-forward time limitation for MY 2016 credits from five to seven years and the carry-forward limit for MYs 2017–2020 from 5 to 6 years, as shown in Table 3 below.

TABLE 3—EPA PROPOSED EXTENSION OF CREDIT CARRY-FORWARD PROVISIONS

MY credits are banked	MYs credits are valid under EPA's proposed extension										
	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
2016	....	x	x	x	x	x	+	+	....	....	....
2017	....	....	x	x	x	x	x	+	....	....	....
2018	....	....	....	x	x	x	x	x	+	....	....
2019	....	....	....	....	x	x	x	x	x	+	....
2020	....	....	....	....	....	x	x	x	x	x	+
2021	....	....	....	....	....	....	x	x	x	x	x

x = Current program. + = Proposed additional years.

The existing GHG program also includes temporary incentives through MY 2021 that encourage the use of advanced technologies such as electric, hybrid, and fuel cell vehicles, as well as incentives for full-size pickups using strong hybridization or technologies providing similar emissions reductions to hybrid technology. The full-size pickup incentives originally were available through MY 2025, but the SAFE rule removed these incentives for MYs 2022 through 2025. When EPA established these incentives in the 2012 rule, EPA recognized that they would reduce the effective stringency of the standards, but believed that it was worthwhile to have a limited near-term

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[37] See 75 FR 25324, May 7, 2010 and 77 FR 62624, Oct. 15, 2012.

loss of emissions reduction benefits to increase the potential for far greater emissions reduction and technology diffusion benefits in the longer term.[38] EPA believed that the temporary regulatory incentives would help bring low emission technologies to market more quickly than in the absence of incentives.[39] With these same goals in mind for this program, EPA is proposing multiplier incentives from MY 2022 though MY 2025 with a cap on multiplier credits and to reinstate the full-size pickup incentives removed from the program by the SAFE rule. These proposed incentives are intended as a temporary measure supporting the transition to zero-emission vehicles and to provide additional flexibility in meeting the MY 2023–2026 proposed standards, as further discussed in Section II.B.1.

EPA is also proposing to remove the extended multiplier incentives added by the SAFE rule from the GHG program after MY 2022. EPA is proposing to end multipliers for NGVs in this manner because NGVs are not a near-zero emissions technology and EPA believes multipliers are no longer necessary or appropriate for these vehicles. Any NGV multiplier credits generated in MY 2022 would be included under the proposed multiplier cap.

The current program also includes credits for real-world emissions reductions not reflected on the test cycles used for measuring CO_2 emissions for compliance with the fleet average standards. There are credits for using technologies that reduce GHG emissions that aren't captured on EPA tests (''off-cycle'' technologies) and improvements to air conditioning systems that increase efficiency and reduce refrigerant leakage. These credit opportunities do not sunset under the existing regulations, remaining a part of the program through MY 2026 and beyond unless the program is changed by regulatory action. EPA is proposing to modify an aspect of the off-cycle credits program to provide additional opportunities for manufacturers to generate credits by increasing the pre-defined menu credit cap from 10 to 15 g/mile. EPA is also proposing to modify some of the regulatory definitions that are used to determine whether a technology is eligible for the menu credits. EPA is not proposing changes to the air conditioning credits elements of the program.

C. Analytical Support for the Proposed Revised Standards

1. Summary of Analyses for This Proposed Rule

All of EPA's analyses of the national light-duty vehicle GHG program over the past decade have been built on the same overall framework and produce the same types of results. Section III.A below explains this common EPA framework in more detail. In summary, it includes the following primary elements:

i. Analyzing Issues of Feasibility, Costs, and Lead Time

As with our earlier analyses, EPA used a model to simulate the decision process of auto manufacturers in choosing among the emission reduction technologies available to incorporate in vehicles across their fleets. The models take into account both the projected costs of established and newer technologies and the relative ability of each of these technologies to reduce GHG emissions. This process identifies potential pathways for manufacturers to comply with a given set of GHG standards. EPA then estimates projected average and total costs for manufacturers to produce these vehicles to meet the standards under evaluation during the model years covered by the analysis.

In addition to projecting the technological capabilities of the industry and estimating compliance costs for each of the four affected model years (MYs 2023–2026), EPA has considered the role of the averaging, banking, and trading system that has been available and extensively used by the industry since the beginning of the light-duty vehicle GHG program in model year 2012. Our analysis of the current and anticipated near-future usage of the GHG credit mechanisms (III.B.2 below) reinforces the trends we identified in our other analyses showing widespread technological advancement in the industry at reasonable per-vehicle costs. Together, these analyses support EPA's conclusion under section 202(a) of the CAA that technologically feasible pathways are available at reasonable costs for automakers to comply with the proposed standards during each of the four model years. We discuss these analyses and their results further in Section III below.

ii. Analyzing the Projected Impacts of the Proposed Program

We also estimate the GHG and non-GHG emission impacts (tailpipe and upstream) of the proposed standards. EPA then builds on the estimated changes in emissions and fuel consumption to calculate expected net economic impacts from these changes. Key economic inputs include: The social costs of GHGs; measures of health impacts from changes in criteria pollutant emissions; a value for the vehicle miles traveled ''rebound effect;'' estimates of energy security impacts of changes in fuel consumption; and costs associated with crashes, noise, and congestion from additional rebound driving.

Our overall analytical approach generates key results for the following metrics: Incremental costs per vehicle (industry-wide averages and by manufacturer); total vehicle technology costs for the auto industry; GHG emissions reductions and criteria pollutant emissions reductions; penetration of key GHG-reducing technologies across the fleet; consumer fuel savings; oil reductions; and net societal costs and benefits. We discuss these analyses in Sections III, IV, V, and VII below as well as in the DRIA.

2. History of Similar Analyses

At several points during the past decade, EPA has performed detailed analyses to evaluate the technological feasibility, as well as to project program costs and benefits, of the national light-duty vehicle GHG emissions control program. Although the purposes of these analyses varied, and EPA used somewhat different modeling approaches and tools, in each case these analyses included assessments of the program in the later years of the standards, *i.e.*, MYs 2022 through 2025 or 2026. As we describe in more detail in Chapter 1 of the DRIA, EPA performed similar analyses in support of the 2011 proposal and 2012 final rule establishing the original MY 2017–2025 light-duty vehicle GHG standards; in 2016–January 2017 in support of the Midterm Evaluation process and Determination concerning the MY 2022–2025 standards; and in 2018 during the development of the SAFE proposed rule.

It is notable that, although each analysis is based on projections from the then-available fleet data forward to model years 2025 or 2026, the results of each of these earlier analyses, as well as the updated analysis we have performed for our proposed standards, have all produced very similar results in several key metrics. For example, the estimated projected cost to manufacturers to implement similar standards in 2025–2026 has remained fairly consistent since 2012. Thus, while we believe the updated analysis presented in the DRIA provides strong support for the

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[38] See Tables III–2 and III–3, 77 FR 62772, October 15, 2012.

[39] 77 FR 62812, October 15, 2012.

feasibility and appropriateness of the proposed program, the consistent results from the earlier analyses further reinforce the robustness of our conclusions.

D. Summary of Costs and Benefits of the Proposed Program

EPA estimates that this proposal would result in significant present-value net benefits of $86 billion to $140 billion (annualized net benefits of $4.2 billion to $7.3 billion)—that is, the total benefits far exceed the total costs of the program. Table 4 below summarizes EPA's estimates of total discounted costs, fuel savings, and benefits. The results presented here project the monetized environmental and economic impacts associated with the proposed standards during each calendar year through 2050. The proposal also would have significant benefits for consumers, as the fuel savings for American drivers would total $120 to $250 billion through 2050. With these fuel savings, consumers would benefit from reduced operating costs over the vehicle lifetime.

The benefits include climate-related economic benefits from reducing emissions of GHGs that contribute to climate change, 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 rebound effect, and the value of reduced refueling time needed to fill a more fuel-efficient vehicle. The analysis also includes estimates of economic impacts stemming from additional vehicle use, such as the economic damages caused by crashes, congestion, and noise (from increased rebound driving). See the DRIA for more information regarding these estimates.

TABLE 4—MONETIZED DISCOUNTED COSTS, BENEFITS, AND NET BENEFITS OF THE PROPOSED PROGRAM FOR CALENDAR YEARS THROUGH 2050

[Billions of 2018 dollars] [a b c d e]

	Present value		Annualized value	
	3% Discount rate	7% Discount rate	3% Discount rate	7% Discount rate
Costs	$240	$150	$12	$12
Fuel Savings	250	120	13	9.9
Benefits	130	110	6.9	6.3
Net Benefits	140	86	7.3	4.2

Notes:

[a] Values rounded to two significant figures; totals may not sum due to rounding. Present and annualized values are based on the stream of annual calendar year costs and benefits included in the analysis (2021–2050) and discounted back to year 2021.

[b] Climate benefits are based on reductions in CO_2, CH_4 and N_2O emissions and are calculated using four different estimates of the social cost of each greenhouse gas (SC–GHG model average at 2.5%, 3%, and 5% discount rates; 95th percentile at 3% discount rate), which each increase over time. In this table, we show the benefits associated with the average SC–GHGs at a 3% discount rate but the Agency does not have a single central SC–GHG point estimate. We emphasize the importance and value of considering the benefits calculated using all four SC–GHG estimates and present them later in this preamble. As discussed in Chapter 3.3 of the DRIA, a consideration of climate benefits calculated using discount rates below 3 percent, including 2 percent and lower, is also warranted when discounting intergenerational impacts.

[c] The same discount rate used to discount the value of damages from future GHG emissions (SC–GHGs at 5, 3, and 2.5 percent) is used to calculate the present and annualized values of climate benefits for internal consistency, while all other costs and benefits are discounted at either 3% or 7%.

[d] Net benefits reflect the fuel savings plus benefits minus costs.

[e] Non-GHG impacts associated with the standards presented here do not include the full complement of health and environmental effects that, if quantified and monetized, would increase the total monetized benefits. Instead, the non-GHG benefits are based on benefit-per-ton values that reflect only human health impacts associated with reductions in $PM_{2.5}$ exposure.

A second way to present the net benefits of the proposal is using a vehicle MY lifetime basis. Table 5 and Table 6 summarize EPA's estimates of total discounted costs, fuel savings, and benefits through the full lifetime of vehicles projected to be sold in MYs 2023–2026. The estimated results presented here project the monetized environmental and economic impacts associated with the proposed standards. Note that standards continue at their MY2026 levels beyond MY2026 in any scenario. At both a 3% and 7% discount rate all model years show substantial fuel savings and net benefits.

TABLE 5—GHG ANALYSIS OF LIFETIME COSTS & BENEFITS TO MEET THE PROPOSED MYS 2023–2026 GHG STANDARDS, 3% DISCOUNT RATE

[For vehicles produced in MY 2023–2026] [a b c d]

[Billions of 2018$]

MY	Costs	Fuel savings	Benefits	Net benefits
Present values				
2023	$4.8	$3.6	$1.9	$0.68
2024	5.9	7	3.6	4.7
2025	6.7	8.6	4.4	6.2
2026	8.1	13	7.2	12
Sum	26	33	17	24

TABLE 5—GHG ANALYSIS OF LIFETIME COSTS & BENEFITS TO MEET THE PROPOSED MYS 2023–2026 GHG STANDARDS, 3% DISCOUNT RATE—Continued

[For vehicles produced in MY 2023–2026] [a] [b] [c] [d]

[Billions of 2018$]

MY	Costs	Fuel savings	Benefits	Net benefits
Annualized values				
2023	0.21	0.16	0.08	0.029
2024	0.26	0.3	0.16	0.2
2025	0.29	0.37	0.19	0.27
2026	0.35	0.58	0.31	0.54
Sum	1.1	1.4	0.74	1

Notes:

[a] The lifetime costs and benefits of each MY vehicle are discounted back to 2021.

[b] Climate benefits are based on reductions in CO_2, CH_4 and N_2O emissions and are calculated using four different estimates of the social cost of each greenhouse gas (SC–GHG model average at 2.5%, 3%, and 5% discount rates; 95th percentile at 3% discount rate), which each increase over time. In this table, we show the benefits associated with the average SC–GHGs at a 3% discount rate, but the Agency does not have a single central SC–GHG point estimate. We emphasize the importance and value of considering the benefits calculated using all four SC–GHG estimates and present them later in this preamble. As discussed in Chapter 3.3 of the DRIA, a consideration of climate benefits calculated using discount rates below 3 percent, including 2 percent and lower, is also warranted when discounting intergenerational impacts.

[c] The same discount rate used to discount the value of damages from future GHG emissions is used to calculate the present and annualized value of SC–GHGs for internal consistency, while all other costs and benefits are discounted at 3% in this table.

[d] Non-GHG impacts associated with the standards presented here do not include the full complement of health and environmental effects that, if quantified and monetized, would increase the total monetized benefits. Instead, the non-GHG benefits are based on benefit-per-ton values that reflect only human health impacts associated with reductions in $PM_{2.5}$ exposure.

TABLE 6—GHG ANALYSIS OF LIFETIME COSTS & BENEFITS TO MEET THE PROPOSED MYS 2023–2026 GHG STANDARDS, 7% DISCOUNT RATE

[For vehicles produced in MY 2023–2026] [a] [b] [c] [d]

[Billions of 2018$]

MY	Costs	Fuel savings	Benefits	Net benefits
Present values				
2023	$4.4	$2.6	$1.7	−$0.14
2024	5.5	4.7	3.3	2.4
2025	6.1	5.5	3.9	3.4
2026	7.3	8.2	6.2	7.2
Sum	23	21	15	13
Annualized values				
2023	0.33	0.19	0.085	−0.053
2024	0.41	0.35	0.16	0.1
2025	0.45	0.41	0.19	0.15
2026	0.55	0.62	0.31	0.38
Sum	1.7	1.6	0.75	0.58

Notes:

[a] The lifetime costs and benefits of each MY vehicle are discounted back to 2021.

[b] Climate benefits are based on reductions in CO_2, CH_4 and N_2O emissions and are calculated using four different estimates of the social cost of each greenhouse gas (SC–GHG model average at 2.5%, 3%, and 5% discount rates; 95th percentile at 3% discount rate), which each increase over time. In this table, we show the benefits associated with the average SC–GHGs at a 3% discount rate, but the Agency does not have a single central SC–GHG point estimate. We emphasize the importance and value of considering the benefits calculated using all four SC–GHG estimates and present them later in this preamble. As discussed in Chapter 3.3 of the DRIA, a consideration of climate benefits calculated using discount rates below 3 percent, including 2 percent and lower, is also warranted when discounting intergenerational impacts.

[c] The same discount rate used to discount the value of damages from future GHG emissions is used to calculate the present and annualized value of SC–GHGs for internal consistency, while all other costs and benefits are discounted at 7% in this table.

[d] Non-GHG impacts associated with the standards presented here do not include the full complement of health and environmental effects that, if quantified and monetized, would increase the total monetized benefits. Instead, the non-GHG benefits are based on benefit-per-ton values that reflect only human health impacts associated with reductions in $PM_{2.5}$ exposure.

E. How has EPA considered environmental justice in this proposal?

Executive Orders 12898 (59 FR 7629, February 16, 1994) and 14008 (86 FR 7619, February 1, 2021) direct federal agencies, to the greatest extent practicable and permitted by law, to make achieving environmental justice (EJ) part of their mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of their programs, policies, and activities on minority populations and low-income populations in the United States. Chapter 8.3 discusses the potential environmental justice concerns associated with this proposal. EPA defines environmental justice as the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Executive Order 14008 also calls on federal agencies to make achieving environmental justice part of their missions ''by developing programs, policies, and activities to address the disproportionately high and adverse human health, environmental, climate-related and other cumulative impacts on disadvantaged communities, as well as the accompanying economic challenges of such impacts.'' It declares a policy ''to secure environmental justice and spur economic opportunity for disadvantaged communities that have been historically marginalized and overburdened by pollution and under-investment in housing, transportation, water and wastewater infrastructure and health care.'' Under Executive Order 13563 (76 FR 3821), federal agencies may consider equity, human dignity, fairness, and distributional considerations, where appropriate and permitted by law.

EPA's 2016 ''Technical Guidance for Assessing Environmental Justice in Regulatory Analysis'' provides recommendations on conducting the highest quality analysis feasible, recognizing that data limitations, time and resource constraints, and analytic challenges will vary by media and regulatory context. [40]

EPA's mobile source regulatory program has historically reduced significant amounts of both GHG and non-GHG pollutants to the benefit of all U.S. residents, including populations that live near roads and in communities with EJ concerns. EJ concerns may arise in the context of this rulemaking in two key areas.

First, minority populations and low-income populations may be especially vulnerable to the impacts of climate change. As discussed in Section IV.C, this proposed rulemaking would mitigate the impacts of climate change by achieving significant GHG emission reductions, which would benefit populations that may be especially vulnerable to various forms of damages associated with climate change.

Second, in addition to significant climate-change benefits, the proposed standards would also impact non-GHG emissions. As discussed in Section VII.L.2, numerous studies have found that environmental hazards such as air pollution are more prevalent in areas where minority populations and low-income populations represent a higher fraction of the population compared with the general population. There is substantial evidence, for example, that people who live or attend school near major roadways are more likely to be of a racial minority, Hispanic ethnicity, and/or low socioeconomic status (see Section VII.L.2).

We expect this proposed rule would result in both small reductions and small increases of non-GHG emissions. These effects could potentially impact communities with EJ concerns, though not necessarily immediately and not equally in all locations. For this proposal, the air quality information needed to perform a quantified analysis of the distribution of such impacts was not available. We therefore recommend caution when interpreting these broad, qualitative observations.

We note that EPA intends to develop a future rule to control emissions of GHGs as well as criteria and air toxic pollutants from light-duty vehicles for MYs beyond 2026. We are considering how to project air quality impacts from the changes in non-GHG emissions for that future rulemaking (see Section V.C).

F. Affordability and Equity

In addition to considering environmental justice impacts, we have examined the effects of the proposed standards on affordability of vehicles and transportation services for low-income households in Section VII.L of this Preamble and Chapter 8.4 of the DRIA. As with the effects of the proposed standards on vehicle sales discussed in Section VII.B, the effects of the proposed standards on affordability and equity depend in part on two countervailing effects: The increase in the up-front costs of new vehicles subject to more stringent standards, and the decrease in operating costs from reduced fuel consumption over time. The increase in up-front new vehicle costs has the potential to increase the prices of used vehicles, to make credit more difficult to obtain, and to make the least expensive new vehicles less desirable compared to used vehicles. The reduction in operating costs over time has the potential to mitigate or reverse all these effects. Lower operating costs on their own increase mobility (see DRIA Chapter 3.1 for a discussion of rebound driving).

While social equity involves issues beyond income and affordability, including race, ethnicity, gender, gender identification, and residential location, the potential effects of the proposed standards on lower-income households are of great importance for social equity and reflect these contrasting forces. The overall effects on vehicle ownership, including for lower-income households, depend heavily on the role of fuel consumption in vehicle sales decisions, as discussed in Section VII.M. At the same time, lower-income households own fewer vehicles per household, are more likely to buy used vehicles than new, and spend more on fuel than on vehicles on an annual basis than higher-income households. In addition, for lower-income households, fuel expenditures are a larger portion of household income, so the fuel savings that would result from this proposal may be more impactful to these consumers. Thus, the benefits of this proposal may be stronger for lower-income households even if they buy used vehicles: As vehicles meeting the proposed standards enter the used vehicle market, they will retain the fuel economy/GHG-reduction benefits, and associated fuel savings, while facing a smaller portion of the upfront vehicle costs. The reduction in operating costs may also increase access to transportation services, such as ride-hailing and ride-sharing, where the lower per-mile costs may play a larger role than up-front costs in pricing. As a result, lower-income consumers may be affected more from the reduction in operating costs than the increase in up-front costs.

New electric vehicles currently have higher up-front costs and lower operating costs than gasoline vehicles and require access to charging infrastructure that may not be readily available to many. EPA has heard from some environmental justice groups and Tribes that limited access to electric vehicles and charging infrastructure can be a barrier for purchasing EVs. This proposal projects that the vast majority of vehicles produced in the time frame of the proposed standards will be gasoline-fueled vehicles (with EVs and PHEVs gradually increasing to about 8 percent total market share by MY 2026 compared to about 4 percent in the No Action scenario, see DRIA Chapter 4.1.3, Table 4–30). However, EPA will monitor and study affordability issues related to electric vehicles as their prevalence in the vehicle fleet increases.

G. What alternatives is EPA considering?

1. Description of the Alternatives

Along with the proposed standards, EPA analyzed both a more stringent and a less stringent alternative. For the less stringent alternative, Alternative 1, EPA used the coefficients in the California

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[40] ''Technical Guidance for Assessing Environmental Justice in Regulatory Analysis.'' Epa.gov, Environmental Protection Agency, *https://www.epa.gov/sites/production/files/2016-06/documents/ejtg_5_6_16_v5.1.pdf.* (June 2016).

Framework for the 2.7 percent effective stringency level (as described in Section II.B.1) as the basis for the MY 2023 stringency level and the 2012 rule's MY 2025 standards as the basis for the MY 2026 stringency level, with linear year-over-year reductions between the two points for MYs 2024 and 2025. EPA views the California Framework as a reasonable basis for the least stringent alternative that EPA would consider finalizing, since it represents a level of stringency that five manufacturers have already committed to achieving. EPA did not include incentive multipliers for Alternative 1, as doing so would only further reduce the effective stringency of this Alternative, and EPA views Alternative 1 as the lower end of stringency that it believes is appropriate through 2026.

For the more stringent alternative, Alternative 2, EPA used the 2012 rule standards as the basis for MY 2023–2025 targets, with the standards continuing to increase in stringency in a linear fashion for MY 2026. Alternative 2 adopts the 2012 rule stringency levels in MY 2023 and follows the 2012 rule standard target levels through MY 2025. EPA extended the same linear average year-over-year trajectory for MYs 2023–2025 to MY 2026 for the final standards under Alternative 2. As noted in Section II.A.1, EPA believes that it is important to continue to make progress in MY 2026 beyond the MY 2025 standard levels in the 2012 rule. As with the proposal, Alternative 2 meets this objective. EPA did not include in Alternative 2 the proposed incentive multipliers with the proposed cumulative credit cap in MYs 2022–2025, which would have the effect of making Alternative 2 less stringent. As discussed in Section II.B.1, EPA is requesting comment on whether or not to include the proposed multipliers, and our request for comments extends to whether to include multipliers both for the proposal and for Alternative 2.[41]

As previously noted in Section I.B.2, EPA is proposing several modifications to program flexibilities. These proposed program changes, except for the advanced technology multipliers, would also apply to the alternatives. Table 7 below provides a list of the proposed flexibilities and their applicability to the proposed and alternative standards.

TABLE 7—APPLICABILITY OF REVISED FLEXIBILITY PROVISIONS TO THE PROPOSAL AND ALTERNATIVES

Provision	Proposal	Alternative 1	Alternative 2
Extension of credit carry-forward for MY 2016–2020 credits	Yes	Yes	Yes.
Advanced technology incentive multipliers for MYs 2022–2025 with cap	Yes	No	No.
Increase of off-cycle menu cap from 10 to 15 g/mile	Yes	Yes	Yes.
Reinstatement of full-size pickup incentives for strong hybrids or equivalent technologies for MYs 2022–2025.	Yes	Yes	Yes.

EPA's technical analysis, presented in Section III, consists of model runs using a model capable of reflecting some but not all of these provisions. The modeling includes consideration of advanced technology incentive multipliers for the proposal but not for the alternatives. The model runs also include the 15 grams per mile off-cycle menu cap as appropriate given the standards or targets to which a fleet being modeled is complying. Not included in the model runs are the full-size pickup truck technology incentive credit or the extension of the emissions credit carry-forward.

The fleet average targets for the two alternatives compared to the proposed standards are provided in Table 8 below. EPA also requests comment on the level of stringency for MY 2026 for the alternatives and the proposed standards. Specifically, EPA requests comment on standards for MY 2026 that would result in fleet average target levels that are in the range of 5–10 g/mile lower (*i.e.*, more stringent) than the levels shown for MY 2026 in Table 8. EPA is requesting specific comment on whether the level of stringency for MY 2026 should be greater in keeping with the additional lead time available for this out-year compared to MYs 2023–2025, and because EPA may determine that it is appropriate, particularly in light of the accelerating transition to electrified vehicles, to require additional reductions in this timeframe. As discussed in detail in Section A.3 of the Executive Summary, there has been a proliferation of recent announcements from automakers signaling a rapidly growing shift in investment away from internal-combustion technologies and toward high levels of electrification. EPA has also heard from a wide range of stakeholders over the past several months, including but not limited to the automotive manufacturers and the automotive suppliers, that the significant investments being made now to develop and launch new EV product offerings and in the expansion of EV charging infrastructure could enable higher levels of EV penetration to occur in the marketplace by the MY 2026 time frame than EPA has projected in this proposal for both the proposed MY 2026 standards and the Alternative 2 MY 2026 standards. The information concerning the investment landscape potentially accelerating to an even greater extent of market penetration of EV products helps inform EPA's request for comment on the potential for a more stringent MY 2026 standard that would reflect this information and related considerations, including any additional information provided by commenters. In light of these stakeholder views and other available information, EPA is soliciting comment on the appropriateness of more stringent MY 2026 standards.

TABLE 8—PROJECTED FLEET AVERAGE TARGET LEVELS FOR PROPOSED STANDARDS AND ALTERNATIVES

[CO_2 grams/mile]

Model year	Proposal projected targets	Alternative 1 projected targets	Alternative 2 projected targets
2021	* 223	* 223	* 224
2022	* 220	* 220	* 220

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[41] 41 See "Benefits and Costs of the EPA Light-duty Vehicle GHG Proposal with and without Advanced Technology Multipliers," memorandum to Docket.

TABLE 8—PROJECTED FLEET AVERAGE TARGET LEVELS FOR PROPOSED STANDARDS AND ALTERNATIVES—Continued

[CO_2 grams/mile]

Model year	Proposal projected targets	Alternative 1 projected targets	Alternative 2 projected targets
2023	199	203	195
2024	189	194	186
2025	180	185	177
2026 **	171	177	169

* SAFE rule standards included here for reference.

** EPA is also requesting comment on MY 2026 standards that would result in fleet average levels that are 5–10 g/mile more stringent than the levels shown.

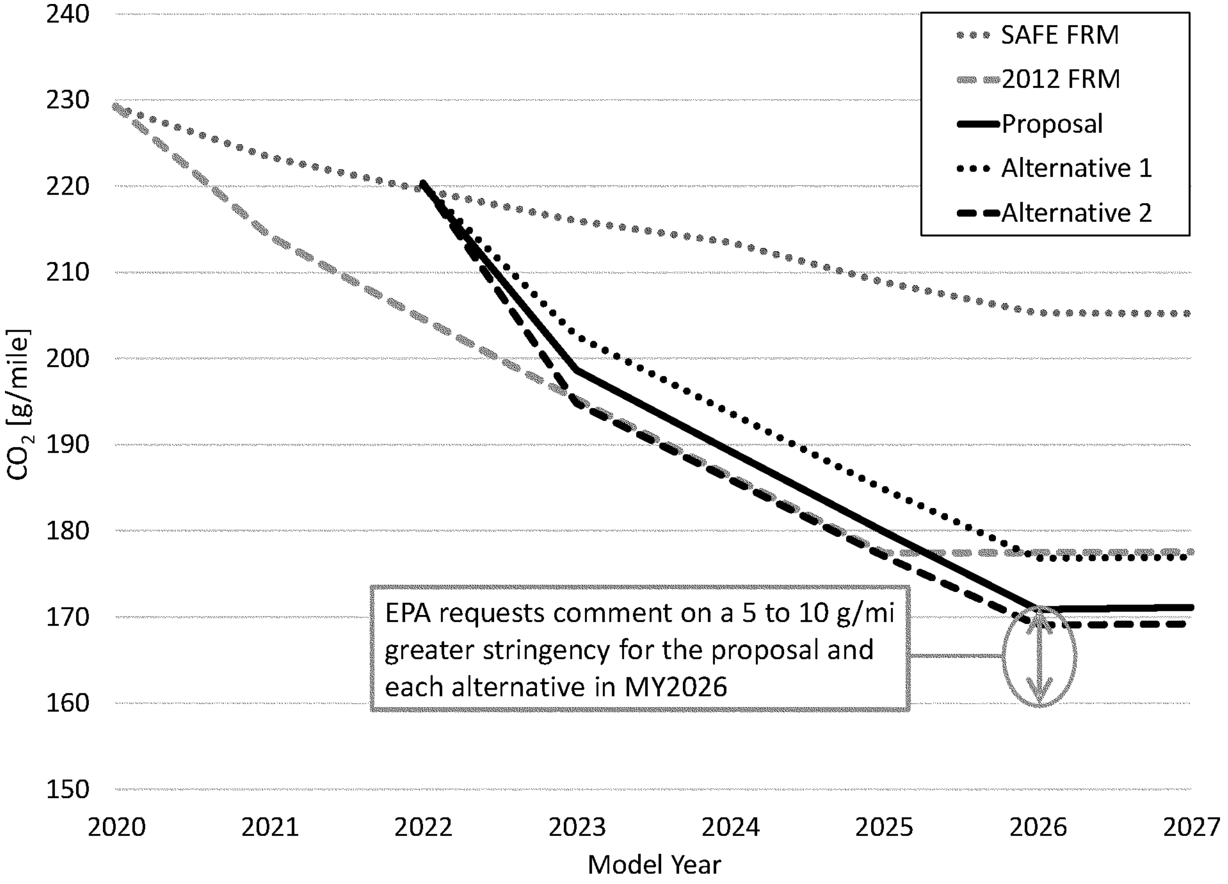

Figure 2 Proposed Standards Fleet Average Targets Compared to Alternatives

As shown in Figure 2, the range of alternatives that EPA has analyzed is fairly narrow, with the proposed standard targets differing from the alternatives in any given MY in MYs 2023–2026 by 2 to 6 g/mile, although EPA is requesting comment on a wider range of standards, particularly for MY 2026 as noted above. EPA believes this approach is reasonable and appropriate considering the relatively limited lead time for the proposed standards, especially for MYs 2023–2025, EPA's assessment of feasibility, the existing automaker commitments to meet the California Framework (representing about one-third of the auto market), the standards adopted in the 2012 rule; and the need to reduce GHG emissions. EPA provides a discussion of the feasibility of the proposed standard and alternatives and the selection of the proposed standards in Section III.D. The analysis of costs and benefits of Alternatives 1 and 2 is shown in the DRIA Chapters 4, 6, and 10. EPA requests comments on all aspects of Alternatives 1 and 2 or other alternatives roughly within the stringency range of the proposal and the Alternatives.

2. Summary of Costs and Benefits of the Alternatives

EPA estimates that Alternative 1 would result in significant present-value net benefits of $76 billion to $130 billion (annualized net benefits of $4.1 billion to $6.6 billion)—that is, the total benefits far exceed the total costs of the program. Table 9 below summarizes EPA's estimates of total discounted costs, fuel savings, and benefits for Alternative 1. The results presented here project the monetized environmental and economic impacts associated with the proposed standards during each calendar year through 2050. Alternative 1 also would have significant benefits for consumers, as the fuel savings for American drivers would total $98 billion to $200 billion through 2050. With these fuel savings, consumers would benefit from reduced operating costs over the vehicle lifetime.

The benefits include climate-related economic benefits from reducing emissions of GHGs that contribute to climate change, 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 rebound effect, and the value of reduced refueling time needed to fill a more fuel-efficient vehicle. The analysis also includes estimates of economic impacts stemming from additional vehicle use, such as the economic damages caused by crashes, congestion, and noise (from increased rebound driving). See the DRIA for more information regarding these estimates.

TABLE 9—MONETIZED DISCOUNTED COSTS, BENEFITS, AND NET BENEFITS OF ALTERNATIVE 1 FOR CALENDAR YEARS THROUGH 2050

[Billions of 2018 dollars] [a b c d e]

	Present value		Annualized value	
	3% Discount rate	7% Discount rate	3% Discount rate	7% Discount rate
Costs	$190	$110	$9.5	$9.2
Fuel savings	200	98	10	7.9
Benefits	120	93	6	5.4
Net benefits	130	76	6.6	4.1

Notes:

[a] Values rounded to two significant figures; totals may not sum due to rounding. Present and annualized values are based on the stream of annual calendar year costs and benefits included in the analysis (2021–2050) and discounted back to year 2021.

[b] Climate benefits are based on reductions in CO_2, CH_4 and N_2O emissions and are calculated using four different estimates of the social cost of each greenhouse gas (SC–GHG model average at 2.5%, 3%, and 5% discount rates; 95th percentile at 3% discount rate), which each increase over time. In this table, we show the benefits associated with the average SC–GHGs at a 3% discount rate but the Agency does not have a single central SC–GHG point estimate. We emphasize the importance and value of considering the benefits calculated using all four SC–GHG estimates and present them later in this preamble. As discussed in Chapter 3.3 of the DRIA, a consideration of climate benefits calculated using discount rates below 3 percent, including 2 percent and lower, is also warranted when discounting intergenerational impacts.

[c] The same discount rate used to discount the value of damages from future GHG emissions (SC–GHGs at 5, 3, and 2.5 percent) is used to calculate the present and annualized values of climate benefits for internal consistency, while all other costs and benefits are discounted at either 3% or 7%.

[d] Net benefits reflect the fuel savings plus benefits minus costs.

[e] Non-GHG impacts associated with the standards presented here do not include the full complement of health and environmental effects that, if quantified and monetized, would increase the total monetized benefits. Instead, the non-GHG benefits are based on benefit-per-ton values that reflect only human health impacts associated with reductions in $PM_{2.5}$ exposure.

A second way to present the net benefits of the proposal is using a vehicle MY lifetime basis. Table 10 and Table 11 summarize EPA's estimates of total discounted costs, fuel savings, and benefits through the full lifetime of vehicles projected to be sold in MYs 2023–2026 under Alternative 1. The estimated results presented here project the monetized environmental and economic impacts associated with the Alternative 1 standards. Note that standards continue at their MY2026 levels beyond MY2026 in any scenario. At both a 3% and 7% discount rate all model years show substantial fuel savings and net benefits.

TABLE 10—GHG ANALYSIS OF LIFETIME COSTS & BENEFITS TO MEET THE ALTERNATIVE 1 MYS 2023–2026 GHG STANDARDS, 3% DISCOUNT RATE

[For vehicles produced in MY 2023–2026] [a b c d]

[Billions of 2018$]

MY	Costs	Fuel savings	Benefits	Net benefits
Present values				
2023	$3.9	$3.4	$2	$1.5
2024	4.9	6.5	3.7	5.3
2025	5.6	7.7	4.5	6.5
2026	6.4	10	6	9.7
Sum	21	28	16	23
Annualized values				
2023	0.17	0.15	0.085	0.067
2024	0.21	0.28	0.16	0.23
2025	0.24	0.33	0.19	0.28
2026	0.28	0.44	0.26	0.42
Sum	0.9	1.2	0.7	1

Notes:

[a] The lifetime costs and benefits of each MY vehicle are discounted back to 2021.

[b] Climate benefits are based on reductions in CO_2, CH_4, and N_2O emissions and are calculated using four different estimates of the social cost of each greenhouse gas (SC–GHG model average at 2.5%, 3%, and 5% discount rates; 95th percentile at 3% discount rate), which each increase over time. In this table, we show the benefits associated with the average SC–GHGs at a 3% discount rate, but the Agency does not have a single central SC–GHG point estimate. We emphasize the importance and value of considering the benefits calculated using all four SC–GHG estimates and present them later in this preamble. As discussed in Chapter 3.3 of the DRIA, a consideration of climate benefits calculated using discount rates below 3 percent, including 2 percent and lower, is also warranted when discounting intergenerational impacts.

[c] The same discount rate used to discount the value of damages from future GHG emissions is used to calculate the present and annualized value of SC–GHGs for internal consistency, while all other costs and benefits are discounted at 3% in this table.

[d] Non-GHG impacts associated with the standards presented here do not include the full complement of health and environmental effects that, if quantified and monetized, would increase the total monetized benefits. Instead, the non-GHG benefits are based on benefit-per-ton values that reflect only human health impacts associated with reductions in $PM_{2.5}$ exposure.

TABLE 11—GHG ANALYSIS OF LIFETIME COSTS & BENEFITS TO MEET THE ALTERNATIVE 1 MYS 2023–2026 GHG STANDARDS, 7% DISCOUNT RATE

[For Vehicles Produced in MY 2023–2026] [a] [b] [c] [d]

[Billions of 2018$]

MY	Costs	Fuel savings	Benefits	Net benefits
Present values				
2023	$3.7	$2.4	$1.7	$0.4
2024	4.7	4.3	3.2	2.8
2025	5.1	4.9	3.8	3.6
2026	5.6	6.2	5	5.6
Sum	19	18	14	12
Annualized values				
2023	0.28	0.18	0.091	−0.0084
2024	0.35	0.32	0.17	0.14
2025	0.38	0.37	0.2	0.19
2026	0.42	0.47	0.26	0.31
Sum	1.4	1.3	0.72	0.63

Notes:

[a] The lifetime costs and benefits of each MY vehicle are discounted back to 2021.

[b] Climate benefits are based on reductions in CO_2, CH_4 and N_2O emissions and are calculated using four different estimates of the social cost of each greenhouse gas (SC–GHG model average at 2.5%, 3%, and 5% discount rates; 95th percentile at 3% discount rate), which each increase over time. In this table, we show the benefits associated with the average SC–GHGs at a 3% discount rate, but the Agency does not have a single central SC–GHG point estimate. We emphasize the importance and value of considering the benefits calculated using all four SC–GHG estimates and present them later in this preamble. As discussed in Chapter 3.3 of the DRIA, a consideration of climate benefits calculated using discount rates below 3 percent, including 2 percent and lower, is also warranted when discounting intergenerational impacts.

[c] The same discount rate used to discount the value of damages from future GHG emissions is used to calculate the present and annualized value of SC–GHGs for internal consistency, while all other costs and benefits are discounted at 7% in this table.

[d] Non-GHG impacts associated with the standards presented here do not include the full complement of health and environmental effects that, if quantified and monetized, would increase the total monetized benefits. Instead, the non-GHG benefits are based on benefit-per-ton values that reflect only human health impacts associated with reductions in $PM_{2.5}$ exposure.

EPA estimates that Alternative 2 would result in significant present value net benefits of $110 billion to $180 billion (annualized net benefits of $5.7 billion to $9.1 billion)—that is, the total benefits far exceed the total costs of the program. Table 12 below summarizes EPA's estimates of total discounted costs, fuel savings, and benefits for Alternative 2. The results presented here project the monetized environmental and economic impacts associated with the proposed standards during each calendar year through 2050. Alternative 2 also would have significant benefits for consumers, as the fuel savings for American drivers would total $150 billion to $290 billion through 2050. With these fuel savings, consumers would benefit from reduced operating costs over the vehicle lifetime.

The benefits include climate-related economic benefits from reducing emissions of GHGs that contribute to climate change, 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 rebound effect, and the value of reduced time needed to refuel a more fuel efficient vehicle. The analysis also includes estimates of economic impacts stemming from additional vehicle use, such as the economic damages caused by crashes, congestion, and noise (from increased rebound driving). See the DRIA for more information regarding these estimates.

TABLE 12—MONETIZED DISCOUNTED COSTS, BENEFITS, AND NET BENEFITS OF ALTERNATIVE 2 FOR CALENDAR YEARS THROUGH 2050

[Billions of 2018 dollars] [a b c d e]

	Present value		Annualized value	
	3% Discount rate	7% Discount rate	3% Discount rate	7% Discount rate
Costs	$290	$180	$15	$14
Fuel Savings	290	150	15	12
Benefits	170	140	8.8	8
Net Benefits	180	110	9.1	5.7

Notes:

[a] Values rounded to two significant figures; totals may not sum due to rounding. Present and annualized values are based on the stream of annual calendar year costs and benefits included in the analysis (2021–2050) and discounted back to year 2021.

[b] Climate benefits are based on reductions in CO_2, CH_4 and N_2O emissions and are calculated using four different estimates of the social cost of each greenhouse gas (SC–GHG model average at 2.5%, 3%, and 5% discount rates; 95th percentile at 3% discount rate), which each increase over time. In this table, we show the benefits associated with the average SC–GHGs at a 3% discount rate but the Agency does not have a single central SC–GHG point estimate. We emphasize the importance and value of considering the benefits calculated using all four SC–GHG estimates and present them later in this preamble. As discussed in Chapter 3.3 of the DRIA, a consideration of climate benefits calculated using discount rates below 3 percent, including 2 percent and lower, is also warranted when discounting intergenerational impacts.

[c] The same discount rate used to discount the value of damages from future GHG emissions (SC–GHGs at 5, 3, and 2.5 percent) is used to calculate the present and annualized values of climate benefits for internal consistency, while all other costs and benefits are discounted at either 3% or 7%.

[d] Net benefits reflect the fuel savings plus benefits minus costs.

[e] Non-GHG impacts associated with the standards presented here do not include the full complement of health and environmental effects that, if quantified and monetized, would increase the total monetized benefits. Instead, the non-GHG benefits are based on benefit-per-ton values that reflect only human health impacts associated with reductions in $PM_{2.5}$ exposure.

A second way to present the net benefits of the proposal is using a vehicle MY lifetime basis. Table 13 and Table 14 summarize EPA's estimates of total discounted costs, fuel savings, and benefits through the full lifetime of vehicles projected to be sold in MYs 2023–2026 under Alternative 2. The estimated results presented here project the monetized environmental and economic impacts associated with the proposed standards. Note that standards continue at their MY2026 levels beyond MY2026 in any scenario. At both a 3% and 7% discount rate all model years show substantial fuel savings and net benefits.

TABLE 13—GHG ANALYSIS OF LIFETIME COSTS & BENEFITS TO MEET THE ALTERNATIVE 2 MY 2023–2026 GHG STANDARDS, 3% DISCOUNT RATE

[For vehicles produced in MY 2023–2026] [a b c d]

[Billions of 2018$]

MY	Costs	Fuel savings	Benefits	Net benefits
Present values				
2023	$6.8	$7.7	$4.6	$5.5
2024	7.7	9.8	5.7	7.8
2025	8.4	11	6.5	9.1
2026	9.2	13	7.8	12
Sum	32	42	25	34
Annualized values				
2023	$0.3	$0.33	$0.2	$0.24
2024	0.33	0.42	0.25	0.34
2025	0.37	0.48	0.28	0.39
2026	0.4	0.57	0.34	0.51
Sum	1.4	1.8	1.1	1.5

Notes:

[a] The lifetime costs and benefits of each MY vehicle are discounted back to 2021.

[b] Climate benefits are based on reductions in CO_2, CH_4 and N_2O emissions and are calculated using four different estimates of the social cost of each greenhouse gas (SC–GHG model average at 2.5%, 3%, and 5% discount rates; 95th percentile at 3% discount rate), which each increase over time. In this table, we show the benefits associated with the average SC–GHGs at a 3% discount rate, but the Agency does not have a single central SC–GHG point estimate. We emphasize the importance and value of considering the benefits calculated using all four SC–GHG estimates and present them later in this preamble. As discussed in Chapter 3.3 of the DRIA, a consideration of climate benefits calculated using discount rates below 3 percent, including 2 percent and lower, is also warranted when discounting intergenerational impacts.

[c] The same discount rate used to discount the value of damages from future GHG emissions is used to calculate the present and annualized value of SC–GHGs for internal consistency, while all other costs and benefits are discounted at 3% in this table.

[d] Non-GHG impacts associated with the standards presented here do not include the full complement of health and environmental effects that, if quantified and monetized, would increase the total monetized benefits. Instead, the non-GHG benefits are based on benefit-per-ton values that reflect only human health impacts associated with reductions in $PM_{2.5}$ exposure.

TABLE 14—GHG ANALYSIS OF LIFETIME COSTS & BENEFITS TO MEET THE ALTERNATIVE 2 MY 2023–2026 GHG STANDARDS, 7% DISCOUNT RATE

[For vehicles produced in MY 2023–2026] [a] [b] [c] [d]

[Billions of 2018$]

MY	Costs	Fuel savings	Benefits	Net benefits
Present values				
2023	$6.3	$5.4	$4	$3.1
2024	7	6.5	5	4.4
2025	7.4	7.1	5.5	5.2
2026	7.9	8.2	6.6	6.9
Sum	29	27	21	20
Annualized Values				
2023	0.48	0.4	0.21	0.14
2024	0.53	0.49	0.26	0.22
2025	0.56	0.54	0.29	0.27
2026	0.59	0.61	0.34	0.37
Sum	2.2	2	1.1	1

Notes:

[a] The lifetime costs and benefits of each MY vehicle are discounted back to 2021.

[b] Climate benefits are based on reductions in CO_2, CH_4 and N_2O emissions and are calculated using four different estimates of the social cost of each greenhouse gas (SC–GHG model average at 2.5%, 3%, and 5% discount rates; 95th percentile at 3% discount rate), which each increase over time. In this table, we show the benefits associated with the average SC–GHGs at a 3% discount rate, but the Agency does not have a single central SC–GHG point estimate. We emphasize the importance and value of considering the benefits calculated using all four SC–GHG estimates and present them later in this preamble. As discussed in Chapter 3.3 of the DRIA, a consideration of climate benefits calculated using discount rates below 3 percent, including 2 percent and lower, is also warranted when discounting intergenerational impacts.

[c] The same discount rate used to discount the value of damages from future GHG emissions is used to calculate the present and annualized value of SC–GHGs for internal consistency, while all other costs and benefits are discounted at 7% in this table.

[d] Non-GHG impacts associated with the standards presented here do not include the full complement of health and environmental effects that, if quantified and monetized, would increase the total monetized benefits. Instead, the non-GHG benefits are based on benefit-per-ton values that reflect only human health impacts associated with reductions in $PM_{2.5}$ exposure.

3. Summary of the Proposal's Costs and Benefits Compared to the Alternatives

Here we present the proposal's costs and benefits (as summarized previously in Section I.D) alongside the costs and benefits of the alternatives (as summarized previously in Section I.G.2).

Table 15 below summarizes EPA's estimates of present value total discounted costs, fuel savings, and benefits. Table 16 below summarizes EPA's estimates of annualized values of the total discounted costs, fuel savings, and benefits. The results presented in these tables project the monetized environmental and economic impacts associated with the proposed standards during each calendar year through 2050. The benefits include climate-related economic benefits from reducing emissions of GHGs that contribute to climate change, 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 rebound effect, and the value of reduced refueling time needed to fill a more fuel efficient vehicle. The analysis also includes estimates of economic impacts stemming from additional vehicle use, such as the economic damages caused by crashes, congestion, and noise (from increased rebound driving). See the DRIA for more information regarding these estimates.

TABLE 15—PRESENT VALUE MONETIZED DISCOUNTED COSTS, BENEFITS, AND NET BENEFITS OF THE PROPOSED PROGRAM AND ALTERNATIVES FOR CALENDAR YEARS THROUGH 2050

[Billions of 2018 dollars] [a] [b] [c] [d] [e]

	3% Discount rate			7% Discount rate		
	Proposal	Alternative 1	Alternative 2	Proposal	Alternative 1	Alternative 2
Costs	$240	$190	$290	$150	$110	$180
Fuel Savings	250	200	290	120	98	150
Benefits	130	120	170	110	93	140
Net Benefits	140	130	180	86	76	110

Notes:

[a] Values rounded to two significant figures; totals may not sum due to rounding. Present and annualized values are based on the stream of annual calendar year costs and benefits included in the analysis (2021–2050) and discounted back to year 2021.

[b] Climate benefits are based on reductions in CO_2, CH_4 and N_2O emissions and are calculated using four different estimates of the social cost of each greenhouse gas (SC–GHG model average at 2.5%, 3%, and 5% discount rates; 95th percentile at 3% discount rate), which each increase over time. In this table, we show the benefits associated with the average SC–GHGs at a 3% discount rate but the Agency does not have a single central SC–GHG point estimate. We emphasize the importance and value of considering the benefits calculated using all four SC–GHG estimates and present them later in this preamble. As discussed in Chapter 3.3 of the DRIA, a consideration of climate benefits calculated using discount rates below 3 percent, including 2 percent and lower, is also warranted when discounting intergenerational impacts.

[c] The same discount rate used to discount the value of damages from future GHG emissions (SC–GHGs at 5, 3, and 2.5 percent) is used to calculate the present and annualized values of climate benefits for internal consistency, while all other costs and benefits are discounted at either 3% or 7%.

[d] Net benefits reflect the fuel savings plus benefits minus costs.

[e] Non-GHG impacts associated with the standards presented here do not include the full complement of health and environmental effects that, if quantified and monetized, would increase the total monetized benefits. Instead, the non-GHG benefits are based on benefit-per-ton values that reflect only human health impacts associated with reductions in $PM_{2.5}$ exposure.

TABLE 16—ANNUALIZED MONETIZED DISCOUNTED COSTS, BENEFITS, AND NET BENEFITS OF THE PROPOSED PROGRAM AND ALTERNATIVES FOR CALENDAR YEARS THROUGH 2050

[Billions of 2018 dollars] [a][b][c][d][e]

	3% Discount rate			7% Discount rate		
	Proposal	Alternative 1	Alternative 2	Proposal	Alternative 1	Alternative 2
Costs	$12	$9.5	$15	$12	$9.2	$14
Fuel Savings	13	10	15	9.9	7.9	12
Benefits	6.9	6	8.8	6.3	5.4	8
Net Benefits	7.3	6.6	9.1	4.2	4.1	5.7

Notes:

[a] Values rounded to two significant figures; totals may not sum due to rounding. Present and annualized values are based on the stream of annual calendar year costs and benefits included in the analysis (2021–2050) and discounted back to year 2021.

[b] Climate benefits are based on reductions in CO_2, CH_4 and N_2O emissions and are calculated using four different estimates of the social cost of each greenhouse gas (SC–GHG model average at 2.5%, 3%, and 5% discount rates; 95th percentile at 3% discount rate), which each increase over time. In this table, we show the benefits associated with the average SC–GHGs at a 3% discount rate but the Agency does not have a single central SC–GHG point estimate. We emphasize the importance and value of considering the benefits calculated using all four SC–GHG estimates and present them later in this preamble. As discussed in Chapter 3.3 of the DRIA, a consideration of climate benefits calculated using discount rates below 3 percent, including 2 percent and lower, is also warranted when discounting intergenerational impacts.

[c] The same discount rate used to discount the value of damages from future GHG emissions (SC–GHGs at 5, 3, and 2.5 percent) is used to calculate the present and annualized values of climate benefits for internal consistency, while all other costs and benefits are discounted at either 3% or 7%.

[d] Net benefits reflect the fuel savings plus benefits minus costs.

[e] Non-GHG impacts associated with the standards presented here do not include the full complement of health and environmental effects that, if quantified and monetized, would increase the total monetized benefits. Instead, the non-GHG benefits are based on benefit-per-ton values that reflect only human health impacts associated with reductions in $PM_{2.5}$ exposure.

A second way to present the net benefits is using a vehicle MY lifetime basis. Table 17 and Table 18 summarize EPA's estimates of total discounted costs, fuel savings, and benefits through the full lifetime of vehicles projected to be sold in MYs 2023–2026. The estimated results presented here project the monetized environmental and economic impacts associated with the proposed standards. Note that standards continue at their MY2026 levels beyond MY2026 in any scenario. At both a 3% and 7% discount rate all model years show substantial fuel savings and net benefits.

TABLE 17—PRESENT VALUE GHG ANALYSIS OF LIFETIME COSTS & BENEFITS FOR MY 2023–2026 GHG STANDARDS UNDER THE PROPOSAL AND ALTERNATIVES

[For vehicles produced in MY 2023–2026] [a][b][c][d]

[Billions of 2018$]

MY	3% Discount rate				7% Discount rate			
	Costs	Fuel savings	Benefits	Net benefits	Costs	Fuel savings	Benefits	Net benefits
Proposal								
2023	$4.8	$3.6	$1.9	$0.68	$4.4	$2.6	$1.7	−$0.14
2024	5.9	7	3.6	4.7	5.5	4.7	3.3	2.4
2025	6.7	8.6	4.4	6.2	6.1	5.5	3.9	3.4
2026	8.1	13	7.2	12	7.3	8.2	6.2	7.2
Sum	26	33	17	24	23	21	15	13
Alternative 1								
2023	$3.9	$3.4	$2	$1.5	$3.7	$2.4	$1.7	$0.4
2024	4.9	6.5	3.7	5.3	4.7	4.3	3.2	2.8
2025	5.6	7.7	4.5	6.5	5.1	4.9	3.8	3.6
2026	6.4	10	6	9.7	5.6	6.2	5	5.6
Sum	21	28	16	23	19	18	14	12
Alternative 2								
2023	$6.8	$7.7	$4.6	$5.5	$6.3	$5.4	$4	$3.1

TABLE 17—PRESENT VALUE GHG ANALYSIS OF LIFETIME COSTS & BENEFITS FOR MY 2023–2026 GHG STANDARDS UNDER THE PROPOSAL AND ALTERNATIVES—Continued

[For vehicles produced in MY 2023–2026] [a b c d]
[Billions of 2018$]

MY	3% Discount rate				7% Discount rate			
	Costs	Fuel savings	Benefits	Net benefits	Costs	Fuel savings	Benefits	Net benefits
2024	7.7	9.8	5.7	7.8	7	6.5	5	4.4
2025	8.4	11	6.5	9.1	7.4	7.1	5.5	5.2
2026	9.2	13	7.8	12	7.9	8.2	6.6	6.9
Sum	32	42	25	34	29	27	21	20

Notes:

[a] The lifetime costs and benefits of each MY vehicle are discounted back to 2021.

[b] Climate benefits are based on reductions in CO_2, CH_4 and N_2O emissions and are calculated using four different estimates of the social cost of each greenhouse gas (SC–GHG model average at 2.5%, 3%, and 5% discount rates; 95th percentile at 3% discount rate), which each increase over time. In this table, we show the benefits associated with the average SC–GHGs at a 3% discount rate, but the Agency does not have a single central SC–GHG point estimate. We emphasize the importance and value of considering the benefits calculated using all four SC–GHG estimates and present them later in this preamble. As discussed in Chapter 3.3 of the DRIA, a consideration of climate benefits calculated using discount rates below 3 percent, including 2 percent and lower, is also warranted when discounting intergenerational impacts.

[c] The same discount rate used to discount the value of damages from future GHG emissions is used to calculate the present and annualized value of SC–GHGs for internal consistency, while all other costs and benefits are discounted at 3% in this table.

[d] Non-GHG impacts associated with the standards presented here do not include the full complement of health and environmental effects that, if quantified and monetized, would increase the total monetized benefits. Instead, the non-GHG benefits are based on benefit-per-ton values that reflect only human health impacts associated with reductions in $PM_{2.5}$ exposure.

TABLE 18—ANNUALIZED GHG ANALYSIS OF LIFETIME COSTS & BENEFITS FOR MY 2023–2026 GHG STANDARDS UNDER THE PROPOSAL AND ALTERNATIVES

[For vehicles produced in MY 2023–2026] [a b c d]
[Billions of 2018$]

MY	3% Discount rate				7% Discount rate			
	Costs	Fuel savings	Benefits	Net benefits	Costs	Fuel savings	Benefits	Net benefits
Proposal								
2023	$0.21	$0.16	$0.08	$0.029	$0.33	$0.19	$0.085	−$0.053
2024	0.26	0.3	0.16	0.2	0.41	0.35	0.16	0.1
2025	0.29	0.37	0.19	0.27	0.45	0.41	0.19	0.15
2026	0.35	0.58	0.31	0.54	0.55	0.62	0.31	0.38
Sum	1.1	1.4	0.74	1	1.7	1.6	0.75	0.58
Alternative 1								
2023	$0.17	$0.15	$0.085	$0.067	$0.28	$0.18	$0.091	−$0.0084
2024	0.21	0.28	0.16	0.23	0.35	0.32	0.17	0.14
2025	0.24	0.33	0.19	0.28	0.38	0.37	0.2	0.19
2026	0.28	0.44	0.26	0.42	0.42	0.47	0.26	0.31
Sum	0.9	1.2	0.7	1	1.4	1.3	0.72	0.63
Alternative 2								
2023	$0.3	$0.33	$0.2	$0.24	$0.48	$0.4	$0.21	$0.14
2024	0.33	0.42	0.25	0.34	0.53	0.49	0.26	0.22
2025	0.37	0.48	0.28	0.39	0.56	0.54	0.29	0.27
2026	0.4	0.57	0.34	0.51	0.59	0.61	0.34	0.37
Sum	1.4	1.8	1.1	1.5	2.2	2	1.1	1

Notes:

[a] The lifetime costs and benefits of each MY vehicle are discounted back to 2021.

[b] Climate benefits are based on reductions in CO_2, CH_4 and N_2O emissions and are calculated using four different estimates of the social cost of each greenhouse gas (SC–GHG model average at 2.5%, 3%, and 5% discount rates; 95th percentile at 3% discount rate), which each increase over time. For the presentational purposes of this table, we show the benefits associated with the average SC–GHGs at a 3% discount rate, but the Agency does not have a single central SC–GHG point estimate. We emphasize the importance and value of considering the benefits calculated using all four SC–GHG estimates and present them later in this preamble. As discussed in Chapter 3.3 of the RIA, a consideration of climate benefits calculated using discount rates below 3 percent, including 2 percent and lower, are also warranted when discounting intergenerational impacts.

[c] The same discount rate used to discount the value of damages from future GHG emissions is used to calculate the present and annualized value of SC–GHGs for internal consistency, while all other costs and benefits are discounted at 3% in this table.

[d] Non-GHG impacts associated with the standards presented here do not include the full complement of health and environmental effects that, if quantified and monetized, would increase the total monetized benefits. Instead, the non-GHG benefits are based on benefit-per-ton values that reflect only human health impacts associated with reductions in $PM_{2.5}$ exposure.

II. EPA Proposal for MY 2023–2026 Light-Duty Vehicle GHG Standards

A. Proposed Model Year 2023–2026 GHG Standards for Light-Duty Vehicles, Light-Duty Trucks, and Medium Duty Passenger Vehicles

As noted, the transportation sector is the largest U.S. source of GHG emissions, making up 29 percent of all emissions.[42] Within the transportation sector, light-duty vehicles are the largest contributor, 58 percent, to transportation GHG emissions in the U.S.[43] EPA has concluded that more stringent standards are appropriate in light of our reassessment of the need to reduce GHG emissions, technological feasibility, costs, lead time, and other factors. The program that EPA is proposing through MY 2026 in this notice does not represent the level of GHG reductions that will ultimately be achievable and appropriate for the light-duty sector, but it does serve as an important stepping off point for a longer-term program beyond 2026. The following section provides the details of EPA's proposed standards and related provisions, followed by a discussion of the alternatives EPA considered. EPA requests comments on all of the proposed provisions and alternatives.

EPA is proposing revised, more stringent standards to control the emissions of greenhouse gases (GHGs) from MY 2023 and later light-duty vehicles.[44] Carbon dioxide (CO_2) is the primary greenhouse gas resulting from the combustion of vehicular fuels. The standards regulate CO_2 on a gram per mile (g/mile) basis, which EPA defines by separate footprint curves for a manufacturer's car and truck fleets.[45] Based on complying with these proposed standards, the industry-wide average emissions target for new light-duty vehicles is projected to be 171 g/mile of CO_2 in MY 2026.[46] Also, as discussed in Section II.C below, EPA is requesting comment on standards for MY 2026 that are in the range of 5–10 g/mile lower (*i.e.,* more stringent) than the levels proposed, resulting in fleet average target levels that are in the range of 166–161 g/mile. EPA is not proposing to change existing averaging, banking, and trading program elements, except for a proposed limited extension of credit carry-forward for one or two years for credits generated in MYs 2016–2020, as discussed in Section II.B.4. The proposed standards would apply to passenger cars, light-duty trucks, and medium-duty passenger vehicles (MDPVs).[47] As an overall group, they are referred to in this preamble as light-duty vehicles or simply as vehicles. In this preamble, passenger cars may be referred to simply as ''cars,'' and light-duty trucks and MDPVs as ''light trucks'' or ''trucks.''

As discussed in section II.B, EPA is proposing several revised provisions that would allow manufacturers to generate credits or that provide additional incentives for use of advanced emission reduction technologies. These include ''off-cycle'' credits for technologies that reduce CO_2 emissions during off-cycle operation that are not reasonably accounted for by the 2-cycle tests used for compliance purposes. EPA is proposing to increase the existing credit cap for menu-based credits from 10 g/mile to 15 g/mile and is proposing a number of program revisions and clarifications to address issues that have been identified as EPA has implemented the program. In addition, EPA is proposing to extend multiplier incentives for EVs, PHEVs, and FCVs, with a cumulative cap on credits. Multiplier incentives allow these low-emitting vehicles to count as more than one vehicle in a manufacturer's compliance calculation. EPA is proposing to eliminate multiplier incentives for natural gas vehicles adopted in the SAFE rule after MY 2022. EPA is also proposing to reinstate full size pick-up truck incentives through MY 2025 for vehicles that meet efficiency performance criteria or include strong hybrid technology at a minimum level of production volumes. The SAFE rule removed the full-size pickup incentives for MYs 2022–2025.

The current program includes several program elements that will remain in place, without change. EPA is not proposing to change the fundamental structure of the standards, which are based on the footprint attribute with separate footprint curves for cars and trucks. EPA is not proposing to change the existing CH_4 and N_2O emissions standards. EPA is not proposing changes to the program structure in terms of vehicle certification, compliance, and enforcement. These aspects of the program continue to function as intended and EPA does not currently believe changes are needed. EPA is continuing to use tailpipe-only values to determine vehicle GHG emissions, without accounting for upstream emissions (EVs and PHEVs will continue to use 0 g/mile through MY 2026). EPA is also not proposing changes to current program opportunities to earn credits toward the fleet-wide average CO_2 standards for improvements to air conditioning systems. The current A/C credits program provides credits for improvements to address both hydrofluorocarbon (HFC) refrigerant direct losses (*i.e.,* system ''leakage'') and indirect CO_2 emissions related to the increased load on the engine (also referred to as ''A/C efficiency'' related emissions).

1. What fleet-wide emissions levels correspond to the CO_2 standards?

EPA is proposing revised more stringent standards for MYs 2023–2026 that are projected to result in an industry-wide average target for the light-duty fleet of 171 g/mile of CO_2 in MY 2026. The proposed standards are designed to reach the same level of stringency as the California Framework emission reduction targets in MY 2023, and then ramp down in a linear fashion with year over year average stringency increases of 4.7–5.0 percent. For MY 2026, the proposal goes beyond the 2012 rule level of stringency for MY 2025, by about 3 percent more stringent, making the proposed MY 2026 standard the most stringent vehicle GHG standard that EPA has proposed to date. EPA believes that is possible and worthwhile to make additional progress in MY 2026 by surpassing the level of stringency of the original MY 2025 standards established nine years ago in the 2012 rule. EPA is proposing an ambitious and reasonable approach that would take the initial steps towards making needed

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[42] *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2019* (EPA–430–R–21–005, published April 2021).

[43] *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2019* (EPA–430–R–21–005, published April 2021).

[44] See Sections III and VI for a discussion of lead time.

[45] Footprint curves are graphical representations of the algebraic formulae defining the emission standards in the regulatory text.

[46] The reference to CO_2 here refers to CO_2 equivalent reductions, as this level includes some reductions in emissions of greenhouse gases other than CO_2, from refrigerant leakage, as one part of the A/C related reductions.

[47] As with the previous GHG emissions standards, EPA will continue to use the same vehicle category definitions as in the CAFE program. MDPVs are grouped with light trucks for fleet average compliance determinations.

reductions in GHG emissions. EPA does not propose any change to the approach of having separate standards for cars and light trucks under existing program definitions.

The industry fleet average and car/truck year-over-year percent reductions for the proposed standards compared to the existing SAFE rule standards are provided in Table 19 below. For passenger cars, the proposed footprint curves call for reducing CO_2 by 8.3 percent in MY 2023 followed by year over year reductions of 4.7 to 5.1 percent from the MY 2023 passenger car standard through MY 2026. For light-duty trucks, the proposed footprint curves standards would require reducing CO_2 by 10.8 percent in MY 2023 followed by year over year reductions of 4.7 to 5.2 percent on average from the MY 2023 light-duty truck standard through MY 2026.

TABLE 19—PROJECTED INDUSTRY FLEET AVERAGE TARGET YEAR-OVER-YEAR PERCENT REDUCTIONS

	SAFE rule			Proposal		
	Cars (%)	Trucks (%)	Combined (%)	Cars (%)	Trucks (%)	Combined (%)
2023	1.7	1.5	1.6	8.3	10.8	9.8
2024	1.1	1.2	1.2	4.8	4.7	4.7
2025	2.3	2.0	2.2	5.1	5.0	4.9
2026	1.8	1.6	1.7	*4.7	*5.2	*5.0

*The percentages shown do not include EPA's request for comments on MY 2026 standards that are 5–10 g/mile more stringent than proposed.

For light-trucks, EPA is proposing to change the upper right cutpoints of the CO_2-footprint curves (*i.e.*, the footprint sizes in sq. ft. at which the CO_2 standards level off as flat CO_2 target values for larger vehicle footprints. See Figure 5 below). The SAFE rule altered these cutpoints and EPA is now proposing to restore them to the original upper right cutpoints initially established in the 2012 rule, for MYs 2023–2026, essentially requiring increasingly more stringent CO_2 targets at the higher footprint range up to the revised cutpoint levels. The shapes of the curves and the cutpoints are discussed in Section II.A.2.

The 171 g/mile estimated industry-wide target for MY 2026 noted above is based on EPA's current fleet mix projections for MY 2026 (approximately 50 percent cars and 50 percent trucks, with only slight variations from MY 2023–2026). As discussed below, the final fleet average standards for each manufacturer ultimately will depend on each manufacturer's actual rather than projected production in each MY from MY 2023 to MY 2026 under the sales-weighted footprint-based standard curves for the car and truck regulatory classes. In the 2012 rule, EPA estimated that the fleet average target would be 163 g/mile in MY 2025 based on the projected fleet mix for MY 2025 (67 percent car and 33 percent trucks) based on information available at the time of the 2012 rulemaking. Primarily due to the historical and ongoing shift in fleet mix that included more crossover and small and mid-size SUVs and fewer passenger cars, EPA's projection in the Midterm Evaluation (MTE) January 2017 Final Determination for the original MY 2025 fleet average target level increased to 173 g/mile.[48] EPA has again updated its fleet mix projections and now projects that the original 2012 rule MY 2025 footprint curves standards would result in an industry-wide fleet average target level of 177 g/mile. The projected fleet average targets under the 2012 rule, using the updated fleet mix projections and the projected fleet average targets for the proposal are provided in Table 20 below. Figure 3 below, based on the values in Table 20, shows the proposed standards target levels along with estimated targets for the 2012 rule, SAFE rule, and California Framework for comparison.[49]

TABLE 20—FLEET AVERAGE TARGET PROJECTIONS FOR THE PROPOSED STANDARDS COMPARED TO UPDATED FLEET AVERAGE TARGET PROJECTIONS FOR THE 2012 RULE, SAFE RULE AND CALIFORNIA FRAMEWORK

[CO_2 grams/mile]

MY	Proposal projected targets	2012 Rule projected targets (updated)	SAFE rule projected targets (updated)	California framework projected targets
2021	*223	214	223	214
2022	*220	205	220	206
2023	199	195	216	199
2024	189	186	214	191
2025	180	177	209	184

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[48] "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.

[49] For comparison purposes, the California Framework estimates are based on a scenario in which all manufacturers meet the California Framework in MYs 2021–2026 (not only the manufacturers that agreed to the California Framework).

TABLE 20—FLEET AVERAGE TARGET PROJECTIONS FOR THE PROPOSED STANDARDS COMPARED TO UPDATED FLEET AVERAGE TARGET PROJECTIONS FOR THE 2012 RULE, SAFE RULE AND CALIFORNIA FRAMEWORK—Continued

[CO_2 grams/mile]

MY	Proposal projected targets	2012 Rule projected targets (updated)	SAFE rule projected targets (updated)	California framework projected targets
2026	* 171	177	205	177

* Projected targets under the SAFE rule standards.

** EPA is also requesting comment on MY 2026 standards that would result in fleet average levels that are 5–10 g/mile more stringent than the level shown.

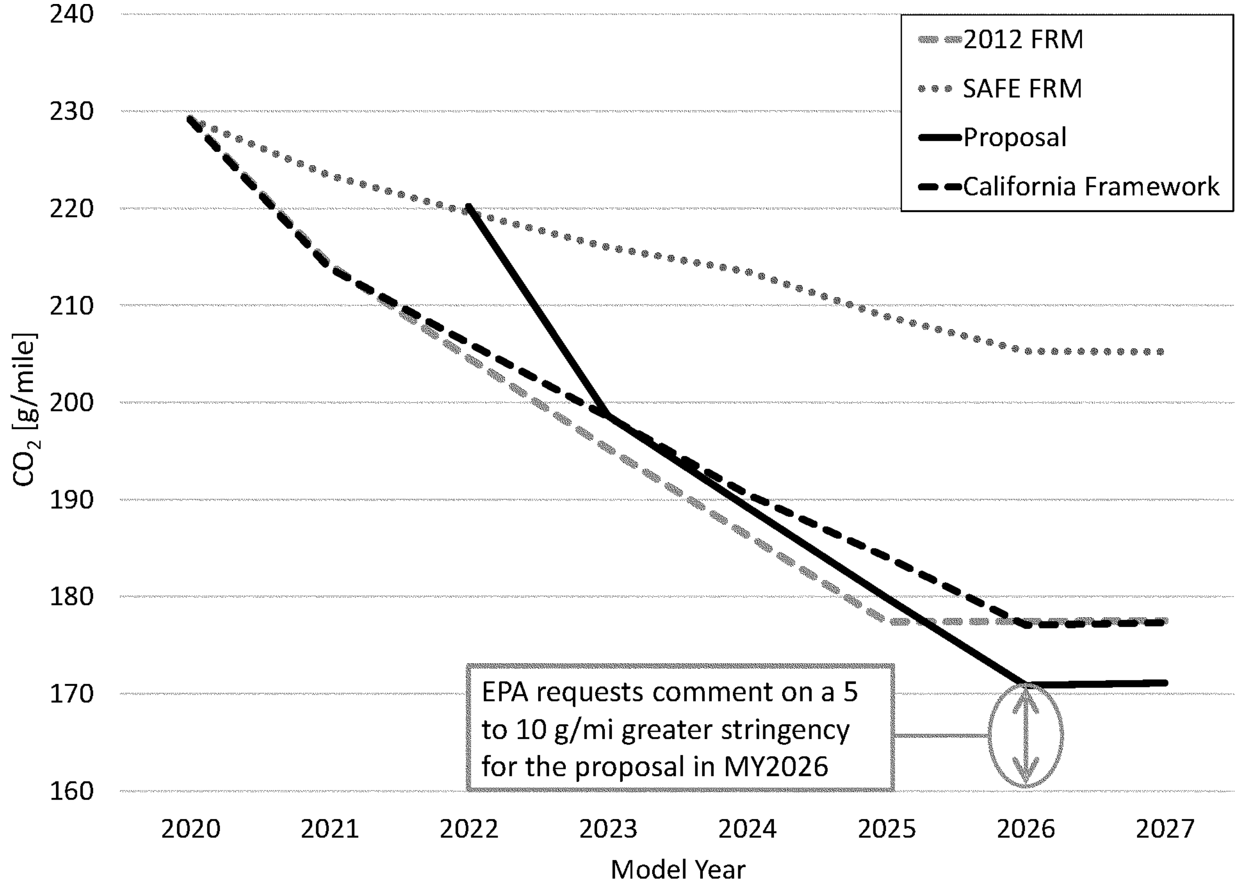

Figure 3 Proposed CO_2 Standard Target Levels Compared to Other Programs

EPA's standards are based in part on EPA's projection of average industry wide CO_2-equivalent emission reductions from A/C improvements, where the footprint curves are made numerically more stringent by an amount equivalent to this projection of A/C refrigerant leakage credits.[50] Including this projection of A/C credits for purposes of setting GHG standards levels is consistent with the 2012 rule and the SAFE rule.

Table 21 below shows overall fleet average target levels for both cars and light trucks that are projected over the implementation period of the proposed standards. A more detailed manufacturer by manufacturer break down of the projected target and achieved levels is provided in Section III.B.1 below. The actual fleet-wide average g/mile level that would be achieved in any year for cars and trucks will depend on the actual production of vehicles for that year, as well as the use of the various credit and averaging, banking, and trading provisions. For example, in any year, manufacturers would be able to generate credits from cars and use them for compliance with the truck standard, or vice versa. In Section V, EPA discusses the year-by-year estimate of emissions reductions that are projected to be achieved by the proposed standards.

In general, the schedule of the proposed standards allows an incremental phase-in to the MY 2026 level and reflects consideration of the appropriate lead time for manufacturers to take actions necessary to meet the

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[50] The total A/C adjustment is 18.8 g/mile for cars and 24.4 g/mile for trucks.

proposed standards.[51] The technical feasibility of the standards is discussed in Section III below and in the DRIA. Note that MY 2026 is the final MY in which the proposed standards become more stringent. The MY 2026 CO_2 standards would remain in place for later MYs, unless and until revised by EPA in a future rulemaking for those MYs.

EPA has estimated the overall fleet-wide CO_2 emission levels that correspond with the attribute-based footprint standards, based on projections of the composition of each manufacturer's fleet in each year of the program. As noted above, EPA estimates that, on a combined fleet-wide national basis, the 2026 MY standards would result in a level of 171 g/mile CO_2. The derivation of the 171 g/mile estimate is described in Section III.A. EPA aggregated the estimates for individual manufacturers based on projected production volumes into the fleet-wide averages for cars, trucks, and the entire fleet, shown in Table 21.[52] As discussed above, the combined fleet estimates are based on projected fleet mix of cars and trucks that varies over the MY 2023–2026 timeframe. This fleet mix distribution can also be found in Section III.A.

TABLE 21—ESTIMATED FLEET-WIDE CO_2 TARGET LEVELS CORRESPONDING TO THE PROPOSED STANDARDS

Model year	Cars CO_2 (g/mile)	Trucks CO_2 (g/mile)	Fleet CO_2 (g/mile)
2023	165	232	199
2024	157	221	189
2025	149	210	180
2026 and later *	142	199	171

** EPA is also requesting comment on MY 2026 standards that would result in fleet average levels that are 5–10 g/mile more stringent than the levels shown.

As shown in Table 21, fleet-wide CO_2 emission target levels for cars under the proposed standards are projected to decrease from 165 to 142 g/mile between MY 2023 and MY 2026. Similarly, fleet-wide CO_2 target levels for trucks are projected to decrease from 232 to 199 g/mile. These numbers do not reflect the effects of flexibilities and credits in the program.[53] The estimated fleetwide achieved values can be found in Section V.

As noted above, EPA is proposing standards that set increasingly stringent levels of CO_2 control from MY 2023 though MY 2026. Applying the CO_2 footprint curves applicable in each MY to the vehicles (and their footprint distributions) expected to be sold in each MY produces progressively more stringent estimates of fleet-wide CO_2 emission standards. EPA believes manufacturers can achieve the proposed standards' important CO_2 emissions reductions through the application of available control technology at reasonable cost, as well as the use of program flexibilities.

The existing program includes several provisions that we are not proposing to change and so would continue during the implementation timeframe of this proposed rule. Consistent with the requirement of CAA section 202(a)(1) that standards be applicable to vehicles ''for their useful life,'' the proposed MY 2023–2026 vehicle standards will apply for the useful life of the vehicle.[54] Also, EPA is not proposing any changes to the test procedures over which emissions are measured and weighted to determine compliance with the GHG standards. These procedures are the Federal Test Procedure (FTP or ''city'' test) and the Highway Fuel Economy Test (HFET or ''highway'' test). While EPA may consider requiring the use of test procedures other than the 2-cycle test procedures in a future rulemaking, EPA is not considering any test procedure changes in this rulemaking.

EPA has analyzed the feasibility of achieving the proposed CO_2 standards through the application of currently available technologies, based on projections of the technology and technology penetration rates to reduce emissions of CO_2, during the normal redesign process for cars and trucks, taking into account the effectiveness and cost of the technology. The results of the analysis are discussed in detail in Section III below and in the DRIA. EPA also presents the overall estimated costs and benefits of the proposed car and truck CO_2 standards in Section VII.I.

2. What are the proposed CO_2 attribute-based standards?

As with the existing GHG standards, EPA is proposing separate car and truck standards—that is, vehicles defined as cars would have one set of footprint-based curves, and vehicles defined as trucks would have a different set.[55] In general, for a given footprint, the CO_2 g/mile target[56] for trucks is higher than the target for a car with the same footprint. The curves are described mathematically in EPA's regulations by a family of piecewise linear functions (with respect to vehicle footprint) that gradually and continually ramp down from the MY 2022 curves established in the SAFE rule. EPA's proposed minimum and maximum footprint targets and the corresponding cutpoints are provided below in Table 22 for MYs 2023–2026 along with the slope and intercept defining the linear function for footprints falling between the minimum and maximum footprint values. For footprints falling between the minimum and maximum, the targets are calculated as follows: Slope × Footprint + Intercept = Target. Figure 4 and Figure 5 provide the existing MY 2021–2022 and proposed MY 2023–2026 footprint curves graphically for both car and light trucks, respectively.

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[51] As discussed in Section III, EPA has used the Corporate Average Fuel Economy (CAFE) Compliance and Effects Modeling System (CCEMS) to support the technical assessment. Among the ways EPA has considered lead time in the proposal is by using the constraints built into the CCEMS model which are designed to represent lead-time constraints, including the use of redesign and refresh cycles. See CCEMS Model Documentation on web page *https://www.nhtsa.gov/corporate-average-fuel-economy/compliance-and-effects-modeling-system* and contained in the docket for this rule.

[52] Due to rounding during calculations, the estimated fleet-wide CO_2 target levels may vary by plus or minus 1 gram.

[53] Nor do they reflect flexibilities under the ABT program.

[54] The GHG emission standards apply for a useful life of 10 years or 120,000 miles for LDVs and LLDTs and 11 years or 120,000 miles for HLDTs and MDPVs. See 40 CFR 86.1805–17.

[55] See 49 CFR part 523. Generally, passenger cars include cars and smaller cross-overs and SUVs, while the truck category includes larger cross-overs and SUVs, minivans, and pickup trucks.

[56] Because compliance is based on a sales-weighting of the full range of vehicles in a manufacturer's car and truck fleets, the foot-print based CO_2 emission levels of specific vehicles within the fleet are referred to as targets, rather than standards.

TABLE 22—PROPOSED FOOTPRINT-BASED CO_2 STANDARD CURVE COEFFICIENTS

	Car				Truck			
	2023	2024	2025	2026	2023	2024	2025	2026
MIN CO_2 (g/mi)	145.6	138.6	131.9	125.6	181.1	172.1	163.5	155.4
MAX CO_2 (g/mi)	199.1	189.5	180.3	171.6	312.1	296.5	281.8	267.8
Slope (g/mi/ft^2)	3.56	3.39	3.23	3.07	3.97	3.77	3.58	3.41
Intercept (g/mi)	−0.4	−0.4	−0.3	−0.3	18.4	17.4	16.6	15.8
MIN footprint (ft^2)	41	41	41	41	41	41	41	41
MAX footprint (ft^2)	56	56	56	56	74	74	74	74

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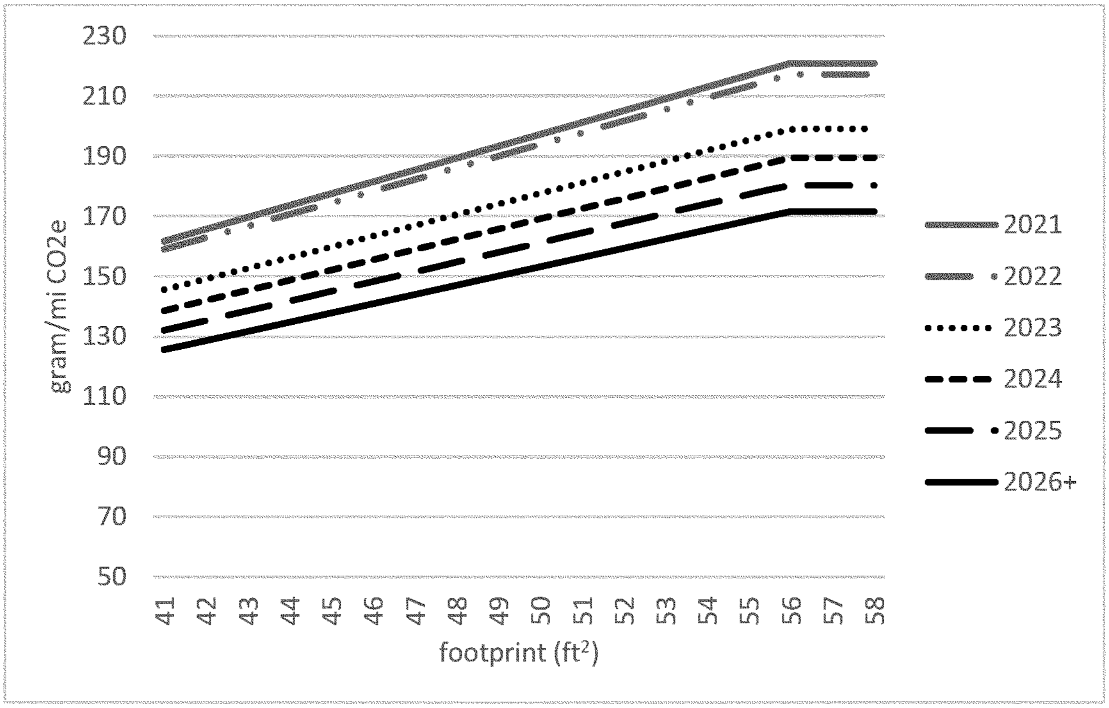

Figure 4 **Car Curves**

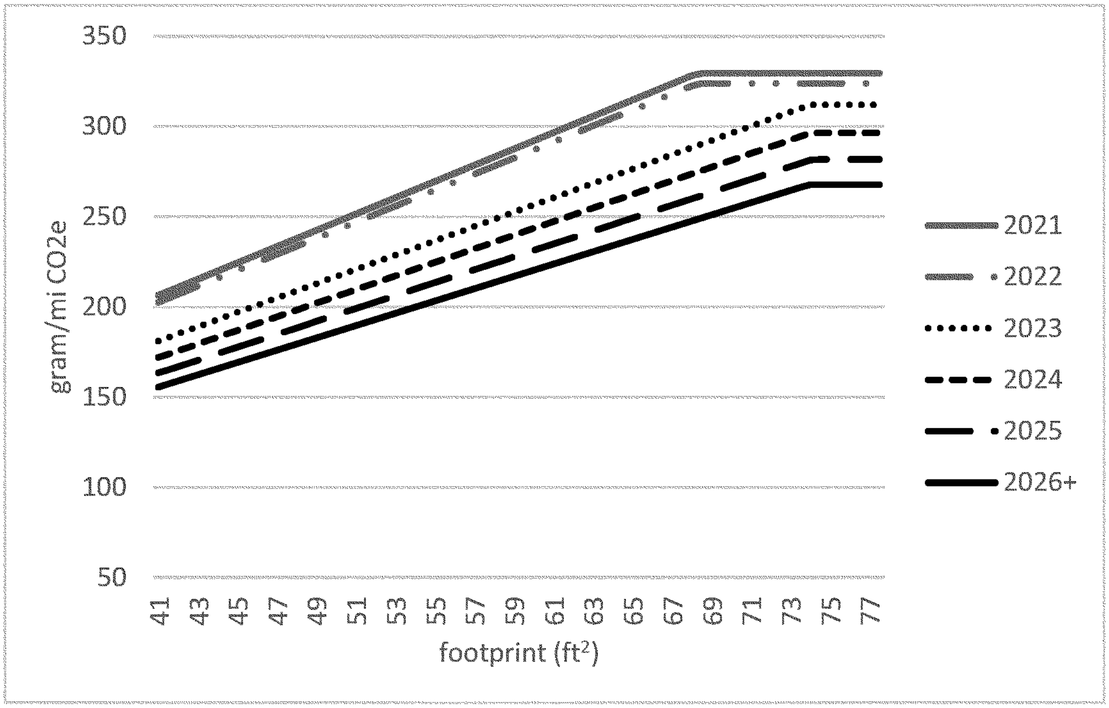

Figure 5 Truck Curves

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The shapes of the proposed MY 2023–2026 car curves are similar to the MY 2022 curve. By contrast, the proposed MY 2023–2026 truck curves return to the cutpoint of 74.0 sq ft originally established in the 2012 rule, but changed in the SAFE rule.[57] The gap between the 2022 curves and the 2023 curves is indicative of the design of the proposed standards as described earlier, where the gap between the MY 2022 and MY 2023 curves is roughly double the gap between the curves for MYs 2024–2026.

3. EPA's Statutory Authority Under the CAA

i. Standards-Setting Authority Under CAA Section 202(a)

Title II of the Clean Air Act (CAA) provides for comprehensive regulation of mobile sources, authorizing EPA to regulate emissions of air pollutants from all mobile source categories. Pursuant to these sweeping grants of authority, when setting GHG standards for light-duty vehicles, EPA considers such issues as technology effectiveness, technology cost (per vehicle, per manufacturer, and per consumer), the lead time necessary to implement the technology, and—based on these considerations—the feasibility and practicability of potential standards; as weel as the impacts of potential standards on emissions reductions of both GHGs and non-GHGs; the impacts of standards on oil conservation and energy security; the impacts of standards on fuel savings by consumers; the impacts of standards on the auto industry; other energy impacts; and other relevant factors such as impacts on safety.

Pursuant to Title II of the Clean Air Act, EPA has taken a comprehensive, integrated approach to mobile source emission control that has produced benefits well in excess of the costs of regulation. In developing the Title II program, the Agency's historic, initial focus was on personal vehicles since that category represented the largest source of mobile source emissions.

Title II emission standards have stimulated the development of a broad set of advanced automotive technologies, such as on-board computers and fuel injection systems, which have been the building blocks of automotive designs and have yielded not only lower pollutant emissions, but improved vehicle performance, reliability, and durability. In response to EPA's adoption of Title II emission standards for GHGs from light-duty vehicles in 2010 and later, manufacturers have continued to significantly ramp up their development and application of a wide range of new and improved technologies, including more fuel-efficient engine designs, transmissions, aerodynamics, and tires, air conditioning systems that contribute to lower GHG emissions, and various levels of electrified vehicle technologies.

This proposed rule implements a specific provision from Title II, section 202(a). Section 202(a)(1) of the CAA, 42 U.S.C. 7521(a)(1), states that "the Administrator shall by regulation prescribe (and from time to time revise) . . . standards applicable to the emission of any air pollutant from any class or classes of new motor vehicles . . . which in his judgment cause, or contribute to, air pollution which may reasonably be anticipated to endanger public health or welfare." Once EPA makes the appropriate endangerment and cause or contribute findings,[58] then section 202(a) authorizes EPA to issue standards applicable to emissions of those pollutants. Indeed, EPA's obligation to do so is mandatory. *See Coalition for Responsible Regulation* v.

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[57] 77 FR 62781.

[58] EPA did so in 2009 for the group of six well-mixed greenhouse gases—carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride—which taken in combination endanger both the public health and the public welfare of current and future generations. EPA further found that the combined emissions of these greenhouse gases from new motor vehicles and new motor vehicle engines contribute to greenhouse gas air pollution that endangers public health and welfare. 74 FR 66496 (Dec. 15, 2009).

EPA, 684 F.3d 102, 126–27 (D.C. Cir. 2012); *Massachusetts* v. *EPA,* 549 U.S. 497, 533 (2007). Moreover, EPA's mandatory legal duty to promulgate these emission standards derives from ''a statutory obligation wholly independent of DOT's mandate to promote energy efficiency.'' *Massachusetts,* 549 U.S. at 532. Consequently, EPA has no discretion to decline to issue greenhouse gas standards under section 202(a), or to defer issuing such standards due to NHTSA's regulatory authority to establish fuel economy standards. Rather, ''[j]ust as EPA lacks authority to refuse to regulate on the grounds of NHTSA's regulatory authority, EPA cannot defer regulation on that basis.'' *Coalition for Responsible Regulation,* 684 F.3d at 127.

Any standards under CAA section 202(a)(1) ''shall be applicable to such vehicles . . . for their useful life.'' Emission standards set by EPA under CAA section 202(a)(1) are technology-based, as the levels chosen must be premised on a finding of technological feasibility. Thus, standards promulgated under CAA section 202(a) are to take effect only ''after 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.'' CAA section 202(a)(2); see also *NRDC* v. *EPA,* 655 F. 2d 318, 322 (D.C. Cir. 1981). EPA must consider costs to those entities which are directly subject to the standards. *Motor & Equipment Mfrs. Ass'n Inc.* v. *EPA,* 627 F. 2d 1095, 1118 (D.C. Cir. 1979). Thus, ''the [s]ection 202(a)(2) reference to compliance costs encompasses only the cost to the motor-vehicle industry to come into compliance with the new emission standards, and does not mandate consideration of costs to other entities not directly subject to the proposed standards.'' *See Coalition for Responsible Regulation,* 684 F.3d at 128.

EPA is afforded considerable discretion under section 202(a) when assessing issues of technical feasibility and availability of lead time to implement new technology. Such determinations are ''subject to the restraints of reasonableness,'' which ''does not open the door to 'crystal ball' inquiry.'' *NRDC,* 655 F. 2d at 328, quoting *International Harvester Co.* v. *Ruckelshaus,* 478 F. 2d 615, 629 (D.C. Cir. 1973). However, ''EPA is not obliged to provide detailed solutions to every engineering problem posed in the perfection of [a particular device]. In the absence of theoretical objections to the technology, the agency need only identify the major steps necessary for development of the device, and give plausible reasons for its belief that the industry will be able to solve those problems in the time remaining. The EPA is not required to rebut all speculation that unspecified factors may hinder 'real world' emission control.'' *NRDC,* 655 F. 2d at 333–34. In developing such technology-based standards, EPA has the discretion to consider different standards for appropriate groupings of vehicles (''class or classes of new motor vehicles''), or a single standard for a larger grouping of motor vehicles. *NRDC,* 655 F.2d at 338. Finally, with respect to regulation of vehicular greenhouse gas emissions, EPA is not ''required to treat NHTSA's . . . regulations as establishing the baseline for the [section 202(a) standards].'' *Coalition for Responsible Regulation,* 684 F.3d at 127 (noting that the section 202(a) standards provide ''benefits above and beyond those resulting from NHTSA's fuel-economy standards.'')

Although standards under CAA section 202(a)(1) are technology-based, they are not based exclusively on technological capability. EPA has the discretion to consider and weigh various factors along with technological feasibility, such as the cost of compliance (section 202(a)(2)), lead time necessary for compliance (section 202(a)(2)), safety (see *NRDC,* 655 F. 2d at 336 n. 31)[59] and other impacts on consumers, and energy impacts associated with use of the technology. See *George E. Warren Corp.* v. *EPA,* 159 F.3d 616, 623–624 (D.C. Cir. 1998) (ordinarily permissible for EPA to consider factors not specifically enumerated in the Act).

In addition, EPA has clear authority to set standards under CAA section 202(a) that are technology-forcing when EPA considers that to be appropriate, but EPA is not required to do so (as distinguished from standards under provisions such as section 202(a)(3) and section 213(a)(3)). Section 202(a) of the CAA does not specify the degree of weight to apply to each factor, and EPA accordingly has discretion in choosing an appropriate balance among factors. See *Sierra Club* v. *EPA,* 325 F.3d 374, 378 (D.C. Cir. 2003) (even where a provision is technology-forcing, the provision ''does not resolve how the Administrator should weigh all [the statutory] factors in the process of finding the 'greatest emission reduction achievable' ''); *NPRA* v. *EPA,* 287 F.3d 1130, 1135 (D.C. Cir. 2002) (EPA decisions, under CAA provision authorizing technology-forcing standards, based on complex scientific or technical analysis are accorded particularly great deference); see also *Husqvarna AB* v. *EPA,* 254 F. 3d 195, 200 (D.C. Cir. 2001) (great discretion to balance statutory factors in considering level of technology-based standard, and statutory requirement ''to [give appropriate] consideration to the cost of applying . . . technology'' does not mandate a specific method of cost analysis); *Hercules Inc.* v. *EPA,* 598 F. 2d 91, 106 (D.C. Cir. 1978) (''In reviewing a numerical standard we must ask whether the agency's numbers are within a zone of reasonableness, not whether its numbers are precisely right''); Permian Basin Area Rate Cases, 390 U.S. 747, 797 (1968) (same); *Federal Power Commission* v. *Conway Corp.,* 426 U.S. 271, 278 (1976) (same); *Exxon Mobil Gas Marketing Co.* v. *FERC,* 297 F. 3d 1071, 1084 (D.C. Cir. 2002) (same).

ii. Testing Authority

Under section 203 of the CAA, sales of vehicles are prohibited unless the vehicle is covered by a certificate of conformity. EPA issues certificates of conformity pursuant to section 206 of the CAA, based on (necessarily) pre-sale testing conducted either by EPA or by the manufacturer. The Federal Test Procedure (FTP or ''city'' test) and the Highway Fuel Economy Test (HFET or ''highway'' test) are used for this purpose. Compliance with standards is required not only at certification but throughout a vehicle's useful life, so that testing requirements may continue post-certification. Useful life standards may apply an adjustment factor to account for vehicle emission control deterioration or variability in use (section 206(a)).

EPA establishes the test procedures under which compliance with the CAA GHG standards is measured. EPA's testing authority under the CAA is broad and flexible. EPA has also developed tests with additional cycles (the so-called 5-cycle tests) which are used for purposes of fuel economy labeling and are also used in the EPA program for extending off-cycle credits under the light-duty vehicle GHG program.

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[59] Since its earliest Title II regulations, EPA has considered the safety of pollution control technologies. See 45 FR 14496, 14503 (1980) (''EPA would not require a particulate control technology that was known to involve serious safety problems. If during the development of the trap-oxidizer safety problems are discovered, EPA would reconsider the control requirements implemented by this rulemaking'').

iii. Compliance and Enforcement Authority

EPA oversees testing, collects and processes test data, and performs calculations to determine compliance with CAA standards. CAA standards apply not only at certification but also throughout the vehicle's useful life. The CAA provides for penalties should manufacturers fail to comply with their fleet average standards, and there is no option for manufacturers to pay fines in lieu of compliance with the standards. Under the CAA, penalties for violation of a fleet average standard are typically determined on a vehicle-specific basis by determining the number of a manufacturer's highest emitting vehicles that cause the fleet average standard violation. Penalties for reporting requirements under Title II of the CAA apply per day of violation, and other violations apply on a per vehicle, or a per part or component basis. See CAA sections 203(a) and 205(a) and 40 CFR 19.4.

Section 207 of the CAA grants EPA broad authority to require manufacturers to remedy vehicles if EPA determines there are a substantial number of noncomplying vehicles. In addition, section 205 of the CAA authorizes EPA to assess penalties of up to $48,762 per vehicle for violations of various prohibited acts specified in the CAA. In determining the appropriate penalty, EPA must consider a variety of factors such as the gravity of the violation, the economic impact of the violation, the violator's history of compliance, and ''such other matters as justice may require.'' The CAA does not authorize vehicle manufacturers to pay fines in lieu of meeting emission standards.

4. Averaging, Banking, and Trading Provisions for CO_2 Standards

i. Background

Averaging, banking, and trading (ABT) is an important compliance flexibility and ABT has been built into various highway engine and vehicle programs (and nonroad engines and equipment programs) to support emissions standards that through the introduction of new technologies, result in reductions in air pollution. The light-duty ABT program for GHG standards includes existing provisions initially established in the 2010 rule for how credits may be generated and used within the program.[60] These provisions include credit carry-forward, credit carry-back (also called deficit carry-forward), credit transfers (within a manufacturer), and credit trading (across manufacturers).

Credit carry-forward refers to banking (saving) credits for future use, after satisfying any needs to offset prior MY debits within a vehicle category (car fleet or truck fleet). Credit carry-back refers to using credits to offset any deficit in meeting the fleet average standards that had accrued in a prior MY. A manufacturer may have a deficit at the end of a MY (after averaging across its fleet using credit transfers between cars and trucks)—that is, a manufacturer's fleet average level may fail to meet the required fleet average standard for the MY. The CAA does not expressly limit the duration of such credit provisions, and in the MY 2012–2016 and 2017–2025 programs, EPA chose to adopt 5-year credit carry-forward (generally, with an exception noted below) and 3-year credit carry-back provisions as a reasonable approach that maintained consistency between the EPA GHG and NHTSA's CAFE provisions.[61] While some stakeholders had suggested that light-duty GHG credits should have an unlimited credit life, EPA did not adopt that suggestion for the light-duty GHG program because it would pose enforcement challenges and could lead to some manufacturers accumulating large banks of credits that could interfere with the program's goal to develop and transition to progressively more advanced emissions control technologies in the future.

Although the credit carry-forward and carry-back provisions generally remained in place for MY 2017 and later standards, EPA finalized provisions allowing all unused (banked) credits generated in MY 2010–2016 (but not MY 2009 early credits) to be carried forward through MY 2021. See § 86.1865–12(k)(6)(ii); 77 FR 62788 October 15, 2012. This is the normal 5-year carry-forward for MY 2016 and later credits but provides additional carry-forward years for credits generated in MYs 2010–2015. Extending the life of MY 2010–2015 credits provided greater flexibility for manufacturers in using the credits. This provision was intended to facilitate the transition to increasingly stringent standards through MY 2021 by helping manufacturers resolve lead time issues they might face in the early MYs of the program. This extension of credit carry-forward also provided additional incentive for manufacturers to generate credits earlier, for example in MYs 2014 and 2015, thereby encouraging the earlier use of additional CO_2 reducing technologies.

Transferring credits in the EPA program refers to exchanging credits between the two averaging sets—passenger cars and light trucks—within a manufacturer. For example, credits accrued by overcompliance with a manufacturer's car fleet average standard can be used to offset debits accrued due to that manufacturer not meeting the truck fleet average standard in a given year. (Put another way, a manufacturer's car and truck fleets are, in essence, a single averaging set in the EPA program). Finally, accumulated credits may be traded to another manufacturer. Credit trading has occurred on a regular basis in EPA's vehicle program.[62] Manufacturers acquiring credits may offset credit shortfalls and bank credits for use toward future compliance within the carry-forward constraints of the program.

The ABT provisions are an integral part of the vehicle GHG program and the agency expects that manufacturers will continue to utilize these provisions into the future. EPA's annual Automotive Trends Report provides details on the use of these provisions in the GHG program.[63] ABT allows EPA to consider standards more stringent than we would otherwise consider by giving manufacturers an important tool to resolve lead time and feasibility issues. EPA believes the targeted extension of credit carry-forward that we are proposing, discussed below, is appropriate considering the stringency and implementation timeframe of the proposed standards.

ii. Extended Credit Carry-Forward Proposal

As in the transition to more stringent standards under the 2012 rule, EPA recognizes that auto manufacturers are again facing a transition to more stringent standards with our MY 2023–2026 standards proposal. We also recognize that the stringency increase from MY 2022 to MY 2023 is the steepest step in our proposed program with relatively limited lead time. Therefore, we believe it is again appropriate in the current context to provide a targeted, limited amount of additional flexibility to carry-forward

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[60] 40 CFR 86.1865–12.

[61] The EPCA/EISA statutory framework for the CAFE program limits credit carry-forward to 5 years and credit carry-back to 3 years.

[62] EPA provides general information on credit trades annually as part of its annual Automotive Trends and GHG Compliance Report. The latest report is available at: *https://www.epa.gov/automotive-trends* and the docket for this rulemaking.

[63] ''The 2020 EPA Automotive Trends Report, Greenhouse Gas Emissions, Fuel Economy, and Technology since 1975,'' EPA–420–R–21–003 January 2021.

credits into the 2023–2026 MYs, to ease the manufacturers' transition to these more stringent standards.

EPA is proposing to temporarily increase the number of years that MY 2016–2020 vintage credits that may be carried-forward to provide additional flexibility for manufacturers in the transition to more stringent standards. EPA proposes to increase credit carry-forward for MY 2016 credits by two years such that they would not expire until after MY 2023. For MY 2017–2020 credits, EPA proposes to extend the credit life by one year, so that those banked credits can be used through MYs 2023–2026, depending on the MY in which the credits are banked. For MY 2021 and later credits, EPA is not proposing any modification to credit carry-forward in this notice. Credit carry-forward would return to the normal 5 years in the existing ABT regulations. Table 23 below provides an illustration of the proposed credit carry-forward provisions.

TABLE 23—PROPOSED EXTENSION OF CREDIT CARRY-FORWARD FOR MY 2016–2020 CREDITS

MY credits are banked	MYs credits are valid under EPA's proposed extension										
	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
2016	....	x	x	x	x	x	+	+	....	....	....
2017	....	....	x	x	x	x	x	+	....	....	....
2018	....	....	....	x	x	x	x	x	+	....	....
2019	....	....	....	....	x	x	x	x	x	+	....
2020	....	....	....	....	....	x	x	x	x	x	+
2021	....	....	....	....	....	....	x	x	x	x	x

x = Current program. + = Proposed additional years.

Extending the life for MY 2016–2020 credits provides greater flexibility for manufacturers in using the credits they have generated through overcompliance with the stringent standards in those MYs. These credits would help manufacturers to ease the transition to the more stringent proposed standards. Providing the extended credit carry-forward will help some manufacturers to lower overall costs and address any potential lead time issues they may face during these MYs, especially in the first year of the proposed standards (MY 2023).

EPA is proposing to extend credit life only for credits generated against standards established in the 2012 rule for MYs 2016–2020. EPA views these credits as a reflection of manufacturers' having achieved reductions beyond and earlier than those required by the standards. EPA is not proposing to extend credit life for credits generated in MYs 2021–2022 against the SAFE standards, as we view these credits as windfall credits, accumulated by manufacturers mostly because of the large reduction in the stringency of standards under the SAFE rule, as compared to the 2012 rule standards previously in effect, rather than for technology-based actions taken by a manufacturer to reduce fleet emissions.

As noted above, there is precedent for extending credit carry-forward temporarily beyond five years to help manufacturers transition to more stringent standards. In the 2012 rule, EPA extended carry-forward for MY 2010–2015 credits to MY 2021 for similar reasons, to provide more flexibility for a limited time during a transition to more stringent standards.[64] ABT is an important compliance flexibility and has been built into various highway engine and vehicle programs to support emissions standards programs that through the introduction of new technologies result in reductions in air pollution. While the normal five-year credit life in the light-duty GHG program is generally sufficient to address the need for manufacturer flexibility while considering the practical challenges of properly tracking credits over an extended period of time for compliance and enforcement purposes, there are occasions—such as when the industry is transitioning to significantly more stringent standards—where more flexibility is appropriate. As noted above, ABT allows EPA to consider standards more stringent than we would otherwise consider by giving manufacturers an important tool to resolve lead time and feasibility issues, and EPA believes the targeted extension of credit life that we are proposing is appropriate given the stringency and implementation timeframe of the proposed standards.

5. Certification, Compliance, and Enforcement

EPA established comprehensive vehicle certification, compliance, and enforcement provisions for the GHG standards as part of the rulemaking establishing the initial GHG standards for MY 2012–2016 vehicles.[65] Manufacturers have been using these provisions since MY 2012 and EPA is not proposing or seeking comment on changes in the areas of certification, compliance, or enforcement.

6. On-Board Diagnostics Program Updates

EPA regulations state that onboard diagnostics (OBD) systems must generally detect malfunctions in the emission control system, store trouble codes corresponding to detected malfunctions, and alert operators appropriately. EPA adopted (as a requirement for an EPA certificate) the 2013 California Air Resources Board (CARB) OBD regulation, with certain additional provisions, clarifications and exceptions, in the Tier 3 Motor Vehicle Emission and Fuel Standards final rulemaking (40 CFR 86.1806–17; 79 FR 23414, April 28, 2014). Since that time, CARB has made several updates to their OBD regulations and continues to consider changes periodically.[66] Manufacturers may find it difficult to meet both the 2013 OBD regulation adopted in the EPA regulations and the currently applicable CARB OBD regulation on the same vehicles. This may result in different calibrations being required for vehicles sold in states subject to Federal OBD (2013 CARB OBD) and vehicles sold in states subject to current CARB OBD.

To provide clarity and regulatory certainty to manufacturers, EPA is proposing a limited regulatory change to

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[64] 77 FR 62788.

[65] See 75 FR 25468–25488 and 77 FR 62884–62887 for a description of these provisions. See also "The 2020 EPA Automotive Trends Report, Greenhouse Gas Emissions, Fuel Economy, and Technology since 1975," EPA–420–R–21–003 January 2021 for additional information regarding EPA compliance determinations.

[66] See *https://ww2.arb.ca.gov/our-work/programs/obd-board-diagnostic-program/obd-workshops.*

streamline OBD requirements. Under the proposed change, EPA could find that a manufacturer met OBD requirements for purposes of the EPA certification process if the manufacturer could show that the vehicles meet newer CARB OBD regulations than the 2013 CARB regulation which currently establishes the core OBD requirements for EPA certification and that the OBD system meets the intent of the EPA regulation, including provisions that are in addition to or different from the applicable CARB regulation. The intent of the proposed provision is to allow manufacturers to produce vehicles with one OBD system (software, calibration, and hardware) for all 50 states.

7. Stakeholder Engagement

In developing this proposal, EPA conducted outreach with a wide range of stakeholders, including auto manufacturers, automotive suppliers, labor groups, state/local governments, environmental and public interest groups, public health professionals, consumer groups, and other organizations. We also coordinated extensively with the California Air Resources Board as we considered this proposal. Consistent with Executive Order 13990, in developing this proposal EPA has considered the views from labor unions, states, and industry, as well as other stakeholders.

EPA looks forward to hearing from all stakeholders through comments on this proposal and during the public hearing. Looking ahead, we also plan to continue engagement with interested stakeholders as we embark on a future rulemaking to set standards beyond 2026, so diverse views can continue to be considered in our development of a longer-term program.

8. How do EPA's proposed standards relate to NHTSA's CAFE proposal and to California's GHG program?

i. EPA and NHTSA Rulemaking Coordination

In Executive Order 13990, President Biden directed NHTSA and EPA to consider whether to propose suspending, revising, or rescinding the SAFE Rule standards for MYs 2021–2026.[67] Both agencies have determined that it is appropriate to propose revisions to their respective standards; EPA is proposing to revise its GHG standards and, in a separate rulemaking action, NHTSA will propose to revise its CAFE standards. Since 2010, EPA and NHTSA have adopted fuel economy and greenhouse gas standards in joint rulemakings. In the 2010 joint rule, EPA and NHTSA explained the purpose of the joint rulemaking effort was to develop a coordinated and harmonized approach to implementing the two agencies' statutes. The joint rule approach was one appropriate mechanism for the agencies to coordinate closely, given the common technical issues both agencies needed to consider and the importance of avoiding inconsistency between the programs. However, in light of additional experience as the GHG and CAFE standards have co-existed since the 2010 rule and the agencies have engaged in several joint rulemakings, EPA has concluded that, while it remains committed to ensuring that GHG emissions standards for light duty vehicles are coordinated with fuel economy standards for those vehicles, it is unnecessary for EPA to do so specifically through a joint rulemaking.

In reaching this conclusion, EPA notes that the agencies have different statutory mandates and their respective programs have always reflected those differences. As the Supreme Court has noted "EPA has been charged with protecting the public's 'health' and 'welfare,' a statutory obligation wholly independent of DOT's mandate to promote energy efficiency." [68] The agencies have recognized these different mandates, and the fact that they have produced different analytical approaches and standards. For example, since EPA's responsibility is to address air pollution, it sets standards not only for carbon dioxide (measured as grams per mile), but also for methane and nitrous oxide. Even more significantly, EPA regulates leakage of fluorocarbons from air conditioning units by providing a credit against the tailpipe CO_2 standard for leakage reduction and adjusting those standards numerically downwards to reflect the anticipated availability of those credits. NHTSA, given its responsibility for fuel economy (measured as miles per gallon), does not have these elements in the CAFE program. There have always been other differences between the programs as well, which generally can be traced back to differences in statutory mandates.

Finally, EPA notes that EPA may coordinate with NHTSA, and has done so, regardless of the formality of joint rulemaking. EPA has consulted significantly with NHTSA in the development of this proposal. Consultation is the usual approach Congress specifies when it recognizes that EPA and another agency share expertise and equities in an area. Indeed, the Clean Air Act does not require joint rulemaking for its many provisions that require EPA's consultation with other agencies on topics such as the impacts of ozone-depleting substances on the atmosphere, renewable fuels, the importance of visibility on public lands, regulation of aerospace coatings, and federal procurement. For example, for aircraft emissions standards, where EPA sets the standards in consultation with the Federal Aviation Administration (FAA), and FAA implements the standards, the two agencies may undertake, and have undertaken, separate rulemakings. Likewise, when EPA revises tests procedures for NHTSA's fuel economy standards, those rules are not done as joint rulemaking (unless they were included as part of a larger joint rulemaking on GHG and fuel economy standards). Thus, EPA concludes that joint rulemaking is unnecessary, particularly to the extent it was originally intended to ensure that the agencies work together and coordinate their rules.

ii. California GHG Program

California has long been a partner in reducing light-duty vehicle emissions, often leading the nation by setting more stringent standards before similar standards are adopted by EPA. This historically has been the case with GHG emissions standards in past federal rulemakings, where California provided technical support to EPA's nationwide programs. Prior to EPA's 2010 rule establishing the first nationwide GHG standards for MY 2012–2016 vehicles, California had adopted GHG standards for MYs 2009–2016.[69] After EPA adopted its standards in the 2012 rule for MYs 2017–2025, California also adopted similar standards for these MYs.[70] California also assisted and worked with EPA in the development of the 2016 Draft Technical Assessment Report for the Mid-term Evaluation,[71] issued jointly by EPA, CARB and NHTSA, that served as an important technical basis for EPA's original January 2017 Final Determination that the standards adopted in the 2012 rule

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[67] 86 FR 7037, January 25, 2021.

[68] *Massachusetts* v. *EPA,* 549 U.S. at 532.

[69] *https://ww2.arb.ca.gov/our-work/programs/advanced-clean-cars-program/lev-program/low-emission-vehicle-greenhouse-gas.*

[70] The California Air Resources Board (CARB) received a waiver of Clean Air Act preemption on January 9, 2013 (78 FR 2211) for its Advanced Clean Car (ACC) program. CARB's ACC program includes the MYs 2017–2025 greenhouse gas (GHG) standards as well as regulations for zero-emission vehicle (ZEV) sales requirements and California's low emission vehicle (LEV) III requirements.

[71] 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.

for MYs 2022–2025 remained appropriate. California also conducted its own Midterm Review that arrived at a similar conclusion.[72]

In August 2018, EPA and NHTSA jointly issued the SAFE rule proposal, which included an EPA proposal to withdraw CARB's Advanced Clean Car (ACC) waiver as it related to California GHG emission standards and ZEV sales requirements (that would preclude California from enforcing its own program) as well as a proposal to sharply reduce the stringency of the national standards.[73] In September 2019, EPA and NHTSA then jointly issued a final SAFE ''Part One'' rule, which included a final EPA action withdrawing CARB's ACC waiver as it related to California GHG emission standards and ZEV sales requirements.[74] In response to the SAFE rule proposal, California and five auto manufacturers entered into identical agreements commonly referred to as the California Framework Agreements. The Framework Agreements included GHG emission reduction targets for MYs 2021–2026 that in terms of stringency are about halfway between the original 2012 rule standards and those adopted in the final SAFE rule. The Framework Agreements also included additional flexibilities such as additional incentive multipliers for advanced technologies, off-cycle credits, and full-size pickup strong hybrid incentives. These flexibilities are discussed further in Section II.B, below.

EPA has considered California standards in past vehicle standards rules as we considered the factors of feasibility, costs of compliance and lead time. The California Framework Agreement provisions, and the fact that five automakers representing about a third of U.S. vehicle sales voluntarily committed to them, at a minimum provide a clear indication of manufacturers' capabilities to produce cleaner vehicles than required by the SAFE rule standards in the implementation timeframe of this proposed rule.[75] The Framework Agreements' emissions reduction targets therefore served as one starting point for EPA's assessment of potential standards and other provisions for the proposal. EPA conducted extensive outreach with the California Air Resources Board, Framework manufacturers, and manufacturers that have not entered into California Framework Agreements, along with numerous other stakeholders in developing this proposed rule, as further described in Section II.A.7. As discussed further below, EPA is proposing standards that are equivalent to the stringency of the California Framework Agreements emission reduction targets in MY 2023 and increasingly more stringent than the Framework Agreements from MY 2024 through 2026.

In a separate but related action, on April 28, 2021, EPA issued a Notice of Reconsideration for the previous withdrawal of the California ACC waiver, requesting comments on whether the withdrawal should be rescinded, which would reinstate the waiver.[76] EPA conducted a virtual public hearing on June 2, 2021 and the comment period closed on July 6, 2021. EPA is currently reviewing comments, after which EPA plans to take final action.

B. Additional Manufacturer Compliance Flexibilities

As discussed previously in Section II.A.4, the ABT provisions, including credit carry-forward and carry-back provisions, define how credits may be used and are an important part of the program. The program also includes several additional credit and incentive program elements that allow manufacturer flexibility in deciding how to comply with the standards laid out in Section II.A. This section provides an overview of those provisions as well as areas where EPA is proposing changes or is seeking comment.

The current GHG program includes temporary incentives through MY 2021 that encourage the use of advanced technologies such as all electric, plug-in hybrid, and fuel cell vehicles, as well as incentives for full-size pickups using either strong hybridization or technologies providing similar emissions reductions. When EPA established these incentives in the 2012 rule, EPA recognized that temporary regulatory incentives would reduce the overall emission reductions required by the standards, but the agency believed that it was worthwhile to have a limited short-term loss of emission reductions to increase the potential for far-greater emissions reductions in the longer run.[77] EPA understood that the temporary regulatory incentives may help bring some technologies to market more quickly than in the absence of incentives.[78] EPA continues to believe that temporary regulatory incentives will help accomplish those goals, which supported those incentives in the 2012 rule. As such, EPA is proposing to increase and extend multiplier incentives though MY 2025 and to reinstate the full-size pickup incentives that were removed from the program by the SAFE rule for MYs 2022–2025. Also, EPA is proposing to remove the multiplier incentives for natural gas vehicles for MYs 2023–2026 established by the SAFE rule. Multipliers and full-size pickup incentives are discussed in Sections II.B.1 and II.B.2, respectively.

The current program also includes credits for real-world emissions reductions not reflected on the test cycles used for measuring CO_2 emissions for compliance with the fleet average GHG standards. Credits for using technologies that reduce emissions that are not captured on EPA tests (''off-cycle'' technologies) and improvements to air conditioning (A/C) systems that increase efficiency and reduce refrigerant leakage (''A/C credits'') are discussed below in sections II.B.3 and II.B.1, respectively. These credit opportunities currently do not sunset, remaining a part of the program through MY 2026 and beyond unless the program is changed as part of a future regulatory action. EPA is not proposing any changes for the A/C credits but is proposing to modify the off-cycle credit program.

The use of the optional credit and incentive provisions has varied, and EPA continues to expect it to vary, from manufacturer to manufacturer. However, most manufacturers are currently using at least some of the flexibilities.[79] Although a manufacturer's use of the credit and incentive provisions is optional, EPA projects that the proposed standards would be met fleet-wide by using a combination of reductions in tailpipe CO_2 and some use of the optional credit and incentive provisions. These projections are discussed in Section III, below and in the Draft RIA.

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[72] *https://ww2.arb.ca.gov/our-work/programs/advanced-clean-cars-program/advanced-clean-cars-midterm-review.*

[73] EPA's waiver for CARB's Advanced Clean Car regulations is at 78 FR 2211 (January 9, 2013). The SAFE NPRM is at 83 FR 42986 (August 24, 2018).

[74] 84 FR 51310 (Sept. 27, 2019).

[75] The five California Framework Agreements may be found in the docket for this rulemaking and at: *https://ww2.arb.ca.gov/news/framework-agreements-clean-cars.*

[76] 80 FR 22421 (April 28, 2021).

[77] See Tables III–2 and III–3, 77 FR 62772, October 15, 2012.

[78] 77 FR 62812, October 15, 2012.

[79] See ''The 2020 EPA Automotive Trends Report, Greenhouse Gas Emissions, Fuel Economy, and Technology since 1975,'' EPA–420–R–21–003 January 2021 for additional information regarding manufacturer use of program flexibilities.

1. Multiplier Incentives for Advanced Technology Vehicles

i. Background

In the 2012 rule, EPA included incentives for advanced technologies to promote the commercialization of technologies that have the potential to transform the light-duty vehicle sector by achieving zero or near-zero GHG emissions in the longer term, but which faced major near-term market barriers. EPA recognized that providing temporary regulatory incentives for certain advanced technologies would decrease the overall GHG emissions reductions associated with the program in the near term, by reducing the effective stringency of the standards in years in which the incentives were available, to the extent the incentives were used. However, in setting the 2017–2025 standards, EPA believed it was worthwhile to forego modest additional emissions reductions in the near term in order to lay the foundation for much larger GHG emissions reductions in the longer term. EPA also believed that the temporary regulatory incentives may help bring some technologies to market more quickly than in the absence of incentives.[80]

EPA established multiplier incentives for MYs 2017–2021 electric vehicles (EVs), plug-in hybrid electric vehicles (PHEVs), fuel cell vehicles (FCVs), and natural gas vehicles (NGVs).[81] The multiplier allows a vehicle to ‘‘count’’ as more than one vehicle in the manufacturer's compliance calculation. Table 24 provides the multipliers for the various vehicle technologies included in the 2012 final rule for MY 2017–2021 vehicles.[82] Since the GHG performance for these vehicle types is significantly better than that of conventional vehicles, the multiplier provides a significant benefit to the manufacturer. EPA chose the magnitude of the multiplier levels to be large enough to provide a meaningful incentive, but not be so large as to provide a windfall for vehicles that still would have been produced even at lower multiplier levels. The multipliers for EVs and FCVs were larger because these technologies faced greater market barriers.

TABLE 24—INCENTIVE MULTIPLIERS FOR EV, FCV, PHEVS, AND NGVS ESTABLISHED IN 2012 RULE

Model years	EVs and FCVs	PHEVs and NGVs
2017–2019	2.0	1.6
2020	1.75	1.45
2021	1.5	1.3

EPA requested comments in the SAFE rule proposal on increasing and/or extending CNG multiplier incentives. After considering comments, EPA adopted a multiplier of 2.0 for MYs 2022–2026 NGVs, noting that no NGVs were being sold by auto manufacturers at that time. EPA did not extend multipliers for other vehicle types in the SAFE rule, as the SAFE standards did not contemplate the extensive use of these technologies in the future so there was no need to continue the incentives.

ii. Proposed Multiplier Extension and Cap

EPA is proposing to extend multipliers for EVs, PHEVs, and FCVs for MYs 2022–2025, but with a cap to limit the magnitude of resulting emissions reduction losses and to provide a means to more definitively project the impact of the multipliers on the overall stringency of the program. Although EPA chose not to include additional multipliers in the SAFE rule except for natural gas vehicles, EPA is now proposing standards significantly more stringent than in the SAFE rule and therefore EPA believes limited additional multiplier incentives are appropriate for the purposes of encouraging manufacturers to accelerate the introduction of zero and near-zero emissions vehicles and maintaining momentum for that market transition. EPA requests comment on all aspects of the proposed extension of multipliers, including the proposed multiplier levels, model years when multipliers are available, and the size and structure of the multiplier credit cap.

Given that the previously established multipliers only run through MY 2021, EPA proposes to start the new multipliers in MY 2022 to provide continuity for the incentives over MYs 2021–2025. The multipliers would function in the same way as they have in the past, allowing manufacturers to count eligible vehicles as more than one vehicle in their fleet average calculations. The levels of the proposed multipliers, shown in Table 25 below, are the same as those contained in the California Framework Agreements for MY 2022–2025. EPA is proposing to sunset the multipliers after MY 2025, rather than extending them to MY 2026, because EPA has always intended them to be a temporary part of the program to incentivize technology in the near-term. Sunsetting the multipliers in MY 2025 helps signal that EPA does not intend to include multipliers in its proposal for standards for MY 2027 and later MYs, where these technologies are likely to be integral to the feasibility of the standards, as the goal of a long-term program would be to quickly transition the light-duty fleet to zero-emission technology, in which case ‘‘incentives’’ would no longer be appropriate. As zero-emissions technologies become more mainstream, EPA believes it is appropriate to transition away from multiplier incentives. EPA also believes sunsetting multipliers would simplify programmatically a transition to a more stringent program for MY 2027. The MY 2025 sunset date combined with the cap, discussed below, begins the process of transitioning away from auto manufacturers' ability to make use of the incentive multipliers. While EPA is proposing to end multipliers after MY 2025 for these reasons, EPA requests comments on whether it would be more appropriate to allow multiplier credits to be generated in MY 2026 without an increase in the cap. This may provide an additional incentive for manufacturers who have not yet produced advanced technology vehicles by MY 2026 to do so but could also potentially complicate transitioning to MY 2027 standards for some manufacturers.

TABLE 25—EPA PROPOSED MULTIPLIER INCENTIVES FOR MYS 2022–2025

Model years	EVs and FCVs	PHEVs
2022–2024	2.0	1.6.
2025	1.75	1.45.
2026+	1.0 (no multiplier credits)	1.0 (no multiplier credits).

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[80] See 77 FR 62811 et seq.

[81] 77 FR 62810, October 15, 2012.

[82] 77 FR 62813–62816, October 15, 2012.

EPA believes that an important element of this incentive program is to limit the potential effect of the multipliers on reducing the effective stringency of the standards. Therefore, EPA proposes to cap the credits generated by a manufacturer's use of the multipliers to the Megagram (Mg) equivalent of 2.5 g/mile for their car and light truck fleets per MY for MYs 2022–2025 or 10.0 g/mile on a cumulative basis.[83] Above the cap, the multiplier is effectively a value of 1.0—in other words, after a manufacturer reaches the cap, the multiplier is no longer available and has no further effect on credit calculations. A manufacturer would sum the Mg values calculated for each of its car and light truck fleets at the end of a MY into a single cap value that would serve as the overall multiplier cap for the combined car and light truck fleets for that MY. This approach would limit the effect on stringency of the standards for manufacturers that use the multipliers to no greater than 2.5 g/mile less stringent each year on average over MYs 2022–2025. EPA proposes that manufacturers would be able to choose how to apply the cap within the four-year span of MYs 2022–2025 to best fit their product plans. Manufacturers may opt to use values other than 2.5 g/mile in the cap calculation as long as the sum of those values over MYs 2022–2025 does not exceed 10.0 g/mile (e.g., 0.0, 2.5, 2.5, 5.0 g/mile in MYs 2022–2025).

In the 2012 rule, EPA did not cap the use of multipliers. At that time, the advanced technologies incentivized by the multipliers were in their relative infancy and EPA believed it was appropriate to encourage manufacturers to continue to develop and introduce those vehicles for the long-term benefits of the program. We are now in a transitional period where manufacturers are actively increasing their zero-emission vehicle offerings. In MY 2019, almost all manufacturers made use of advanced technology credits.[84] EPA believes extending the multipliers is important to encourage manufacturers to accelerate bringing these technologies to the market to help sustain market momentum for the long-term. However, EPA also believes that if left uncapped, the multiplier credits have the potential to lead to stagnation or even backsliding for internal combustion engine vehicles for some manufacturers in the near-term as sales of advanced technology vehicles continue to increase. If EPA were to consider a significantly more generous cap or even uncapped credits, EPA would tighten the standards beyond the levels EPA is proposing to rebalance the overall stringency of the program. Therefore, as under the California Framework Agreements, EPA is proposing to extend multiplier credits but also to include a multiplier cap to balance these considerations.

The proposed cap differs from and limits the effective stringency loss more than the cap contained in the California Framework Agreements. The cumulative cap in the Framework Agreements is based on the area between the 2.7 percent and 3.7 percent year over year reduction in the standards from MY 2021 levels, as shown for an average fleet in Figure 6 below. This is equivalent to 27 percent (1%/3.7%) of the total increase in stringency from MY 2021 through MY 2026 in the Framework Agreements.

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[83] Proposed Multiplier Credit Cap [Mg] = (2.5 g/mile CO2 × VMT × Actual Annual Production)/1,000,000 calculated annually for each fleet and summed. Manufacturers may use values higher than 2.5 g/mile in the calculation as long as the sum of the cumulative values over MYs 2022–2025 does not exceed 10.0 g/mile. The vehicle miles traveled (VMT) used in credit calculations in the GHG program, as specified in the regulations, are 195,264 miles for cars and 225,865 for trucks. See 40 CFR 86.1866–12. See also 40 CFR 86.1866–12(c) for the calculation of multiplier credits to be compared to the cap.

[84] See ''The 2020 EPA Automotive Trends Report, Greenhouse Gas Emissions, Fuel Economy, and Technology since 1975,'' EPA–420–R–21–003 January 2021.

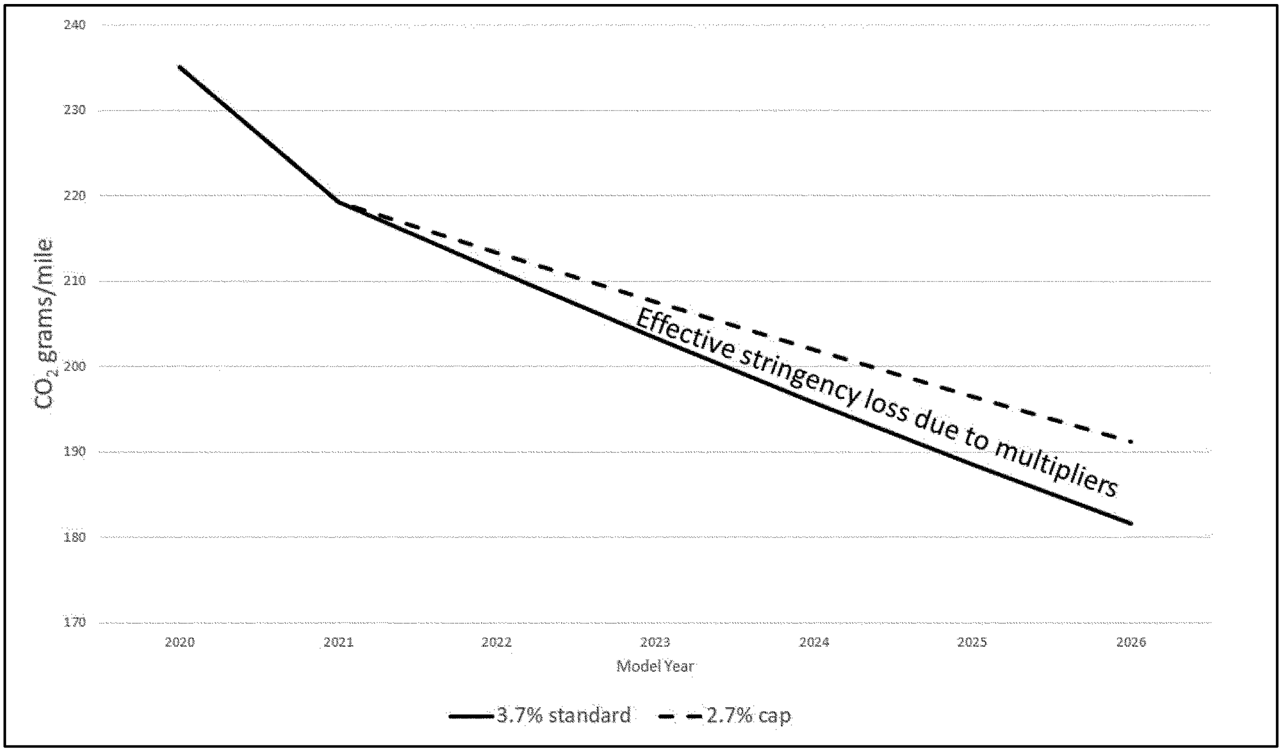

Figure 6 California Framework Standards Fleet Average Target Levels and Multiplier Cap

EPA is proposing a cap that extends over fewer MYs and is less generous than the cap in the California Framework Agreements. The EPA proposed cap would provide additional flexibility in the near term, as shown in Figure 7. This is equivalent to about 6 percent of the total increase in stringency relative to the MY 2021 level from MY 2021 through MY 2026.

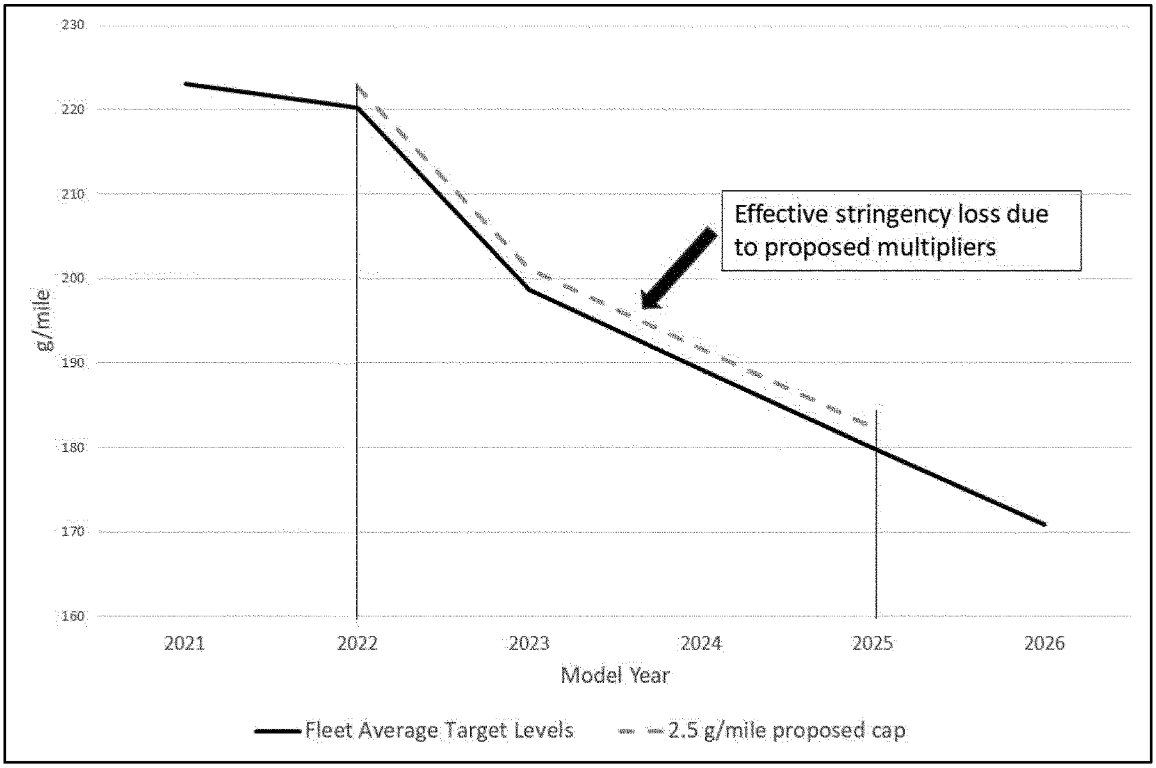

Figure 7 Proposed Multiplier Cap Compared to Fleet Average Target Levels

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To estimate the potential impact of multipliers on the tons of CO_2 reduction provided by the proposed program, EPA modeled scenarios with and without multipliers. As shown, EPA estimates that the proposed multipliers, if fully utilized by manufacturers, would result in roughly 46 MMT (596 minus 550 MMT) fewer tons of CO_2 reduced over the lifetimes of MY 2021–2026 vehicles.[85] We have also analyzed the impact of the advanced technology multipliers on BEV and PHEV penetration rates and have found that the impact on the fleet is less than 0.5 percent in any MY 2023 through 2026 (see RIA Chapter 4.1.3). EPA believes such an approach represents a reasonable balance of providing an incentive for advanced technology vehicles in the timeframe of the rulemaking while limiting the impact on effective stringency of the proposed program. EPA requests comment on the proposed extension of multipliers, including the proposed multiplier levels, model years when multipliers are available, size and structure of the multiplier credit cap. EPA also requests comments on whether the proposed extension of multipliers is appropriate in light of the stringency level of the proposed standards or whether there should be no multipliers beyond those in the current program that are scheduled to end after MY 2021.

iii. Natural Gas Vehicle Multipliers

As noted above, the SAFE rule did not extend multipliers for advanced technology vehicles but did extend and increase multiplier incentives for dual-fuel and dedicated natural gas vehicles (NGVs). The current regulations include a multiplier of 2.0, uncapped, for MY 2022–2026 NGVs. In the SAFE rule, EPA said it was extending the multipliers for NGVs because ‘‘NGVs could be an important part of the overall light-duty vehicle fleet mix, and such offerings would enhance the diversity of potentially cleaner alternative fueled vehicles available to consumers.’’ [86] After further considering the issue, EPA now proposes to remove the extended multiplier incentives added by the SAFE rule from the GHG program after MY 2022. EPA is proposing to end multipliers for NGVs in this manner because NGVs are not a near-zero emissions technology and EPA no longer believes it is appropriate to incentivize these vehicles to encourage manufacturers to introduce them in the light-duty vehicle market. EPA does not view NGVs as a pathway for significant vehicle GHG emissions reductions in the future. Any NGV multiplier credits generated in MY 2022 would be included under the proposed multiplier cap. There are no NGVs currently offered by manufacturers in the light-duty market and EPA is unaware of any plans to introduce NGVs, so EPA does not expect the removal of multipliers for NGVs to have an impact on manufacturers' ability to meet standards.[87] EPA requests comment on its proposed treatment of multipliers for NGVs including whether they should be eliminated altogether for MYs 2023–2026 as proposed or retained partially or at a lower level for MYs 2023–2025.

2. Advanced Technology Incentives for Full-Size Pickups

In the 2012 rule, EPA included a per-vehicle credit provision for manufacturers that hybridize a significant number of their full-size

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[85] EPA analyzed the MY 2021–2026 timeframe to allow for a more direct comparison of the estimated emissions loss in tons of the proposed multipliers and cap with the impact of the California Framework multiplier cap.

[86] 85 FR 25211.

[87] The last vehicle to be offered, a CNG Honda Civic, was discontinued after MY 2015. It had approximately 20 percent lower CO_2 than the gasoline Civic. For more recent advanced internal combustion engines, the difference may be less than 20% due to lower emissions of the gasoline-fueled vehicles.

pickup trucks or use other technologies that comparably reduce CO_2 emissions. EPA's goal was to incentivize the penetration into the marketplace of low-emissions technologies for these pickups. The incentives were intended to provide an opportunity in the program's early years to begin penetration of advanced technologies into this category of vehicles, which face unique challenges in the costs of applying advanced technologies due to the need to maintain vehicle utility and meet consumer expectations. In turn, the introduction of low-emissions technologies in this market segment creates more opportunities for achieving the more stringent later year standards. Under the existing program, full-size pickup trucks using mild hybrid technology are eligible for a per-truck 10 g/mile CO_2 credit during MYs 2017–2021.[88] Full-size pickup trucks using strong hybrid technology are eligible for a per-truck 20 g/mile CO_2 credit during MYs 2017–2021, if certain minimum production thresholds are met.[89] EPA established definitions in the 2012 rule for full-size pickup and mild and strong hybrid for the program.[90]

Alternatively, manufacturers may generate performance-based credits for full-size pickups. This performance-based credit is 10 g/mile CO_2 or 20 g/mile CO_2 for full-size pickups achieving 15 percent or 20 percent, respectively, better CO_2 performance than their footprint-based targets in a given MY.[91] This second option incentivizes other, non-hybrid, advanced technologies that can reduce pickup truck GHG emissions and fuel consumption at rates comparable to strong and mild hybrid technology. These performance-based credits have no specific technology or design requirements; automakers can use any technology or set of technologies as long as the vehicle's CO_2 performance is at least 15 or 20 percent below the vehicle's footprint-based target. However, a vehicle cannot receive both hybrid and performance-based credits, since that would be double-counting.

Access to any of these large pickup credits requires that the technology be used on a minimum percentage of a manufacturer's full-size pickups. These minimum percentages, established in the 2012 final rule, are set to encourage significant penetration of these technologies, leading to long-term market acceptance. Meeting the penetration threshold in one MY does not ensure credits in subsequent years; if the production level in a MY drops below the required threshold, the credit is not earned for that MY. The required penetration levels are shown in Table 26 below.[92]

TABLE 26—PENETRATION RATE REQUIREMENTS BY MODEL YEAR FOR FULL-SIZE PICKUP CREDITS

[% of production]

	2017	2018	2019	2020	2021
Strong hybrid	10	10	10	10	10
Mild Hybrid	20	30	55	70	80
20% better performance	10	10	10	10	10
15% better performance	15	20	28	35	40

Under the 2012 rule, the strong hybrid/20% better performance incentives initially extended out through MY 2025, the same as the 10 percent production threshold. However, the SAFE rule removed these incentives after MY 2021. The mild hybrid/15% better performance incentive was not affected by the SAFE rule, as those provisions end after MY 2021. EPA proposes to reinstate the full-size pickup credits as they existed before the SAFE rule, for MYs 2022 through 2025. While no manufacturer has yet claimed these credits, the rationale for establishing them in the 2012 rule remains valid. At the time of the SAFE rule, EPA did not envision significantly more stringent standards in the future and so did not believe the incentives were useful. In the context of this proposal that includes significantly more stringent standards for MY 2023–2026, EPA believes these full-size pickup truck credits are appropriate to further incentivize advanced technologies penetrating this particularly challenging segment of the market. As with the original program, EPA is limiting this incentive to full-size pickups rather than broadening it to other vehicle types. Introducing advanced technologies with very low CO_2 emissions in the full-size pickup market segment remains a challenge due to the need to preserve the towing and hauling capabilities of the vehicles. The full-size pickup credits incentivize advanced technologies into the full-size pickup truck segment to help address cost, utility, and consumer acceptance challenges. EPA requests comments on whether or not to reinstate the previously existing full-size pickup strong hybrid/20% better performance incentives and the proposed approach for doing so. EPA notes for this proposal our analysis does not include the impacts of this incentive on the projected GHG emissions, costs, benefits and other program effects. EPA requests comment on the potential impacts of the full-size pickup incentive credit, and whether, and how, EPA should take the projected effects into account in the final rulemaking.

In the 2012 rule, EPA included a provision that prevents a manufacturer from using both the full-size pickup performance-based credit pathway and the multiplier credits for the same vehicles. This would prevent, for example, an EV full-size pickup from generating both credits. EPA did not include the same restriction for vehicles qualifying for the full-size pickup

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[88] As with multiplier credits, full-size pickup credits are in Megagrams (Mg). Full-size pickup credits are derived by multiplying the number of full-size pickups produced with the eligible technology by the incentive credit (either 10 or 20 g/mile) and a vehicle miles traveled (VMT) value for trucks of 225,865, as specified in the regulations. The resulting value is divided by 1,000,000 to convert it from grams to Mg. EPA is not proposing a cap for these credits and they are only available for full-size pickups, rather than the entire fleet, so the calculation is simpler than that for multiplier credits.

[89] 77 FR 62825, October 15, 2012.

[90] 77 FR 62825, October 15, 2012. Mild and strong hybrid definitions as based on energy flow to the high-voltage battery during testing. Both types of vehicles must have start/stop and regenerative braking capability. Mild hybrid is a vehicle where the recovered energy over the Federal Test Procedure is at least 15 percent but less than 65 percent of the total braking energy. Strong hybrid means a hybrid vehicle where the recovered energy over the Federal Test Procedure is at least 65 percent of the total braking energy.

[91] 77 FR 62826, October 15, 2012. For additional discussion of the performance requirements, see Section 5.3.4 of the ''Joint Technical Support Document: Final Rulemaking for 2017–2025 Light-duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards'' for the Final Rule,'' EPA–420–R–12–901, August 2012.

[92] 40 CFR 86.1870–12.

hybrid credit pathway. For example, a PHEV could qualify for both the strong hybrid credit and the multiplier credits under the prior regulations as they were established in the 2012 rule. With our proposal to extend the multiplier credits and reinstate the full-size pickup credit, EPA believes allowing both credits would in a sense be double-counting and inappropriate. Therefore, EPA proposes to modify the regulations such that manufacturers may choose between the two credits in instances where full-size pickups qualify for both but may not use both credits for the same vehicles. A manufacturer may choose to use the full-size pickup strong hybrid credit, for example, if the manufacturer either has reached the multiplier credit cap or intends to do so with other qualifying vehicles. Or a manufacturer may instead decide to forego the strong hybrid credit in cases where the manufacturer does not expect to reach the multiplier cap and the multiplier provides more credits than the strong hybrid credit. EPA requests comments on this approach to avoid double-counting of credits, by restricting the use of the two types of credits for the same vehicles.

3. Off-Cycle Technology Credits

i. Background

Starting with MY 2008, EPA started employing a ''five-cycle'' test methodology to measure fuel economy for purposes of new car window stickers (labels) to give consumers better information on the fuel economy they could more reasonably expect under real-world driving conditions.[93] However, for GHG compliance, EPA continues to use the established ''two-cycle'' (city and highway test cycles, also known as the FTP and HFET) test methodology.[94] As learned through development of the ''five-cycle'' methodology and prior rulemakings, there are technologies that provide real-world GHG emissions improvements, but whose improvements are not fully reflected on the ''two-cycle'' test. EPA established the off-cycle credit program to provide an appropriate level of CO_2 credit for technologies that achieve CO_2 reductions, but may not otherwise be chosen as a GHG control strategy, as their GHG benefits are not measured on the specified 2-cycle test. For example: High efficiency lighting is not measured on the EPA 2-cycle tests because lighting is not turned on as part of the test procedure but reduces CO_2 emissions by decreasing the electrical load on the alternator and engine. The key difference between the credits discussed below and the incentives discussed in the previous two sections is that off-cycle credits—as well as A/C credits, discussed in the next section—represent real-world emissions reductions if appropriately sized and therefore their use should not result in deterioration of program benefits, and should not be viewed as cutting into the effective stringency of the program.

Under EPA's existing regulations, there are three pathways by which a manufacturer may accrue off-cycle technology credits.[95] The first pathway is a predetermined list or ''menu'' of credit values for specific off-cycle technologies that was effective starting in MY 2014.[96] This pathway allows manufacturers to use credit values established by EPA for a wide range of off-cycle technologies, with minimal or no data submittal or testing requirements. The menu includes a fleetwide cap on credits of 10 g/mile to address the uncertainty of a one-size-fits-all credit level for all vehicles and the limitations of the data and analysis used as the basis of the menu credits. A second pathway allows manufacturers to use 5-cycle testing to demonstrate and justify off-cycle CO_2 credits.[97] The additional emissions tests allow emission benefits to be demonstrated over some elements of real-world driving not captured by the GHG compliance tests, including high speeds, rapid accelerations, and cold temperatures. Under this pathway, manufacturers submit test data to EPA, and EPA determines whether there is sufficient technical basis to approve the off-cycle credits. The third pathway allows manufacturers to seek EPA approval, through a notice and comment process, to use an alternative methodology other than the menu or 5-cycle methodology for determining the off-cycle technology CO_2 credits.[98] This option is only available if the benefit of the technology cannot be adequately demonstrated using the 5-cycle methodology.

ii. EPA Proposal To Increase Menu Credit Cap

EPA has received comments from manufacturers on multiple occasions requesting that EPA increase the menu credit cap. Previously, EPA has opted not to increase the cap for several reasons.[99] First, the cap is necessary given the uncertainty in the menu values for any given vehicle. Menu credits are values EPA established to be used across the fleet rather than vehicle-specific values. When EPA established the menu credits in the 2012 rule, EPA included a cap because of the uncertainty inherent in using limited data and modeling as the basis of a single credit value for either cars or trucks. While off-cycle technologies should directionally provide an off-cycle emissions reduction, quantifying the reductions and setting an appropriate credit values based on limited data was difficult. Manufacturers wanting to generate credits beyond the cap may do so by bringing in their own test data as the basis for the credits. Credits established under the second and third pathways do not count against the menu cap. Also, until recently most manufacturers still had significant headroom under the cap allowing them to continue to introduce additional menu technologies.[100] Finally, during the implementation of the program, EPA has expended significantly more effort than anticipated on scrutinizing menu credits to determine if a manufacturer's technology approach was eligible under the technology definitions contained in the regulations. This further added to concerns about whether the technology could reasonably be expected to provide the real-world benefits that credits are meant to represent. For these reasons, EPA has been reluctant to consider increasing the cap.

EPA may make changes to the test procedures for the GHG program in the future that could change the need for an off-cycle credits program, but there are no such test procedure changes proposed in this rule. Off-cycle credits, therefore, will likely remain an important source of emissions reductions under the program, at least through MY 2026. Off-cycle technologies are often more cost effective than other available technologies that reduce vehicle GHG emissions over the 2-cycle tests and

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[93] *https://www.epa.gov/vehicle-and-fuel-emissions-testing/dynamometer-drive-schedules.* See also 75 FR 25439 for a discussion of 5-cycle testing.

[94] The city and highway test cycles, commonly referred to together as the ''2-cycle tests'' are laboratory compliance tests are effectively required by law for CAFE, and also used for determining compliance with the GHG standards. 49 U.S.C. 32904(c).

[95] See ''The 2020 EPA Automotive Trends Report, Greenhouse Gas Emissions, Fuel Economy, and Technology since 1975,'' EPA–420–R–21–003 January 2021 for information regarding the use of each pathway by manufacturers.

[96] See 40 CFR 86.1869–12(b).

[97] See 40 CFR 86.1869–12(c).

[98] See 40 CFR 86.1869–12(d).

[99] 85 FR 25237.

[100] See ''The 2020 EPA Automotive Trends Report, Greenhouse Gas Emissions, Fuel Economy, and Technology since 1975,'' EPA–420–R–21–003 January 2021 for information on the use of menu credits.

manufacturer use of the program continues to grow. Off-cycle credits reduce program costs and provide additional flexibility in terms of technology choices to manufacturers which has resulted in many manufacturers using the program. Multiple manufacturers were at or approaching the 10 g/mile credit cap in MY 2019.[101] Also, in the SAFE rule, EPA added menu credits for high efficiency alternators but did not increase the credit cap for the reasons noted above.[102] While adding the technology to the menu has the potential to reduce the burden associated with the credits for both manufacturers and EPA, it further exacerbates the credit cap issue for some manufacturers.

After considering the above points further in the context of the proposed standards, EPA is proposing to increase the cap on menu-based credits from the current 10 g/mile to 15 g/mile beginning as early as MY 2020. As a companion to increasing the credit cap, though, EPA is also proposing modifications to some of the off-cycle technology definitions to improve program implementation and to better accomplish the goal of the off-cycle credits program: To ensure emissions reductions occur in the real-world from the use of the off-cycle technologies. Manufacturers wanting to claim menu credits between 10 and 15 g/mile in MYs 2020–2022 would need to meet all revised technology definitions across both the car and truck fleets. For MYs 2023 and later, the revised definitions would apply exclusively, and the current definitions would no longer be used in the program. EPA is proposing this approach as a reasonable transition to the new definitions.

EPA is proposing not to require the use of the revised definitions prior to MY 2023 for manufacturers not opting into the 15 g/mile credit cap. Requiring their use for MYs 2020 and earlier for all manufacturers would potentially affect credits already awarded to manufacturers, causing significant problems in program implementation and manufacturer plans to comply with the proposed MY 2023–2026 standards. Similarly, MY 2021 is underway, and some manufacturers are already producing MY 2022 vehicles. EPA believes credits that were generated in a manner consistent with the applicable regulatory definitions in place at the time the vehicles were produced should continue to be allowed in compliance determinations for the proposed MY 2023–2026 standards. The 10 g/mile cap EPA adopted to address uncertainties around the menu credits, including the definitions, is acting as intended and the proposed approach of allowing menu credits beyond the 10 g/mile cap only for manufacturers meeting the revised definitions is the appropriate approach until the 15 g/mile menu cap and revised definitions are fully implemented in MY 2023. EPA views the proposed definition updates as refinements to the ongoing off-cycle program to improve its implementation and help ensure that the program produces real-world benefits as intended and believes that it is reasonable to make these updates in parallel with the proposed cap increase. Manufacturers that utilized technologies in MY 2020 that meet the proposed revised definitions, in addition to the unchanged current definitions, would be able to claim menu credits up to the 15 g/mile cap.

EPA requests comment on whether the menu credit cap should be increased to 15 g/mile, EPA's proposed approach for implementing the increased credit cap, including the start date of MY 2020, as well as the proposed application of revised technology definitions, discussed below. EPA specifically requests comment on whether an increased credit cap, if finalized, should begin in MY 2020 as proposed or a later MY such as MY 2021, 2022, or 2023. Commenters supporting off-cycle provisions that differ from EPA's proposal are encouraged to address how such differences could be implemented to improve real-world emissions benefits and how such provisions could be effectively implemented.

iii. EPA Proposed Modifications to Menu Technology Definitions

Some stakeholders have previously raised concerns about whether the off-cycle credit program produces the real-world emissions reductions as intended, or results in a loss of emissions benefits.[103] EPA shares these concerns, as noted above, and believes it is important to address to the extent possible the issues that the agency has experienced in implementing the menu credits, alongside proposing to raise the menu cap. EPA believes that raising the menu cap is appropriate so long as the agency can improve the program and reasonably expect the use of menu technologies to provide real-world emissions reductions, consistent with the intent of the program. Providing additional opportunities for menu credits may allow for more emissions reductions sooner and at a lower cost than would otherwise be possible under a program without off-cycle credits. Indeed, the additional credits are fully incorporated as an element of the cost and feasibility analysis of the proposed standards. With that in mind, EPA proposes to modify the menu definitions discussed below to coincide with increasing the menu cap.

The existing menu technologies and associated credits are provided below in Table 27 and Table 28 for reference.[104]

TABLE 27—EXISTING OFF-CYCLE TECHNOLOGIES AND CREDITS FOR CARS AND LIGHT TRUCKS

Technology	Credit for cars g/mi	Credit for light trucks g/mi
High Efficiency Alternator (at 73%; scalable)	1.0	1.0.
High Efficiency Exterior Lighting (at 100W)	1.0	1.0.
Waste Heat Recovery (at 100W; scalable)	0.7	0.7.
Solar Roof Panels (for 75W, battery charging only)	3.3	3.3.
Solar Roof Panels (for 75W, active cabin ventilation plus battery charging)	2.5	2.5.
Active Aerodynamic Improvements (scalable)	0.6	1.0.
Engine Idle Start-Stop with heater circulation system	2.5	4.4.

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[101] In MY 2019, Ford, FCA, and Jaguar Land Rover reached the 10 g/mile cap and three other manufacturers were within 3 g/mile of the cap. See ''The 2020 EPA Automotive Trends Report, Greenhouse Gas Emissions, Fuel Economy, and Technology since 1975,'' EPA–420–R–21–003 January 2021.

[102] 85 FR 25236.

[103] 85 FR 25237.

[104] See 40 CFR 86.1869–12(b). See also ''Joint Technical Support Document: Final Rulemaking for 2017–2025 Light-duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards for the Final Rule,'' EPA–420–R–12–901, August 2012, for further information on the definitions and derivation of the credits values.

TABLE 27—EXISTING OFF-CYCLE TECHNOLOGIES AND CREDITS FOR CARS AND LIGHT TRUCKS—Continued

Technology	Credit for cars g/mi	Credit for light trucks g/mi
Engine Idle Start-Stop without heater circulation system	1.5	2.9.
Active Transmission Warm-Up	1.5	3.2.
Active Engine Warm-Up	1.5	3.2.
Solar/Thermal Control	Up to 3.0	Up to 4.3.

TABLE 28—OFF-CYCLE TECHNOLOGIES AND CREDITS FOR SOLAR/THERMAL CONTROL TECHNOLOGIES FOR CARS AND LIGHT TRUCKS

Thermal control technology	Car credit (g/mi)	Truck credit (g/mi)
Glass or Glazing	Up to 2.9	Up to 3.9.
Active Seat Ventilation	1.0	1.3.
Solar Reflective Paint	0.4	0.5.
Passive Cabin Ventilation	1.7	2.3.
Active Cabin Ventilation	2.1	2.8.

a. Passive Cabin Ventilation

Some manufacturers have claimed the passive cabin ventilation credits based on the addition of software logic to their HVAC system that sets the interior climate control outside air/recirculation vent to the open position when the power to vehicle is turned off at higher ambient temperatures. The manufacturers have claimed that the opening of the vent allows for the flow of ambient temperature air into the cabin. While opening the vent may ensure that the interior of the vehicle is open for flow into the cabin, no other action is taken to improve the flow of heated air out of the vehicle. This technology relies on the pressure in the cabin to reach a sufficient level for the heated air in the interior to flow out through body leaks or the body exhausters to open and vent heated air out of the cabin.

The credits for passive cabin ventilation were determined based on an NREL study that strategically opened a sunroof to allow for the unrestricted flow of heated air to exit the interior of the vehicle while combined with additional floor openings to provide a minimally restricted entry for cooler ambient air to enter the cabin. The modifications that NREL performed on the vehicle reduced the flow restrictions for both heated cabin air to exit the vehicle and cooler ambient air to enter the vehicle, creating a convective airflow path through the vehicle cabin.

Analytical studies performed by manufacturers to evaluate the performance of the open dash vent demonstrate that while the dash vent may allow for additional airflow of ambient temperature air entering the cabin, it does not reduce the existing restrictions on heated cabin air exiting the vehicle, particularly in the target areas of the occupant's upper torso. That hotter air generally must escape through restrictive (by design to prevent water and exhaust fumes from entering the cabin) body leaks and occasional venting of the heated cabin air through the body exhausters. While this may provide some minimal reduction in cabin temperatures, this open dash vent technology is not as effective as the combination of vents used by the NREL researchers to allow additional ambient temperature air to enter the cabin and also to reduce the restriction of heated air exiting the cabin.

As noted in the Joint Technical Support Document: Final Rulemaking for 2017–2025 Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards, pg. 584, ''For passive ventilation technologies, such as opening of windows and/or sunroofs and use of floor vents to supply fresh air to the cabin (which enhances convective airflow), (1.7 grams/mile for LDVs and 2.3 grams/mile for LDTs) a cabin air temperature reduction of 5.7 °C can be realized.'' The passive cabin ventilation credit values were based on achieving the 5.7 °C cabin temperature reduction.

The Agency has decided to revise the passive cabin ventilation definition to make it consistent with the technology used to generate the credit value. The Agency continues to allow for innovation as the definition includes demonstrating equivalence to the methods described in the Joint TSD.

EPA proposes to revise the definition of passive cabin ventilation to only include methods that create and maintain convective airflow through the body's cabin by opening windows or a sunroof, or equivalent means of creating and maintaining convective airflow, when the vehicle is parked outside in direct sunlight.

Current systems claiming the passive ventilation credit by opening the dash vent would not meet the updated definition. Manufacturers seeking to claim credits for the open dash vent system will be eligible to petition the Agency for credits for this technology using the alternative EPA approved method outlined in § 86.1869–12(d).

b. Active Engine and Transmission Warm-Up

In the NPRM for the 2012 rule (76 FR 74854) EPA proposed capturing waste heat from the exhaust and using that heat to actively warm-up targeted parts of the engine and the transmission fluid. The exhaust waste heat from an internal combustion engine is heat that is not being used as it is exhausted to the atmosphere.

In the 2012 Final Rule (77 FR 62624), the Agency revised the definitions for active engine and transmission warm-up by replacing exhaust waste heat with the waste heat from the vehicle. As noted in the Joint TSD, pages 5–98 and 5–99, the Alliance of Automobile Manufacturers and Volkswagen recommended the definition be broadened to account for other methods of warm-up besides exhaust heat such as a secondary coolant loop.

EPA concluded that other methods, in addition to waste heat from the exhaust, that could provide similar performance—such as coolant loops or direct heating elements—may prove to be more effective alternative to direct exhaust heat. Therefore, the Agency expanded the definition in the 2012 Final Rule.

In the 2012 Final Rule the Agency also required two unique heat exchanger loops—one for the engine and one for the transmission—for a manufacturer to claim both the Active Engine Warm-up and Active Transmission Warm-up credits. EPA stated in the Joint TSD that manufacturers utilizing a single heat exchanging loop would need to demonstrate that the performance of the single loop would be equivalent to two dedicated loops in order for the manufacturer to claim both credits, and that this test program would need to be performed using the alternative method off-cycle GHG credit application described in § 86.1869–12(d).

All Agency analysis regarding active engine and transmission warm-up through the 2012 Final Rule (77 FR 62624) was performed assuming the waste heat utilized for these technologies would be obtained directly from the exhaust prior to being released into the atmosphere and not from any engine-coolant-related loops. At this time no manufacturer has introduced an exhaust waste heat exchanger to be used to warm up the engine or transmission. The systems in use are engine-coolant-loop-based and are taking heat from the coolant to warm-up the engine oil and transmission fluid.

EPA provided additional clarification on the use of waste heat from the engine coolant in preamble to SAFE rule (85 FR 24174). EPA focused on systems using heat from the exhaust as a primary source of waste heat because that heat would be available quickly and also would be exhausted by the vehicle and otherwise unused (85 FR 25240). Heat from the engine coolant already may be used by design to warm up the internal engine oil and components. That heat is traditionally not considered ''waste heat'' until the engine reaches normal operating temperature and subsequently requires it to be cooled in the radiator or other heat exchanger.

EPA allowed for the possible use of other sources of heat such as engine coolant circuits, as the basis for the credits as long as those methods would ''provide similar performance'' as extracting the heat directly from the exhaust system and would not compromise how the engine systems would heat up normally absent the added heat source. However, the SAFE rule also allowed EPA to require manufacturers to demonstrate that the system is based on ''waste heat'' or heat that is not being preferentially used by the engine or other systems to warm up other areas like engine oil or the interior cabin. Systems using waste heat from the coolant do not qualify for credits if their operation depends on, and is delayed by, engine oil temperature or interior cabin temperature. As the engine and transmission components are warming up, the engine coolant and transmission oil typically do not have any ''waste'' heat available for warming up anything else on the vehicle since they are both absorbing any heat from combustion cylinder walls or from friction between moving parts in order to achieve normal operating temperatures. During engine and transmission warm-up, the only waste heat source in a vehicle with an internal combustion engine is the engine exhaust, as the transmission and coolant have not reached warmed-up operating temperature and therefore do not have any heat to share (85 FR 25240).

EPA proposes to revise the menu definitions of active engine and transmission warm-up to no longer allow systems that capture heat from the coolant circulating in the engine block to qualify for the Active Engine and Active Transmission warm-up menu credits. EPA would allow credit for coolant systems that capture heat from a liquid-cooled exhaust manifold if the system is segregated from the coolant loop in the engine block until the engine has reached fully warmed-up operation. The Agency would also allow system design that captures and routes waste heat from the exhaust to the engine or transmission, as this was the basis for these two credits as originally proposed in the proposal for the 2012 rule. EPA's proposed approach would help ensure that the level of menu credit is consistent with the technology design envisioned by EPA when it established the credit in the 2012 rule.

Manufacturers seeking to utilize their existing systems that capture coolant heat before the engine is fully warmed-up and transfer this heat to the engine oil and transmission fluid would remain eligible to seek credits through the alternative method application process outlined in § 86.1869–12(d). EPA expects that these technologies may provide some benefit. But, as noted above since these system designs remove heat that is needed to warm-up the engine the Agency expects that these technologies will be less effective than those that capture and utilize exhaust waste heat.

iv. Clarification Regarding Use of Menu Credits

Finally, EPA proposes to clarify that manufacturers claiming credits for a menu technology must use the menu pathway rather than claim credits through the public process or 5-cycle testing pathways. EPA views this as addressing a potential loophole around the menu cap. As is currently the case, a new technology that represents an advancement compared to the technology represented by the menu credit—that is, by providing significantly more emissions reductions than the menu credit technology—would be eligible for the other two pathways.

4. Air Conditioning System Credits

There are two mechanisms by which A/C systems contribute to the emissions of GHGs: Through leakage of hydrofluorocarbon refrigerants into the atmosphere (sometimes called ''direct emissions'') and through the consumption of fuel to provide mechanical power to the A/C system (sometimes called ''indirect emissions'').[105] The high global warming potential of the previously most common automotive refrigerant, HFC–134a, means that leakage of a small amount of refrigerant will have a far greater impact on global warming than emissions of a similar amount of CO_2. The impacts of refrigerant leakage can be reduced significantly by systems that incorporate leak-tight components, or, ultimately, by using a refrigerant with a lower global warming potential. The A/C system also contributes to increased tailpipe CO_2 emissions through the additional work required to operate the compressor, fans, and blowers. This additional power demand is ultimately met by using additional fuel, which is converted into CO_2 by the engine during combustion and exhausted through the tailpipe. These emissions can be reduced by increasing the overall efficiency of an A/C system, thus reducing the additional load on the engine from A/C operation, which in turn means a reduction in fuel consumption and a commensurate reduction in GHG emissions.

Manufacturers may generate credits for improved A/C systems to help them comply with the CO_2 fleet average standards since the MY 2012 and later MYs. Because A/C credits represent a low-cost and effective technology pathway, EPA expected manufacturers to generate both A/C refrigerant and efficiency credits, and EPA accounted for those credits in developing the final CO_2 standards for the 2012 and SAFE rules, by adjusting the standards to make them more stringent. EPA believes it is important to encourage manufacturers to continue to implement low GWP refrigerants or low leak systems. Thus, EPA is not proposing

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[105] 40 CFR 1867–12 and 40 CFR 86.1868–12.

any changes for its A/C credit provisions and is taking the same approach in adjusting the level of the proposed standards to reflect the use of the A/C credits. However, if EPA were to remove the refrigerant credits from the program, the proposed standards would need to be adjusted or increased by the amount of the credit to reflect its elimination from the program.

5. Natural Gas Vehicles Technical Correction

In the SAFE proposal, EPA sought comment on whether it should adopt additional incentives for natural gas-fueled light-duty vehicles.[106] After considering comments, EPA finalized additional incentive multipliers for MYs 2022–2026 natural gas vehicles.[107] EPA also received comments recommending that EPA adopt an additional incentive for natural gas vehicles in the form of a 0.15 multiplicative factor that would be applied to the CO_2 emissions measured from the vehicle when tested on natural gas. Commenters recommended the 0.15 factor as an appropriate way to account for the potential use of renewable natural gas (RNG) in the vehicles.[108]

EPA decided not to adopt the additional 0.15 factor incentive, as discussed in the preamble to the SAFE Rule.[109] EPA provided a detailed rationale for its decision not to implement a 0.15 factor recommended by commenters in the SAFE Rule.[110] EPA is not revisiting or reopening its decision regarding the 0.15 factor. However, the regulatory text adopted in the SAFE rule contains an inadvertent clerical error that conflicts with EPA's decision and rationale in the final SAFE rule preamble and provides an option for manufacturers to use this additional incentive in MYs 2022–2026 by multiplying the measured CO_2 emissions measured during natural gas operation by the 0.15 factor.[111] EPA is proposing narrow technical amendments to its regulations to correct this clerical error by removing the option to use the 0.15 factor in MY 2022 (as discussed in Section II.B.1.iii, EPA is proposing to eliminate multipliers for NGVs after MY 2022). This will ensure the regulations are consistent with the decision and rationale in the SAFE final rule. EPA likely would not have granted credits under the erroneous regulatory text if such credits were sought by a manufacturer because the intent of the agency was clear in the preamble text. In addition, natural gas vehicles are not currently offered by any manufacturer and EPA is not aware of any plans to do so. Therefore, there are no significant impacts associated with the correction of this clerical error.

C. What alternatives is EPA considering?

Along with the proposed standards, EPA analyzed both a more stringent and a less stringent alternative. For the less stringent alternative, Alternative 1, EPA used the coefficients in the California Framework for the 2.7 percent effective stringency level (as described previously in Section II.B.1) as the basis for the MY 2023 stringency level and the 2012 rule MY 2025 standards as the basis for the MY 2026 stringency level, with linear year-over-year reductions between the two points for MYs 2024 and 2025. EPA views the California Framework as a reasonable basis for the least stringent alternative that EPA would consider finalizing, since it represents a level of stringency that five manufacturers have already committed to achieving. EPA did not include incentive multipliers for Alternative 1, as doing so would only further reduce the effective stringency of this Alternative, and EPA views Alternative 1 as the lower end of stringency that it believes is appropriate through MY 2026.

For the more stringent alternative, Alternative 2, EPA used the 2012 rule standards as the basis for MY 2023–2025 targets, with the standards continuing to increase in stringency in a linear fashion for MY 2026. Alternative 2 adopts the 2012 rule stringency levels in MY 2023 and follows the 2012 rule standard target levels through MY 2025. EPA extended the same linear average year-over-year trajectory for MYs 2023–2025 to MY 2026 for the final standards under Alternative 2. As noted in Section II.A.1, EPA believes it is important to continue to make progress in MY 2026 beyond the MY 2025 standard levels in the 2012 rule. As with the proposal, Alternative 2 meets this objective. EPA also did not include in Alternative 2 the proposed incentive multipliers with the proposed cumulative credit cap in MYs 2022–2025, which would have the effect of making Alternative 2 less stringent. As noted in Section II.B.1, EPA is requesting comment on whether or not to include the proposed multipliers, and our request for comments extends to whether to include multipliers both for the proposal and for Alternative 2.

The fleet average targets for the two alternatives compared to the proposed standards are provided in Table 29 below. EPA also requests comment on the level of stringency for MY 2026 for the alternatives and the proposed standards. Specifically, EPA requests comment on standards for MY 2026 that would result in fleet average target levels that are in the range of 5–10 g/mile lower (*i.e.,* more stringent) than the levels shown for MY 2026 in Table 29. EPA is requesting specific comment on whether the level of stringency for MY 2026 should be greater in keeping with the additional lead time available for this out-year compared to MYs 2023–2025, and because EPA may determine that it is appropriate, particularly in light of the accelerating transition to electrified vehicles, to require additional reductions in this time frame. As discussed in detail in Section A.3 of the Executive Summary, there has been a proliferation of recent announcements from automakers signaling a rapidly growing shift in investment away from internal-combustion technologies and toward high levels of electrification. EPA has also heard from a wide range of stakeholders over the past several months, including but not limited to the automotive manufacturers and the automotive suppliers, that the significant investments being made now to develop and launch new EV product offerings and in the expansion of EV charging infrastructure could enable higher levels of EV penetration to occur in the marketplace by the MY 2026 time frame than EPA has projected as the basis for both the proposed MY 2026 standards and the Alternative 2 MY 2026 standards. The information concerning the investment landscape potentially accelerating to an even greater extent of market penetration of EV products is the basis on which EPA is relying in soliciting comment on the potential for a more stringent MY 2026 standard that would reflect this information and related considerations, including any additional information provided by commenters.

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[106] 83 FR 43464, August 24, 2018.

[107] 85 FR 25211, April 30, 2020.

[108] 85 FR 25210–25211.

[109] 85 FR 25211.

[110] *Ibid.*

[111] See 40 CFR 600.510–12(j)(2)(v) and (j)(2)(vii)(A).

TABLE 29—PROJECTED FLEET AVERAGE TARGET LEVELS FOR PROPOSED STANDARDS AND ALTERNATIVES

[CO_2 grams/mile]

Model year	Proposal projected targets	Alternative 1 projected targets	Alternative 2 projected targets
2021	*223	*223	*224
2022	*220	*220	*220
2023	199	203	195
2024	189	194	186
2025	180	185	177
2026**	171	177	169

* SAFE rule standards included here for reference.

** EPA is also requesting comment on MY 2026 standards and alternatives that would result in fleet average levels that are 5–10 g/mile more stringent than the levels shown.

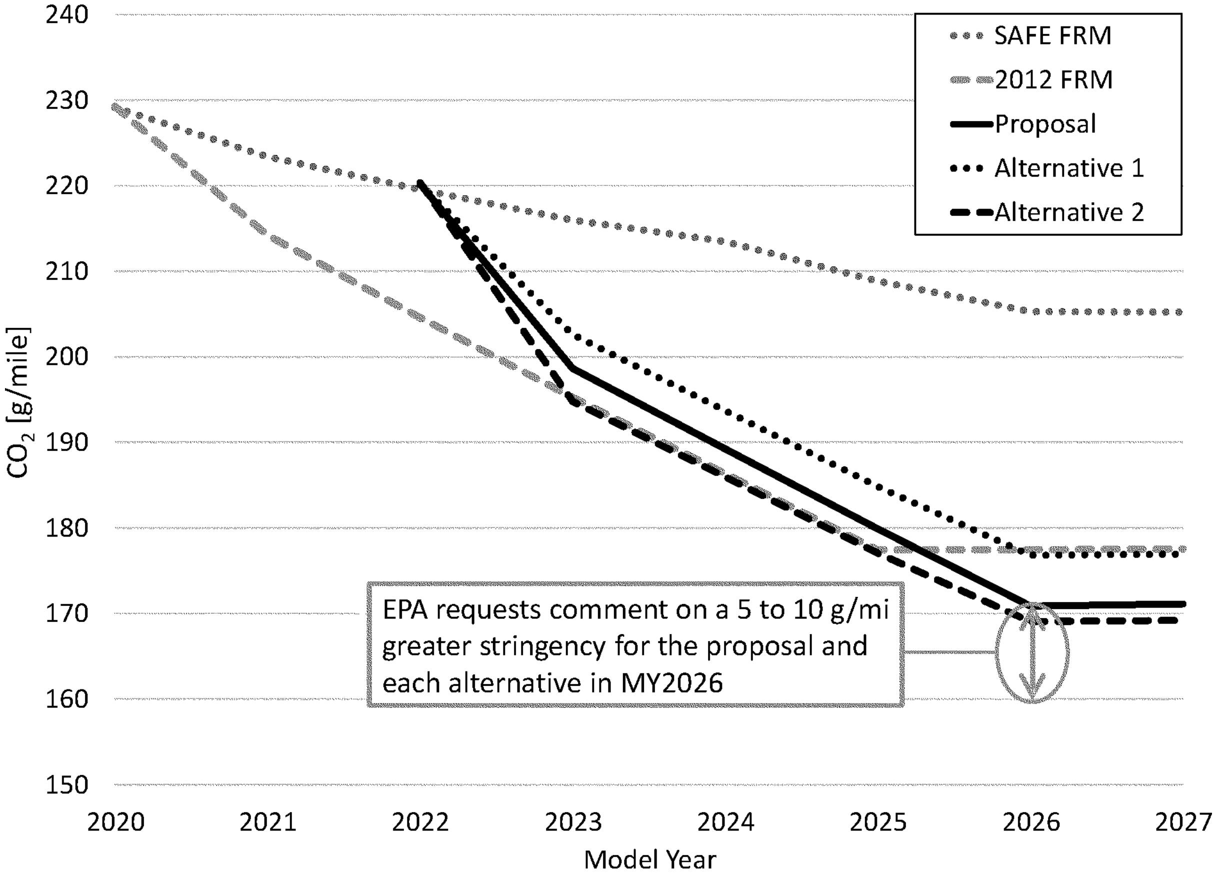

Figure 8 Proposed Standards Fleet Average Targets Compared to Alternatives

As shown in Figure 8, the range of alternatives that EPA is considering is fairly narrow, with the proposed standard targets differing from the alternatives in any given MY in MYs 2023–2026 by 2 to 6 g/mile, notwithstanding EPA's request for comment on more stringent standards for MY 2026 standards noted above. EPA believes this approach is reasonable and appropriate considering the relatively short lead time for the proposed standards, especially for MYs 2023–2025; our assessment of feasibility, the existing automaker commitments to meet the California Framework (representing about one-third of the auto market), the standards adopted in the 2012 rule; and the need to reduce GHG emissions. EPA provides a discussion of the feasibility of the proposed standard and alternatives and the selection of the proposed standards in Section III.D. The analysis of costs and benefits of Alternatives 1 and 2 is shown in the DRIA Chapters 4, 6, and 10. EPA requests comments on all aspects of Alternatives 1 and 2 or other alternatives roughly within the stringency range of the proposal and the Alternatives.

III. Technical Assessment of the Proposed CO_2 Standards

Section II provided a description of EPA's proposed standards and related program elements and industry-wide estimates of projected GHG emissions targets. This Section III provides an overview of EPA's technical assessment of the proposed standards including the approach EPA used for its analysis, EPA's projected target levels by manufacturer, projected per vehicle cost for each manufacturer, EPA's projections of EV and PHEV technology penetration rates, and a discussion of why EPA believes the proposed standards are technologically feasible, drawing from these analyses. Finally, this section discusses the alternative standards EPA analyzed in developing the proposal. The DRIA presents further details of the analysis including a full assessment of technology penetration rate and cost projections. EPA discusses the basis for our proposed standards under CAA section 202(a) in Section VI, and Section VII presents aggregate cost and benefit projections as well as other program impacts.

a. What approach did EPA use in analyzing potential standards?

The proposed standards are based on the extensive light-duty GHG technical analytical record developed over the past dozen years, as represented by the EPA supporting analyses for the 2010 and 2012 final rules, the Mid-Term Evaluation (including the Draft TAR, Proposed Determination and Final Determinations), as well as the updated analysis for this proposed rule and the supporting analysis for the SAFE rule. The updated analysis for this proposed rule is intended to allow direct comparison to the analysis used in the SAFE FRM and is not intended to be the sole technical basis of the proposed standards. EPA's extensive record is consistent and makes clear that GHG standards at the level of stringency and in the time frame of this proposed rule are feasible at reasonable costs and result in significant GHG emission reductions and public health and welfare benefits. The updated analysis also shows that, consistent with past analyses, when modeling standards of similar stringency to those set forth in the 2012 rule, the results are similar to those results presented previously. In particular, the estimated costs for manufacturers to meet standards similar to those proposed have been roughly consistent since EPA first estimated them in 2012. The DRIA Chapter 1 further discusses and synthesizes EPA's record supporting stringent GHG standards through the MY 2025/2026 time frame.

To confirm that these past analyses continue to provide valid results for consideration by the Administrator in selecting the most appropriate level of stringency and other aspects of the proposed standards, we have conducted an updated analysis of the proposed standards. In the past, EPA has traditionally used its OMEGA (Optimization Model for reducing Emissions of Greenhouse gases from Automobiles) model as the basis for setting light-duty GHG emissions standards. EPA's OMEGA model was not used to support the analysis of the GHG standards for the SAFE FRM; instead, NHTSA's Corporate Average Fuel Economy (CAFE) Compliance and Effects Modeling System (CCEMS) model was used.

In considering modeling tools to support the analysis for today's proposed GHG standards, EPA has chosen to use the peer reviewed CCEMS model and to use the same version of that model used in support of the SAFE FRM. EPA has made this choice specific to this proposal for the purpose of enabling direct comparison to the SAFE FRM analysis, which addressed a model-year timespan consistent with this proposal.

Given that the SAFE FRM was published only a year ago, direct comparisons between the analysis presented here and the analysis presented in support of the SAFE FRM are made more direct if the same modeling tool is used. For example, CCEMS has categorizations of technologies and model output formats that are distinct to the model, so continuing use of CCEMS for this proposal facilitates comparisons to the SAFE FRM. Also, by using the same modeling tool as used in the SAFE rule, we can more clearly illustrate the influence of some of the key updates to the inputs used in the SAFE FRM. EPA believes that using that same tool, with changes to some of the critical inputs as discussed below (see Table 30), provides a better apples-to-apples comparison and serves to strengthen the basis for why we are proposing changes to the standards.

Some public comments received on the SAFE NPRM argued that EPA should use its own modeling tools to support the EPA action. In addition to the reasoning described above on the value of comparing results to the SAFE FRM, our decision here to utilize the CCEMS model as an appropriate tool for this analysis is informed by our consideration of the significant revisions made to the model between the SAFE proposal and the SAFE FRM and carried over here, and by the opportunity this analysis provides to incorporate additional updates to key inputs and assumptions.

Other commenters expressed concerns about technical issues with the NPRM analysis. During EPA's own review and after consideration of public comments, we concluded that a number of these concerns were well founded, and potentially significant enough to merit revisions to the analysis. Some key revisions made for the SAFE FRM version of the CCEMS model include changes to the decision logic for technology application by manufacturers and changes related to the SAFE NPRM's unrealistic changes in VMT associated with the scrappage modeling. Similarly, a number of revisions were also made to the model inputs for the SAFE FRM, including the adjustment of some technology effectiveness values.

In considering what revisions to the analysis were needed from the SAFE NRPM to the SAFE FRM, and from the SAFE FRM to this proposal, we are careful to make a distinction between the model and the inputs. As stated in the SAFE FRM preamble, ''[I]nputs do not define models; models use inputs. Therefore, disagreements about inputs do not logically extend to disagreements about models. Similarly, while models determine resulting outputs, they do so based on inputs.'' [112] To illustrate, while CCEMS and OMEGA are different models, they both provide comparable results when comparable inputs are used. For example, as discussed in Chapter 1.2.2 of the DRIA, EPA's OMEGA model runs conducted for the MTE show a MY2025 technology cost for the 2012 rule relative to the SAFE FRM of between $922 to $1,228 per vehicle, depending on the specific analysis. Thus, the MY2025 per vehicle costs of $942 (see RIA Chapter 4.1.2.1) from CCEMS modeling runs for this proposal relative to a full fleet meeting the SAFE FRM are comparable to our past analyses of standards for the similar level of stringency and are within the bounds of previous EPA analyses and sensitivity studies conducted for the MTE using OMEGA (see DRIA Chapter 1.2.2).

Throughout the development of the SAFE FRM, EPA had significant input on revisions to the analysis and EPA considered the FRM version of the CCEMS model, given changes made in response to public comments and our own input, to be an effective modeling tool for purposes of assessing standards through the MY 2026 timeframe.

While we believe the SAFE FRM model and inputs, together with the key changes that we have made since the SAFE FRM, are appropriate for the particular analysis at hand in assessing standards through MY2026, we welcome comments on other changes to the inputs that may be more appropriate for use in the final rule.

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[112] See 85 FR 24218.

Finally, EPA recognizes that in the Revised Final Determination [113] and the SAFE rule, the agency expressed concerns that were based at least in part on comments from certain stakeholders about uncertainties, lack of rigor and certain technical issues in the analyses used for the 2016 Proposed Determination and 2017 Final Determination. However, EPA has reconsidered those criticisms, as well as the prior analyses, and concludes that the prior concerns expressed do not undermine the utility and relevance of the prior analyses for this rulemaking. Our consideration of such analyses is reasonable because EPA no longer agrees with those concerns and/or because the concerns raised technical issues that we believe do not significantly impact the analyses. Additionally, the updated modeling for this rulemaking addresses many of the concerns previously identified.

For use in future vehicle standards analyses, EPA is developing an updated version of its OMEGA model. This updated model, OMEGA2, is being developed to better account for the significant evolution over the past decade in vehicle markets, technologies, and mobility services. In particular, the recent advancements in battery electric vehicles (BEVs), and their introduction into the full range of market segments provides strong evidence that vehicle electrification can play a central role in achieving greater levels of emissions reduction in the future. In developing OMEGA2, EPA is exploring the interaction between consumer and producer decisions when modeling compliance pathways and the associated technology penetration into the vehicle fleet. OMEGA2 also is being designed to have expanded capability to model a wider range of GHG program options than are possible using existing tools, which will be especially important for the assessment of policies that are designed to address future GHG reduction goals. While the OMEGA2 model is not available for use in this proposal, we plan to begin peer review of the draft model in the fall of 2021.

As noted, to allow for direct comparison to the analytical results used to support the recent SAFE FRM, our updated analysis is based on the same version of the CCEMS model that was used for the SAFE FRM. The CCEMS model was extensively documented by NHTSA for the SAFE FRM and the documentation also applies to the updated analysis for this proposed rule.[114] While the CCEMS model itself remains unchanged from the version used in the SAFE rule, EPA has made the following changes (shown in Table 30) to the inputs for this analysis. Additional information concerning the changes in model inputs can be found in the sections of the preamble and DRIA cited in the table. EPA invites public comment on the input changes noted below, as well as on whether there are other input choices that EPA should consider making for the final rule. In offering comments on the modeling inputs, EPA encourages stakeholders to provide technical support for any suggestions in changes to modeling inputs.

TABLE 30—CHANGES MADE TO CCEMS MODEL INPUTS FOR THIS PROPOSAL, RELATIVE TO THE SAFE FRM ANALYSIS

Input file	Changes
parameters file	Global social cost of carbon $/ton values in place of domestic values (see DRIA Chapter 3.3).
	Inclusion of global social cost of methane (CH_4) and nitrous oxide (N_2O) $/ton values (see Section IV).
	Updated $PM_{2.5}$ cost factors (benefit per ton values, see Section VII.E).
	Rebound effect of −0.10 rather than −0.20 (see DRIA Chapter 3.1).
	AEO2021 fuel prices (expressed in 2018 dollars) rather than AEO2019.
	Updated energy security cost per gallon factors (see Section VII.F).
	Congestion cost factors of 6.34/6.34/5.66 (car/van-SUV/truck) cents/mile rather than 15.4/15/4/13.75 (see RIA Chapter 5).
	Discounting values to calendar year 2021 rather than calendar year 2019.
	The following fuel import and refining inputs have been changed based on AEO2021 (see DRIA Chapter 3.2): Share of fuel savings leading to lower fuel imports: Gasoline 7%; E85 19%; Diesel 7% rather than 50%; 7.5%; 50%. Share of fuel savings leading to reduced domestic fuel refining: Gasoline 93%; E85 25.1%; Diesel 93% rather than 50%; 7.5%; 50%. Share of reduced domestic refining from domestic crude: Gasoline 9%; E85 2.4%; Diesel 9% rather than 10%; 1.5%; 10%. Share of reduced domestic refining from imported crude: Gasoline 91%; E85 24.6%; Diesel 91% rather than 90%; 13.5%; 90%.
technology file	High compression ratio level 2 (HCR2, sometimes referred to as Atkinson cycle) technology allowance set to TRUE for all engines beginning in 2018 (see DRIA Chapter 2).
market file	On the Engines sheet, we allow high compression ratio level 1 (HCR1) and HCR2 technology on all 6-cylinder and smaller engines rather than allowing it on no engines (see DRIA Chapter 2).
	Change the off-cycle credit values on the Credits and Adjustments sheet to 15 grams/mile for 2020 through 2026 (for the CA Framework) or to 15 gram/mile for 2023 through 2026 (for the proposed option) depending on the model run.

Consistent with the SAFE FRM, EPA is using the MY2017 base year fleet, which is projected to a future fleet based on the CCEMS model's sales, scrappage, and fleet mix responses to the standards being analyzed. When performing compliance analyses, EPA will often attempt to utilize the most recent base year data that is available as finalized compliance data, which at the time of this analysis was for MY2019. It is important to note that because the model applies technologies to future vehicles for all alternatives being analyzed, including the ''No Action'' scenario, the vintage of the base year normally will not have a significant impact on the model results for

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[113] See 83 FR 16077.

[114] See CCEMS Model Documentation on web page *https://www.nhtsa.gov/corporate-average-fuel-economy/compliance-and-effects-modeling-system.*

projected fleets. There might be additional reason to update the base year fleet in cases where a broad shift has occurred in vehicle power-to-weight ratios, since that can impact the incremental cost effectiveness of emissions-reducing technologies. EPA's annual Automotive Trends Report[115] shows only a modest increase (approximately 3 percent) in the average vehicle power-to-weight ratio between MYs 2017 and 2019, and therefore we have concluded that the MY2017 base year remains a sound basis for this analysis. EPA requests comment on the use of the MY2017 base year fleet and whether it would be more appropriate to update the base year fleet for the final rule, for example by using a base year fleet reflecting the most recent final compliance data. Accordingly, we are using the data contained in the SAFE FRM market file (the base year fleet) except as described in Table 30 and splitting the market file into separate California Framework OEM (FW–OEM) and non-Framework OEM (NonFW–OEM) fleets for some model runs. Note that the scrappage model received many negative comments in response to the SAFE NPRM, but changes made for the FRM version of the CCEMS model were responsive to the identified issues involving sales and VMT results of the SAFE NPRM version of the CCEMS model.[116]

As mentioned, for some model runs we have split the fleet in two, one fleet consisting of California Framework OEMs (FW–OEMs) and the other consisting of the non-Framework OEMs (NonFW–OEMs). This was done because the FW–OEMs would be meeting more stringent emission reduction targets (as set in the scenarios file) and would have access to more (15 g/mi rather than 10 g/mi) off-cycle credits (as set in the market and scenarios file) and more advanced technology incentive multipliers, while the NonFW–OEMs would be meeting less stringent standards and would have access to 10 g/mi off-cycle credits and would not have access to any advanced technology multipliers. For such model runs, a post-processing step was necessary to properly sales-weight the two sets of model outputs into a single fleet of results. This post-processing tool is in the docket for this rule.[117]

Importantly, our primary model runs consist of a ''No Action'' scenario and an ''action'' scenario. The results, or impact of our proposed standards, are measured relative to the no action scenario. Our No Action scenario consists of the Framework OEMs (roughly 29 percent of fleet sales) meeting the Framework emission reduction targets and the Non-Framework OEMs (roughly 71 percent of fleet sales) meeting the SAFE FRM standards. Our action scenario consists of the whole fleet meeting our proposed standards for MYs 2023 and later. Throughout this preamble, our ''No Action scenario'' refers to this Framework-OEM/NonFramework-OEM compliance split. EPA may consider a different No Action scenario for the final rule. For example, currently the No Action baseline includes the California Framework Agreement emission targets for those automakers who have committed to them, but does not include California's GHG or ZEV standards, because California does not currently have a waiver to enforce those standards. If, after consideration of public comment, EPA were to rescind the withdrawal of California's Advanced Clean Car waiver, then it might be appropriate to update the No Action scenario to reflect California's GHG and ZEV standards. EPA seeks comment on potential adjustments to the No Action scenario.

In our updated analysis, as indicated in Table 18, we are using a vehicle-miles-traveled (VMT) rebound effect of 10 percent. The 10 percent value has been used in EPA supporting analyses for the 2010 and 2012 final rules as well as the MTE. The SAFE rule used a VMT rebound effect of 20 percent. Our assessment indicates that a rebound effect of 10 percent is appropriate and supported by the body of research on the rebound effect for light-duty vehicle driving, as described further in the DRIA Chapter 3.1. We are requesting comment on the use of the 10 percent VMT rebound value, or an alternative value such as 5 or 15 percent, for our analysis of the MY2023 through 2026 standards.

EPA has chosen to change a select number of the SAFE FRM model inputs, as listed in Table 30, largely because we concluded that other potential updates, regardless of their potential merit, such as the continued use of the MY2017 base year fleet, would not have a significant impact on the assessment of the proposed standards. In addition, while the technology effectiveness estimates used in the CCEMS model to support the SAFE FRM could have been updated with more recent engine maps, the incremental effectiveness values are of primary importance within the CCEMS model and, while the maps are somewhat dated, the incremental effectiveness values derived from them are in rough agreement with incremental values derived from more up-to-date engine maps (see DRIA Chapter 2). Likewise, while the electrified vehicle battery costs used in the SAFE FRM could have been lower based on EPA's latest assessment, we concluded that updating those costs for this proposal would not have a notable impact on overall cost estimates, although we may consider doing so for the final rule. The past EPA analyses described above generally have estimated EV penetrations of less than 5 percent, and electrification continues to play a relatively modest role in our projections of compliance paths for the proposed standards. In contrast to the model inputs unchanged from the SAFE rule as described above, the treatment of HCR1 and HCR2 technologies in the CCEMS model, specifically a broader availability of those technologies as a compliance choice within the model, was considered by EPA to be significant and we made an update to the model's inputs relative to the SAFE FRM. We made that choice because these are a very cost-effective ICE technology that is in-use today and ready for broader application. In short, there are many modeling inputs that EPA has chosen not to change out of the very large number of inputs required to run a model as complex as the CCEMS model, but there are others we have updated with most of those updated because of the way they value the effects of emissions on public health. EPA seeks comment on our choice of modeling inputs, including whether additional inputs should be modified for the final rule analysis.

B. Projected Compliance Costs and Technology Penetrations

1. GHG Targets and Compliance Levels

The proposed curve coefficients were presented in Table 22. Here we present the projected fleet targets for each manufacturer. These targets are projected based on each manufacturer's car/truck fleets and their sales weighted footprints. As such, each manufacturer has a set of targets unique to them. The projected targets are shown by manufacturer for MYs 2023 through 2026 in Table 31 for cars, Table 32 for trucks, and Table 33 for the combined fleets.[118]

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[115] See Table 3.1, U.S. Environmental Protection Agency (2021). 2020 EPA Automotive Trends Report: Greenhouse Gas Emissions, Fuel Economy, and Technology since 1975. EPA–420–R–21–003.

[116] See 85 FR 24647.

[117] See EPA_CCEMS_PostProcessingTool, Release 0.3.1 July 21, 2021.

[118] Note that these targets are projected based on both projected future sales in applicable MYs and our proposed standards; after the standards are finalized the targets will change depending on each manufacturer's actual sales.

TABLE 31—CAR TARGETS

[CO_2 gram/mile]

	2023	2024	2025	2026
BMW	166	158	150	143
Daimler	173	165	157	149
FCA	169	161	153	146
Ford	167	159	151	144
General Motors	166	158	151	143
Honda	163	155	147	140
Hyundai Kia-H	165	157	149	142
Hyundai Kia-K	164	156	149	142
JLR	174	166	158	150
Mazda	163	155	147	140
Mitsubishi	151	143	136	130
Nissan	164	156	148	141
Subaru	160	152	145	138
Tesla	191	182	173	165
Toyota	162	154	147	140
Volvo	172	164	156	148
VWA	160	152	145	138
Total	165	157	149	142

TABLE 32—TRUCK TARGETS

[CO_2 gram/mile]

	2023	2024	2025	2026
BMW	219	208	198	188
Daimler	225	214	203	193
FCA	233	222	211	200
Ford	246	234	222	211
General Motors	252	239	228	216
Honda	215	205	195	185
Hyundai Kia-H	214	203	193	183
Hyundai Kia-K	217	206	196	186
JLR	221	210	199	190
Mazda	206	196	186	177
Mitsubishi	194	184	175	166
Nissan	225	214	203	193
Subaru	197	187	178	169
Tesla	....	....	....	....
Toyota	227	216	205	195
Volvo	222	211	200	190
VWA	218	207	196	187
Total	232	221	210	199

TABLE 33—COMBINED FLEET TARGETS

[CO_2 gram/mile]

	2023	2024	2025	2026
BMW	187	178	169	161
Daimler	195	186	177	168
FCA	221	210	200	190
Ford	215	205	195	185
General Motors	215	204	195	185
Honda	185	176	167	159
Hyundai Kia-H	168	160	152	145
Hyundai Kia-K	177	169	161	153
JLR	211	200	190	181
Mazda	176	167	159	151
Mitsubishi	168	160	152	145
Nissan	185	176	167	159
Subaru	187	178	169	161
Tesla	191	182	173	165
Toyota	194	185	176	167
Volvo	205	195	185	176
VWA	179	171	162	155

TABLE 33—COMBINED FLEET TARGETS—Continued

[CO_2 gram/mile]

	2023	2024	2025	2026
Total	198	189	180	171

The modeled achieved CO_2-equivalent (CO_2e) levels for the proposed standards are shown in Table 34 for cars, Table 35 for trucks, and Table 36 for the combined fleets. These values were produced by the modeling analysis and represent the projected certification emissions values for possible compliance approaches with the proposed standards for each manufacturer. These achieved values, shown as averages over the respective car, truck and combined fleets, include the 2-cycle tailpipe emissions based on the modeled application of emissions-reduction technologies minus the modeled application of off-cycle credit technologies and the full A/C efficiency credits. The values also reflect any application of the proposed advanced technology multipliers, up to the cap. Hybrid pickup truck incentive credits were not modeled (the CCEMS version used does not have this capability) and are therefore not included in the achieved values.

Comparing the target and achieved values, it can be seen that some manufacturers are projected to have achieved values that are over target (higher emissions) on trucks, and under target (lower emissions) on cars, and vice versa for other manufacturers. This is a feature of the unlimited credit transfer provision, which results in a compliance determination that is based on the combined car and truck fleet credits rather than a separate determination of each fleet's compliance. The application of technologies is influenced by the relative cost-effectiveness of technologies among each manufacturer's vehicles, which explains why different manufacturers exhibit different compliance approaches in the modeling results. For the combined fleet, the achieved values are typically close to, or slightly under the target values, which would represent the banking of credits that can be carried over into other model years. For all manufacturers, the total achieved values for MYs 2023 to 2026 are within −1 to +3 grams/mile of the total target values. This indicates that overall, the modeled fleet tracks the standards very closely from year-to-year. Note that an achieved value for a manufacturer's combined fleet that is above the target in a given model year does not indicate a likely failure to comply with the standards, since the model includes the GHG program credit banking provisions that allow credits from one year to be carried into another year.

TABLE 34—CAR ACHIEVED LEVELS

[CO_2e gram/mile]

	2023	2024	2025	2026
BMW	173	168	168	131
Daimler	184	169	166	168
FCA	183	178	178	171
Ford	168	160	159	151
General Motors	152	136	133	132
Honda	161	161	161	130
Hyundai Kia-H	162	147	146	145
Hyundai Kia-K	138	134	134	137
JLR	217	162	158	165
Mazda	156	156	156	146
Mitsubishi	136	136	129	129
Nissan	165	153	147	147
Subaru	193	193	193	174
Tesla	−20	−20	−20	−20
Toyota	161	143	135	133
Volvo	185	185	184	145
VWA	146	144	143	135
Total	161	150	147	141

TABLE 35—TRUCK ACHIEVED LEVELS

[CO_2e gram/mile]

	2023	2024	2025	2026
BMW	220	210	156	161
Daimler	206	206	151	126
FCA	218	217	217	207
Ford	245	234	234	216
General Motors	270	261	245	224
Honda	212	210	210	210
Hyundai Kia-H	222	129	129	140
Hyundai Kia-K	225	209	209	209
JLR	210	210	176	187
Mazda	177	177	177	176

TABLE 35—TRUCK ACHIEVED LEVELS—Continued

[CO_2e gram/mile]

	2023	2024	2025	2026
Mitsubishi	194	194	185	185
Nissan	220	218	198	192
Subaru	187	187	187	168
Tesla	....	....	....	....
Toyota	239	231	224	204
Volvo	181	180	176	183
VWA	240	200	173	122
Total	233	226	218	203

TABLE 36—COMBINED FLEET ACHIEVED LEVELS

[CO_2e gram/mile]

	2023	2024	2025	2026
BMW	192	184	163	143
Daimler	194	185	159	150
FCA	211	210	210	200
Ford	215	205	205	190
General Motors	220	208	197	185
Honda	183	181	182	164
Hyundai Kia-H	166	146	145	145
Hyundai Kia-K	160	153	153	156
JLR	212	200	172	182
Mazda	162	162	162	155
Mitsubishi	159	160	152	152
Nissan	184	175	164	163
Subaru	189	189	189	170
Tesla	−20	−20	−20	−20
Toyota	199	186	179	168
Volvo	182	182	179	170
VWA	178	163	153	131
Total	197	188	183	172

2. Projected Compliance Costs per Vehicle

EPA has performed an updated assessment of the estimated per vehicle costs for manufacturers to meet the proposed MY2023–2026 standards. The car costs per vehicle from this analysis are shown in Table 37, followed by truck costs in Table 38 and combined fleet costs in Table 39.[119]

As shown in these tables, the combined cost for car and truck fleets, averaged over all manufacturers, increases from MY 2023 to MY 2026 as the proposed standards become more stringent. The costs for trucks tend to be somewhat higher than for cars—many technology costs scale with engine and vehicle size—but it is important to note that the absolute emissions, and therefore emissions reductions, also tend to be higher for trucks. Projected costs for individual manufacturers vary based on the composition of vehicles produced. The estimated costs for California Framework Agreement manufacturers in MY 2026 range from approximately $500–$850 dollars per vehicle—because the proposed standards are more stringent than the Framework emission reduction targets—and fall within the wider cost range of non-Framework manufacturers. The estimated costs for Framework manufacturers are somewhat lower than the overall industry average costs of approximately $1,000 per vehicle in MY 2026.

TABLE 37—CAR COSTS PER VEHICLE RELATIVE TO THE NO ACTION SCENARIO

[2018 dollars]

	2023	2024	2025	2026
BMW *	$64	$40	$42	$254
Daimler	37	414	490	487
FCA	465	525	511	823
Ford *	22	234	228	458
General Motors	662	1,351	1,354	1,512
Honda *	39	44	43	766
Hyundai Kia-H	457	845	847	878

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[119] As shown in Table 23, Tesla incurs nearly $400 in costs per vehicle despite being a pure electric vehicle maker (0 grams/mile) and despite there being no upstream emissions accounting under the proposal. The costs shown for Tesla represent the costs of 15 grams/mile of off-cycle credit.

TABLE 37—CAR COSTS PER VEHICLE RELATIVE TO THE NO ACTION SCENARIO—Continued

[2018 dollars]

	2023	2024	2025	2026
Hyundai Kia-K	395	406	396	416
JLR	−510	1,075	1,076	1,006
Mazda	510	522	517	745
Mitsubishi	870	860	993	985
Nissan	614	825	940	912
Subaru	403	397	392	710
Tesla	398	393	387	382
Toyota	470	822	958	979
Volvo *	212	210	222	211
VWA *	158	168	177	185
Total	383	643	682	846

* Framework Manufacturer.

TABLE 38—TRUCK COST PER VEHICLE RELATIVE TO THE NO ACTION SCENARIO

[2018 dollars]

	2023	2024	2025	2026
BMW *	$270	$264	$1,080	$1,037
Daimler	1,641	1,582	2,964	4,233
FCA	1,074	1,022	974	1,423
Ford *	34	279	267	500
General Motors	786	977	1,350	2,100
Honda *	25	64	63	62
Hyundai Kia-H	398	3,370	3,170	2,995
Hyundai Kia-K	435	482	475	468
JLR	752	740	2,140	2,007
Mazda	787	783	777	788
Mitsubishi	440	434	599	592
Nissan	556	590	978	1,178
Subaru	415	410	404	808
Tesla	0	0	0	0
Toyota	440	590	763	1,081
Volvo *	1,193	1,140	1,040	997
VWA *	35	1,028	1,595	2,148
Total	546	682	855	1,232

* Framework Manufacturer.

TABLE 39—FLEET AVERAGE COST PER VEHICLE RELATIVE TO THE NO ACTION SCENARIO

[2018 dollars]

	2023	2024	2025	2026
BMW *	$145	$129	$459	$566
Daimler	727	917	1,567	2,123
FCA	957	927	886	1,309
Ford *	29	261	252	485
General Motors	733	1,138	1,353	1,854
Honda *	33	52	52	467
Hyundai Kia-H	454	1,006	997	1,015
Hyundai Kia-K	404	424	413	426
JLR	471	813	1,904	1,784
Mazda	591	599	595	758
Mitsubishi	697	688	833	825
Nissan	595	746	954	1,005
Subaru	412	406	401	783
Tesla	398	393	387	382
Toyota	456	709	863	1,033
Volvo *	860	827	766	731
VWA *	116	456	656	853
Total	465	663	771	1,044

* Framework Manufacturer.

Overall, EPA estimates the average costs of today's proposal at $1,044 per vehicle in MY2026 relative to meeting the No Action scenario in MY2026. As discussed in Section VII, there are benefits resulting from these costs including savings to consumers in the form of lower fuel costs.

3. Technology Penetration Rates

In this section we discuss the projected new sales technology penetration rates from EPA's updated analysis for the proposed standards. Additional detail on this topic can be found in the DRIA. EPA's assessment for the proposal, consistent with past EPA assessments, shows that the proposed standards can largely be met with increased sales of advanced gasoline vehicle technologies, and relatively low penetration rates of electrified vehicle technology.

Table 40, Table 41, and Table 42 show the EPA projected penetration rates of BEV+PHEV technology under today's proposal with the remaining share being traditional or advanced ICE technology. Values shown reflect absolute values of fleet penetration and are not increments from the No Action scenario or other standards. It is important to note that this is a projection and represents one out of many possible compliance pathways for the industry. The proposed standards are performance-based and do not mandate any specific technology for any manufacturer or any vehicles. As the proposed standards become more stringent over MYs 2023 to 2026, the projected penetration of electrified vehicles increases by approximately 4 percent over this 4-year period (from 3.6 percent to 7.8 percent), reaching nearly 8 percent of overall vehicle production in MY2026. While this is not an insignificant change, it is notable that we estimate that over 92 percent of new light-duty vehicle sales will continue to utilize ICE technology under our updated analysis. This conclusion that ICE vehicles will continue to play an important role in meeting GHG standards is consistent with EPA's prior analyses for this timeframe.

TABLE 40—CAR BEV+PHEV PENETRATION RATES UNDER THE PROPOSED STANDARDS

	2023	2024	2025	2026
BMW	8.4%	8.4%	8.4%	19.5%
Daimler	7.2	8.0	8.0	8.0
FCA	4.3	6.3	6.2	6.2
Ford	7.7	9.3	9.6	9.6
General Motors	6.1	12.2	12.1	13.3
Honda	0.1	0.1	0.1	12.7
Hyundai Kia-H	0.3	3.4	3.8	3.8
Hyundai Kia-K	9.2	9.2	9.1	9.1
JLR	0.5	11.2	11.2	11.2
Mazda	0.0	0.0	0.0	0.0
Mitsubishi	0.0	0.0	0.0	0.0
Nissan	1.0	1.2	1.2	1.2
Subaru	0.0	0.0	0.0	0.0
Tesla	100.0	100.0	100.0	100.0
Toyota	2.6	4.0	4.4	4.4
Volvo	0.0	0.0	0.0	16.6
VWA	15.4	15.5	15.5	17.2
Total	4.6	6.3	6.4	8.4

TABLE 41—TRUCK BEV+PHEV PENETRATION RATES UNDER THE PROPOSED STANDARDS

	2023	2024	2025	2026
BMW	4.3%	4.3%	8.9%	8.9%
Daimler	28.8	28.8	38.3	39.6
FCA	5.6	5.6	5.6	5.6
Ford	1.8	4.8	4.8	7.3
General Motors	2.3	3.7	5.0	11.0
Honda	0.0	0.0	0.0	0.0
Hyundai Kia-H	0.0	20.6	20.6	20.6
Hyundai Kia-K	0.0	0.0	0.0	0.0
JLR	13.0	13.0	24.6	24.6
Mazda	0.0	0.0	0.0	0.0
Mitsubishi	0.0	0.0	0.0	0.0
Nissan	0.0	0.0	3.7	5.9
Subaru	0.0	0.0	0.0	0.0
Tesla	0.0	0.0	0.0	0.0
Toyota	0.0	0.0	1.9	1.9
Volvo	15.6	15.6	17.3	17.3
VWA	1.2	20.8	20.8	39.5
Total	2.6	4.0	5.1	7.2

TABLE 42—FLEET BEV+PHEV PENETRATION RATES UNDER THE PROPOSED STANDARDS

	2023	2024	2025	2026
BMW	6.8%	6.8%	8.6%	15.2%

TABLE 42—FLEET BEV+PHEV PENETRATION RATES UNDER THE PROPOSED STANDARDS—Continued

	2023	2024	2025	2026
Daimler	16.5	17.0	21.2	21.8
FCA	5.3	5.7	5.7	5.7
Ford	4.1	6.5	6.7	8.2
General Motors	3.9	7.4	8.0	12.0
Honda	0.1	0.1	0.1	7.3
Hyundai Kia-H	0.2	4.5	4.9	4.9
Hyundai Kia-K	6.9	6.9	6.8	6.8
JLR	10.2	12.6	21.7	21.7
Mazda	0.0	0.0	0.0	0.0
Mitsubishi	0.0	0.0	0.0	0.0
Nissan	0.6	0.8	2.1	2.8
Subaru	0.0	0.0	0.0	0.0
Tesla	100.0	100.0	100.0	100.0
Toyota	1.3	2.0	3.1	3.1
Volvo	10.3	10.3	11.5	17.0
VWA	10.7	17.3	17.3	24.7
Total	3.6	5.1	5.8	7.8

C. Are the proposed standards feasible?

The proposed standards are based on the extensive light-duty GHG technical analytical record developed over the past dozen years, as represented by the EPA supporting analyses for the 2010 and 2012 final rules, the Mid-Term Evaluation (including the Draft TAR, Proposed Determination and Final Determinations), as well as the updated analysis for this proposed rule and the supporting analysis for the SAFE rule.[120] Our conclusion that the proposed program is technologically feasible is based in part on a projection that the standards will be met using the same advances in light-duty vehicle engine technologies, transmission technologies, electric drive systems, aerodynamics, tires, and vehicle mass reduction that have gradually entered the light-duty vehicle fleet over the past decade and that are already in place in today's vehicles. This conclusion is also supported by the analysis performed by NHTSA that served as the basis for the SAFE final rule. In the SAFE final rule, the NHTSA analysis showed that the 2012 CO_2 standards could be met primarily with improvements in gasoline vehicle and hybrid technology and with only 6 percent penetration of EV+PHEV, which is very similar to today's projection.[121] The feasibility of the proposed standards does not rely on dramatically increased penetration of electric vehicles into the fleet during the 2023–2026 model years. Our updated analysis projects that the proposed standards can be met with a gradually increasing market share of EVs and PHEVs up to approximately 8 percent by MY 2026 (see Section III.B.3 of this preamble and the following paragraph).

The percentage share of specific MY2015 to MY2020 engine and transmission technologies are summarized from EPA Automotive Trends Report data within Chapter 2.2 of the DRIA. The introduction of GHG reducing technologies has been steadily increasing within the light-duty vehicle fleet. As of MY2020, more than half of light-duty gasoline spark ignition engines now use direct injection (GDI) engines and more than a third are turbocharged. Nearly half of all light-duty vehicles have planetary automatic transmissions with 8 or more gear ratios, and one-quarter are using continuously variable transmissions (CVT). The sales of vehicles with 12V start/stop systems has increased from approximately 7 percent to approximately 42 percent between MY2015 and MY2020. Significant levels of powertrain electrification of all types (HEV, PHEV, and EV) have increased more than 3-fold from MY2015 to MY2020. In MY2015, hybrid electric vehicles accounted for approximately 2.4 percent of vehicle sales, which increased to approximately 6.5 percent of vehicle sales in MY2020. Sales of plug-in hybrid electric vehicles (PHEVs) and battery electric vehicles (EVs) together comprised 0.7 percent of vehicle sales in MY2015 and increased to about 2 percent of sales for MY2019.[122] The pace of introduction of new EV and PHEV models is rapidly increasing. For example, the number of EV and PHEV models available for sale in the U.S. has more than doubled from about 24 in MY 2015 to about 60 in MY 2021.[123] Even in the absence of more stringent standards, manufacturers have indicated that the number of EV and PHEV models will increase to more than 80 by MY 2023, with many more expected to reach production before the end of the decade.[124] Although our analysis projects that approximately 8 percent of new vehicles meeting the MY 2026 proposed standards would be EVs or PHEVs, it is possible that an even higher percentage may be electrified during the time period of our proposed MY 2023–2026 standards, when taking into account the pace at which new EV and PHEV models are being announced for introduction by automakers, under

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[120] Although the MTE 2018 Revised Final Determination ''withdrew'' the 2017 Final Determination, the D.C. Circuit Court has noted that EPA did ''not erase[ ] the Draft Technical Assessment Report, Technical Support Document, or any of the other prior evidence [EPA] collected.'' *California* v. *EPA,* 940 F.3d 1342, 1351 (D.C. Cir. 2019).

[121] See the SAFE Final Rule preamble: ''The levels of electrified vehicle technologies projected in this final rule to meet the baseline Alternative (the previous GHG standards) differ slightly from those projected in the 2017 Final Determination. In this final rule, EPA projects a combined strong and mild hybrid penetration of 16 percent (compared to 20 percent in the 2017 Final Determination), with the share of mild hybrids somewhat lower (7 percent compared to 18 percent in the 2017 Final Determination) and the share of strong hybrids higher (9 percent compared to 2 percent in the 2017 Final Determination). EPA projects a total level of plug-in vehicles of 6 percent, similar to the 5 percent total projected in the 2017 Final Determination, but with a slightly different mix of plug-in hybrid electric vehicles (0.4 percent compared to 2 percent in the 2017 Final Determination) and dedicated electric vehicles (5.7 percent compared to 3 percent in the 2017 Final Determination). 85 FR 25107, April 30, 2020.

[122] ''The 2020 EPA Automotive Trends Report, Greenhouse Gas Emissions, Fuel Economy, and Technology since 1975,'' EPA–420–R–21–003, January 2021.

[123] *Fueleconomy.gov,* 2015 Fuel Economy Guide and 2021 Fuel Economy Guide.

[124] Environmental Defense Fund and M.J. Bradley & Associates, ''Electric Vehicle Market Status—Update, Manufacturer Commitments to Future Electric Mobility in the U.S. and Worldwide,'' April 2021.

current policy, over the next three to five years.[125]

EPA believes that the proposed program is technologically feasible based on our projection that the standards can be met largely with the kinds of advanced gasoline vehicle technologies already in place in vehicles within today's new vehicle fleet and relies on a penetration of plug-in electric vehicles into the fleet during the 2023–2026 model years that is commensurate with current trends in the industry. This conclusion, which is supported by EPA's updated analysis, is consistent with EPA's past analyses of standards similar to those proposed in this notice, see Section III.B and Chapter 2 of the DRIA. The analysis confirms EPA's previous conclusions that a wide variety of emission reducing technologies are already available at reasonable costs for manufacturers to incorporate into their vehicles within the timeframe of the proposed standards.

D. How did EPA consider the two alternatives in choosing the proposed program?

In Section II.C, we described two alternative stringency levels that we considered in developing the level of stringency of the proposed program—Alternative 1 (less stringent than the proposed program) and Alternative 2 (more stringent). All three potential programs would incorporate year-over-year increases in GHG stringency, with varying starting stringencies in MY2023, and varying ending stringencies in MY2026, and with fairly linear increases in stringency between MY2023 and 2026 that would essentially follow the same slope as the 2012 program. All three potential programs would also result, by MY2026, in standards at least as stringent as the last year (MY2025) of the 2012 program. See Figure 8 and Table 16 in Section II.C.

In determining the stringency of the proposed standards, our primary focus was on the first and last model years of the proposed program, 2023 and 2026. Some stakeholders have encouraged EPA to propose standards that would closely follow the stringency levels of the California Framework Agreements, or that would represent less stringent standards (between the California Framework emission reduction targets and the relaxed standards of the SAFE rule). In Section VI below, we discuss why we believe the auto industry's technological achievements over the past decade, and the availability of a range of existing and proposed compliance flexibilities, puts automakers in a strong position to meet the proposed revised standards for model years 2023 through 2026 on a year-by-year trajectory close to the standards in the 2012 program. Given our conclusion that standards more stringent than those in Alternative 1 are clearly feasible considering available technology and compliance costs, and in light of the critical national need to quickly and substantially reduce light-duty GHG emissions, we believe at this time that a program of the stringency of Alternative 1 (and any less stringent alternative) would not be appropriate given EPA's consideration of the public health and welfare benefits of potential standards. Nonetheless, we invite comment on Alternative 1 and may consider it in determining the standards for the final rule.

Similarly, we considered the implications of a more stringent program in Alternative 2. In this alternative program, the standards would more quickly return to the 2012 program's trajectory, in model year 2023. While we believe, given the combination of factors discussed in Section VI, reaching the 2012 program's levels in 2023 may be feasible industrywide, we are proposing a slightly less stringent standard for that first year to provide a more gradual transition to the 2012 trajectory.

All three alternative programs after MY2023 would essentially follow the same slope of increasing year-over-year stringency of the 2012 program. For Alternative 1, this would mean that the standards would reach the model year 2025 level of the 2012 rule (the final increase in stringency of the 2012 program) in model year 2026, resulting in a less stringent program compared to the 2012 rule until MY2026. Chapter 5.1.1.2 of the DRIA shows the associated lower amount of GHG reductions achieved under Alternative 1 compared to the proposal. Again, given the urgent need for GHG reductions to address the climate challenge, we believe Alternative 1 does not go far enough and would be inappropriate, as discussed above.

For Alternative 2, the standards by MY2025 would nearly match the stringency level of the MY2025 standards in the 2012 rule and would continue to increase in stringency for one additional year in MY2026. Consistent with EPA's previous discussions regarding feasibility, compliance costs, and lead time, we believe that Alternative 2 may be feasible. Several arguments can be made in support of Alternative 2 that are similar to those that support the proposed standards. In terms of technology penetrations, Alternative 2 projects that nearly 10 percent of the fleet would need to be made up of EV/PHEVs compared with about 8 percent for the proposed standards. See Table 4–23, and Table 4–28 of the DRIA. Several automakers have made public announcements regarding electrification of the light-duty fleet, particularly regarding the latter years of the proposed program. These electrified products will provide a significant contribution to the ability of these manufacturers to comply with more stringent standards. However, EPA recognizes that the additional penetration of electrification by 2026 could be challenging for any manufacturers that are not currently investing in advanced technologies, such as EVs, for this timeframe, although with additional investment and product development, or greater reliance on the emissions ABT program including credit trading, this level of stringency may be achievable. EPA also recognizes Alternative 2 is more stringent than the proposal in MY2023, and EPA believes a lower level of stringency increase for 2023 may be appropriate taking into consideration lead time.

Projected costs and technology penetrations associated with Alternatives 1 and 2 are available in Chapter 4 of the DRIA.

We invite comment on our assessment of Alternatives.

IV. How would this proposal reduce GHG emissions and their associated effects?

A. Impact on GHG Emissions

EPA used the CCEMS to estimate GHG emissions inventories including tailpipe emissions from light-duty cars and trucks and the upstream emissions associated with the fuels used to power those vehicles (both at the refinery and the electricity generating unit). The upstream emission factors used in the modeling are identical to those used for the SAFE FRM and were generated using the DOE/Argonne GREET model as described in the SAFE FRM (See DRIA Chapter 5.1.1, referencing the SAFE FRM).

The resultant annual GHG inventory estimates are shown in Table 43 for the calendar years 2023 through 2050. The table shows our proposed program would result in net GHG reductions compared to the No Action scenario. The CO_2, CH_4 and N_2O emissions

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[125] Rhodium Group, ''Pathways to Build Back Better: Investing in Transportation Decarbonization,'' May 13, 2021.

reductions from the proposed program total 2,205 MMT, 2.7 MMT and 0.072 MMT, respectively, by 2050.

TABLE 43—ESTIMATED GHG IMPACTS OF THE PROPOSED STANDARDS RELATIVE TO THE NO ACTION SCENARIO

Year	Emission impacts relative to no action			Percent change from no action		
	CO_2 (million metric tons)	CH_4 (metric tons)	N_2O (metric tons)	CO_2 (%)	CH_4 (%)	N_2O (%)
2023	−4	−4,821	−105	0	0	0
2024	−7	−8,560	−200	0	0	0
2025	−11	−13,412	−330	−1	−1	−1
2026	−17	−21,154	−534	−1	−1	−1
2027	−25	−30,702	−785	−2	−2	−1
2028	−33	−41,019	−1,051	−2	−2	−2
2029	−42	−51,607	−1,325	−3	−3	−2
2030	−50	−62,014	−1,591	−4	−3	−3
2031	−58	−72,138	−1,847	−4	−4	−3
2032	−66	−81,872	−2,096	−5	−5	−4
2033	−74	−91,079	−2,332	−6	−5	−4
2034	−81	−99,597	−2,555	−6	−6	−5
2035	−86	−106,981	−2,739	−7	−6	−5
2036	−92	−113,813	−2,915	−7	−7	−6
2037	−97	−119,952	−3,090	−8	−7	−6
2038	−101	−125,292	−3,245	−8	−7	−6
2039	−105	−129,675	−3,368	−9	−8	−7
2040	−108	−133,346	−3,474	−9	−8	−7
2041	−110	−136,405	−3,564	−9	−8	−7
2042	−112	−138,441	−3,630	−9	−8	−7
2043	−113	−140,060	−3,693	−9	−9	−7
2044	−114	−141,230	−3,745	−10	−9	−8
2045	−115	−141,929	−3,790	−10	−9	−8
2046	−116	−142,314	−3,826	−10	−9	−8
2047	−116	−142,870	−3,872	−10	−9	−8
2048	−116	−142,942	−3,901	−10	−9	−8
2049	−117	−143,167	−3,938	−10	−9	−8
2050	−117	−143,681	−4,001	−10	−9	−8
Sum	−2,205	−2,720,073	−71,543	−6	−6	−5

B. Climate Change Impacts From GHG Emissions

Elevated concentrations of GHGs have been warming the planet, leading to changes in the Earth's climate including changes in the frequency and intensity of heat waves, precipitation, and extreme weather events, rising seas, and retreating snow and ice. The changes taking place in the atmosphere as a result of the well-documented buildup of GHGs due to human activities are changing the climate at a pace and in a way that threatens human health, society, and the natural environment. While EPA is not making any new scientific or factual findings with regard to the well-documented impact of GHG emissions on public health and welfare in support of this proposal, EPA is providing some scientific background on climate change to offer additional context for this rulemaking and to increase the public's understanding of the environmental impacts of GHGs.

Extensive additional information on climate change is available in the scientific assessments and the EPA documents that are briefly described in this section, as well as in the technical and scientific information supporting them. One of those documents is EPA's 2009 Endangerment and Cause or Contribute Findings for Greenhouse Gases Under Section 202(a) of the CAA (74 FR 66496, December 15, 2009). In the 2009 Endangerment Finding, the Administrator found under section 202(a) of the CAA that elevated atmospheric concentrations of six key well-mixed GHGs—CO_2, methane (CH_4), nitrous oxide (N_2O), HFCs, perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6)—''may reasonably be anticipated to endanger the public health and welfare of current and future generations'' (74 FR 66523). The 2009 Endangerment Finding, together with the extensive scientific and technical evidence in the supporting record, documented that climate change caused by human emissions of GHGs (including HFCs) threatens the public health of the U.S. population. It explained that by raising average temperatures, climate change increases the likelihood of heat waves, which are associated with increased deaths and illnesses (74 FR 66497). While climate change also increases the likelihood of reductions in cold-related mortality, evidence indicates that the increases in heat mortality will be larger than the decreases in cold mortality in the United States (74 FR 66525). The 2009 Endangerment Finding further explained that compared with a future without climate change, climate change is expected to increase tropospheric ozone pollution over broad areas of the United States, including in the largest metropolitan areas with the worst tropospheric ozone problems, and thereby increase the risk of adverse effects on public health (74 FR 66525). Climate change is also expected to cause more intense hurricanes and more frequent and intense storms of other types and heavy precipitation, with impacts on other areas of public health, such as the potential for increased deaths, injuries, infectious and waterborne diseases, and stress-related disorders (74 FR 66525). Children, the elderly, and the poor are among the most vulnerable to these climate-related health effects (74 FR 66498).

The 2009 Endangerment Finding also documented, together with the extensive scientific and technical evidence in the supporting record, that climate change touches nearly every aspect of public welfare[126] in the United States with resulting economic costs, including: Changes in water supply and quality due to changes in drought and extreme rainfall events; increased risk of storm surge and flooding in coastal areas and land loss due to inundation; increases in peak electricity demand and risks to electricity infrastructure; and the potential for significant agricultural disruptions and crop failures (though offset to some extent by carbon fertilization). These impacts are also global and may exacerbate problems outside the United States that raise humanitarian, trade, and national security issues for the United States (74 FR 66530).

In 2016, the Administrator similarly issued Endangerment and Cause or Contribute Findings for greenhouse gas emissions from aircraft under section 231(a)(2)(A) of the CAA (81 FR 54422, August 15, 2016). In the 2016 Endangerment Finding, the Administrator found that the body of scientific evidence amassed in the record for the 2009 Endangerment Finding compellingly supported a similar endangerment finding under CAA section 231(a)(2)(A), and also found that the science assessments released between the 2009 and the 2016 Findings ''strengthen and further support the judgment that GHGs in the atmosphere may reasonably be anticipated to endanger the public health and welfare of current and future generations'' (81 FR 54424).

Since the 2016 Endangerment Finding, the climate has continued to change, with new observational records being set for several climate indicators such as global average surface temperatures, GHG concentrations, and sea level rise. Additionally, major scientific assessments continue to be released that further advance our understanding of the climate system and the impacts that GHGs have on public health and welfare both for current and future generations.

These updated observations and projections document the rapid rate of current and future climate change both globally and in the United States.[127] [128] [129] [130]

C. Global Climate Impacts and Benefits Associated With the Proposal's GHG Emissions Reductions

Transportation is the largest source of GHG emissions in the United States, making up 29 percent of all emissions. Within the transportation sector, light-duty vehicles are the largest contributor, 58 percent, to transportation GHG emissions in the U.S, and 17 percent of all emissions.[131] Reducing GHG emissions, including the four GHGs affected by the proposed program, will contribute toward the goal of holding the increase in the global average temperature to well below 2 °C above pre-industrial levels, and subsequently reducing the probability of severe climate change related impacts including heat waves, drought, sea level rise, extreme climate and weather events, coastal flooding, and wildfires. While EPA did not conduct modeling to specifically quantify changes in climate impacts resulting from this proposal in terms of avoided temperature change or sea-level rise, we did quantify the climate benefits by monetizing the emission reductions through the application of the social cost of greenhouse gases (SC–GHGs), as described in Section VII.D.

V. How would the proposal impact non-GHG emissions and their associated effects?

A. Impact on Non-GHG Emissions

The model runs that EPA conducted estimated the inventories of non-GHG air pollutants resulting from tailpipe emissions from light-duty cars and trucks, and the upstream emissions associated with the fuels used to power those vehicles (both at the refinery and the electricity generating unit). The tailpipe emissions of $PM_{2.5}$, NO_X, VOCs, CO and SO_2 are estimated using emission factors from EPA's Midterm model. The emission factors used are identical to those used in the SAFE FRM. The upstream emissions are then calculated using emission factors applied to the gallons of liquid fuels projected to be consumed and the kilowatt hours of electricity projected to be consumed. The upstream emission factors used in the modeling are identical to those used for the SAFE FRM and were generated using the DOE/Argonne GREET model as described in the SAFE FRM.

On the whole, the proposed standards reduce non-GHG emissions. Table 44 presents the annual tailpipe and upstream inventory impacts for years 2023 through 2050 and Table 45 presents the net annual inventory impacts for those same years. Specifically, we project reductions in emissions of non-GHG pollutants from upstream sources, except for SO_2. For tailpipe emissions we project initial increases from most non-GHG pollutants, except SO_2, followed by decreases in all non-GHG pollutants over time. The increases in non-GHG tailpipe emissions are due to increased driving, and the increases in upstream SO_2 are due to increased EGU emissions.

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[126] The CAA states in section 302(h) that ''[a]ll language referring to effects on welfare includes, but is not limited to, effects on soils, water, crops, vegetation, manmade materials, animals, wildlife, weather, visibility, and climate, damage to and deterioration of property, and hazards to transportation, as well as effects on economic values and on personal comfort and well-being, whether caused by transformation, conversion, or combination with other air pollutants.'' 42 U.S.C. 7602(h).

[127] USGCRP, 2018: Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II [Reidmiller, D.R., C.W. Avery, D.R. Easterling, K.E. Kunkel, K.L.M. Lewis, T.K. Maycock, and B.C. Stewart (eds.)]. U.S. Global Change Research Program, Washington, DC, USA, 1515 pp. doi: 10.7930/NCA4.2018. *https://nca2018.globalchange.gov.*

[128] Roy, J., P. Tschakert, H. Waisman, S. Abdul Halim, P. Antwi-Agyei, P. Dasgupta, B. Hayward, M. Kanninen, D. Liverman, C. Okereke, P.F. Pinho, K. Riahi, and A.G. Suarez Rodriguez, 2018: Sustainable Development, Poverty Eradication and Reducing Inequalities. In: Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5 °C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty [Masson-Delmotte, V., P. Zhai, H.-O. Pörtner, D. Roberts, J. Skea, P.R. Shukla, A. Pirani, W. Moufouma-Okia, C. Péan, R. Pidcock, S. Connors, J.B.R. Matthews, Y. Chen, X. Zhou, M.I. Gomis, E. Lonnoy, T. Maycock, M. Tignor, and T. Waterfield (eds.)]. In Press. *https://www.ipcc.ch/sr15/chapter/chapter-5.*

[129] National Academies of Sciences, Engineering, and Medicine. 2019. Climate Change and Ecosystems. Washington, DC: The National Academies Press. *https://doi.org/10.17226/25504.*

[130] NOAA National Centers for Environmental Information, State of the Climate: Global Climate Report for Annual 2020, published online January 2021, retrieved on February 10, 2021, from *https://www.ncdc.noaa.gov/sotc/global/202013.*

[131] *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2019* (EPA–430–R–21–005, published April 2021).

TABLE 44—ESTIMATED NON-GHG EMISSION IMPACTS OF THE PROPOSED STANDARDS RELATIVE TO THE NO ACTION SCENARIO

Year	Upstream (U.S. tons)					Tailpipe emissions (U.S. tons)				
	PM$_{2.5}$	NO$_X$	SO$_2$	VOC	CO	PM$_{2.5}$	NO$_X$	SO$_2$	VOC	CO
2023	−56	−628	−36	−1,211	−334	17	1,037	−24	1,345	12,884
2024	−97	−1,040	282	−2,245	−539	37	2,385	−45	3,255	29,814
2025	−150	−1,570	699	−3,595	−802	50	3,270	−72	4,501	41,380
2026	−236	−2,454	1,183	−5,699	−1,251	58	4,032	−114	5,583	50,655
2027	−342	−3,546	1,730	−8,279	−1,807	57	4,356	−166	6,183	52,764
2028	−457	−4,747	2,167	−11,023	−2,429	40	4,010	−220	5,817	43,400
2029	−575	−5,973	2,611	−13,840	−3,065	24	3,656	−276	5,491	34,336
2030	−690	−7,182	2,963	−16,588	−3,699	5	3,072	−331	4,889	21,673
2031	−806	−8,419	3,094	−19,228	−4,342	−16	2,359	−383	4,105	7,504
2032	−917	−9,601	3,248	−21,779	−4,952	−41	1,506	−433	3,137	−8,754
2033	−1,023	−10,726	3,340	−24,183	−5,533	−70	573	−480	2,048	−26,420
2034	−1,121	−11,756	3,468	−26,425	−6,058	−101	−401	−525	904	−44,195
2035	−1,207	−12,685	3,364	−28,315	−6,542	−128	−1,265	−561	−116	−59,229
2036	−1,286	−13,520	3,349	−30,084	−6,969	−156	−2,094	−596	−1,085	−74,202
2037	−1,355	−14,232	3,506	−31,727	−7,319	−188	−2,951	−629	−2,088	−90,292
2038	−1,416	−14,846	3,646	−33,163	−7,616	−219	−3,746	−657	−3,021	−105,517
2039	−1,466	−15,374	3,601	−34,301	−7,878	−246	−4,394	−679	−3,809	−117,461
2040	−1,508	−15,804	3,594	−35,264	−8,085	−272	−4,963	−699	−4,502	−127,860
2041	−1,544	−16,174	3,571	−36,067	−8,264	−295	−5,463	−714	−5,091	−138,174
2042	−1,569	−16,411	3,581	−36,619	−8,371	−316	−5,901	−726	−5,600	−147,394
2043	−1,588	−16,573	3,706	−37,098	−8,429	−336	−6,304	−735	−6,065	−156,119
2044	−1,602	−16,679	3,831	−37,464	−8,458	−356	−6,662	−743	−6,472	−164,134
2045	−1,610	−16,714	4,022	−37,729	−8,443	−374	−6,983	−749	−6,834	−171,092
2046	−1,615	−16,711	4,249	−37,913	−8,381	−390	−7,269	−753	−7,153	−177,417
2047	−1,622	−16,708	4,571	−38,172	−8,310	−408	−7,590	−759	−7,507	−185,213
2048	−1,624	−16,659	4,821	−38,284	−8,219	−424	−7,855	−762	−7,801	−191,667
2049	−1,627	−16,620	5,110	−38,450	−8,129	−440	−8,138	−766	−8,100	−198,645
2050	−1,632	−16,556	5,686	−38,781	−8,000	−460	−8,501	−774	−8,475	−207,606

TABLE 45—ESTIMATED NON-GHG EMISSION IMPACTS OF THE PROPOSED STANDARDS RELATIVE TO THE NO ACTION SCENARIO

Year	Upstream (U.S. tons)					Tailpipe emissions (U.S. tons)				
	PM$_{2.5}$	NO$_X$	SO$_2$	VOC	CO	PM$_{2.5}$ (%)	NO$_X$ (%)	SO$_2$ (%)	VOC (%)	CO (%)
2023	−40	409	−59	134	12,550	0	0	0	0	0
2024	−60	1,345	237	1,010	29,275	0	0	0	0	0
2025	−101	1,700	627	907	40,578	0	0	0	0	0
2026	−179	1,578	1,068	−116	49,405	0	0	1	0	0
2027	−285	810	1,565	−2,096	50,956	−1	0	1	0	0
2028	−417	−737	1,947	−5,207	40,971	−1	0	1	0	0
2029	−550	−2,316	2,334	−8,349	31,271	−1	0	1	−1	0
2030	−685	−4,109	2,632	−11,699	17,974	−2	−1	1	−1	0
2031	−822	−6,060	2,711	−15,123	3,162	−2	−1	1	−2	0
2032	−959	−8,095	2,815	−18,642	−13,706	−3	−1	1	−2	0
2033	−1,093	−10,153	2,860	−22,136	−31,953	−3	−1	1	−3	0
2034	−1,222	−12,156	2,943	−25,522	−50,254	−3	−2	1	−3	−1
2035	−1,335	−13,949	2,802	−28,431	−65,771	−4	−2	1	−4	−1
2036	−1,442	−15,614	2,753	−31,169	−81,171	−4	−3	1	−4	−1
2037	−1,543	−17,183	2,877	−33,815	−97,611	−4	−3	1	−5	−1
2038	−1,635	−18,592	2,989	−36,184	−113,133	−5	−3	2	−5	−2
2039	−1,712	−19,769	2,921	−38,110	−125,338	−5	−4	1	−6	−2
2040	−1,779	−20,767	2,895	−39,766	−135,945	−5	−4	1	−6	−2
2041	−1,839	−21,637	2,857	−41,158	−146,438	−5	−4	1	−7	−2
2042	−1,885	−22,312	2,856	−42,219	−155,765	−6	−5	1	−7	−3
2043	−1,924	−22,877	2,971	−43,164	−164,548	−6	−5	2	−7	−3
2044	−1,958	−23,341	3,088	−43,935	−172,591	−6	−5	2	−8	−3
2045	−1,984	−23,697	3,273	−44,563	−179,535	−6	−5	2	−8	−3
2046	−2,005	−23,979	3,496	−45,066	−185,798	−6	−5	2	−8	−3
2047	−2,031	−24,298	3,812	−45,678	−193,523	−6	−5	2	−8	−4
2048	−2,047	−24,515	4,060	−46,086	−199,886	−6	−6	2	−9	−4
2049	−2,067	−24,758	4,344	−46,550	−206,774	−7	−6	2	−9	−4
2050	−2,093	−25,057	4,912	−47,256	−215,607	−7	−6	2	−9	−4

B. Health and Environmental Effects Associated With Exposure to Non-GHG Pollutants Impacted by the Proposed Standards

Along with reducing GHG emissions, these proposed standards would also have an impact on non-GHG (criteria and air toxic pollutant) emissions from vehicles and non-GHG emissions that occur during the extraction, transport, distribution and refining of fuel and from power plants. The non-GHG emissions that would be impacted by the proposed standards contribute, directly or via secondary formation, to concentrations of pollutants in the air which affect human and environmental health. These pollutants include particulate matter, ozone, nitrogen oxides, sulfur oxides, carbon monoxide and air toxics. Chapter 7 of the DRIA includes more detailed information about the health and environmental effects associated with exposure to these non-GHG pollutants. This includes pollutant specific health effect information, discussion of exposure to the mixture of traffic-related pollutants in the near road environment, and effects of particulate matter and gases on visibility, effects of ozone on ecosystems, and the effect of deposition of pollutants from the atmosphere to the surface.

C. Air Quality Impacts of Non-GHG Pollutants

Photochemical air quality modeling is necessary to accurately project levels of most criteria and air toxic pollutants, including ozone and PM. Air quality models use mathematical and numerical techniques to simulate the physical and chemical processes that affect air pollutants as they disperse and react in the atmosphere. Based on inputs of meteorological data and source information, these models are designed to characterize primary pollutants that are emitted directly into the atmosphere and secondary pollutants that are formed through complex chemical reactions within the atmosphere. Photochemical air quality models have become widely recognized and routinely utilized tools in regulatory analysis for assessing the impacts of control strategies.

Section V.A of the preamble presents projections of the changes in non-GHG emissions due to the proposed standards. Section VII.E describes the monetized non-GHG health impacts of this proposal which are estimated using a reduced-form benefit-per-ton approach. The atmospheric chemistry related to ambient concentrations of $PM_{2.5}$, ozone and air toxics is very complex, and making predictions based solely on emissions changes is extremely difficult. However, based on the magnitude of the emissions changes predicted to result from the proposed standards, we expect that there will be very small changes in ambient air quality in most places. The changes in tailpipe and upstream non-GHG emissions that were inputs to the air quality modeling analysis for the 2012 rule were larger than the changes in non-GHG emissions projected for this proposal. The air quality modeling for the 2012 rule projected very small impacts across most of the country, with the direction of the small impact (increase or decrease) dependent on location.[132] For the next phase of LD GHG standards to be considered in a separate, future rulemaking for model years 2027 and beyond, we expect that impacts may be considerably larger and are considering how best to project air quality impacts from changes in non-GHG emissions.

VI. Basis for the Proposed GHG Standards Under CAA Section 202(a)

In this section, EPA discusses the basis for our proposed standards under our authority in CAA section 202(a), how we are balancing the factors considered in our assessment that the proposed standards are appropriate, and how this balancing of factors differs from that used in the SAFE rule. This section draws from information presented elsewhere in this preamble, including EPA's statutory authority in Section II, our presentation of compliance costs and technology penetrations in Section III, GHG emissions impacts in Section IV, non-GHG emissions impacts in Section V, and the total costs and benefits of the proposal in Section VII.

EPA has considered the technological feasibility and cost of the proposed standards, available lead time for manufacturers, and other relevant factors under section 202(a) of the CAA. Based on our analyses, discussed in greater detail in other sections of this preamble and in Chapter 2 of the DRIA, we believe that the proposed standards are reasonable and appropriate. Greater reductions in GHG emissions from light duty vehicles over these model years are both feasible and warranted as a step to reduce the impacts of climate change on public health and welfare. In addition, the proposal would achieve reductions in emissions of some criteria pollutants and air toxics that would achieve benefits for public health and welfare. Our analysis for this proposed rule, as well as our earlier analyses of similar standards, supports the conclusion that the proposed model years 2023–2026 standards are technologically feasible and the costs of compliance for manufacturers are reasonable. In addition, we project that there would be a net savings to consumers over the lifetime of vehicles meeting the proposed standards, which we think is a more significant consideration, particularly for lower-income consumers, than the anticipated increase in cost for new vehicles. Importantly, the benefits of the proposed program would significantly exceed the costs.

A. Consideration of Technological Feasibility and Lead Time

1. Technological Readiness of the Auto Industry in Meeting Revised GHG Standards

The technological readiness of the auto industry to meet the proposed revised standards for model years 2023–2026 is best understood in the context of the decade-long light-duty vehicle GHG emission reduction program in which the auto industry has introduced a wide lineup of ever more fuel-efficient, GHG-reducing technologies. Over this time period, the industry has been planning for increasingly stringent GHG emissions requirements. The result has been the widespread and continual introduction of new and improved GHG-reducing technologies across the industry, many of which were in the early stages of development at the beginning of the EPA program in 2012. (See Section III.A of this preamble and Chapter 2 of the DRIA for a discussion of technological progression, status of technology penetration, and our assessment of continuing technology penetration across the fleet.)

The technological achievements already developed and applied to vehicles within the current new vehicle fleet will enable the industry to achieve the proposed standards even without the development of new technologies beyond those already widely available. Rather, in response to the increased stringency of the proposed standards compared to existing standards, automakers would be expected to adopt these technologies at an increasing pace across more of their vehicle fleets. In other words, the technologies needed to meet the proposed standards are already widely available and in use on vehicles—there is no need for development of new technologies for the time frame of these proposed standards. Instead, compliance with the proposed standards will necessitate

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[132] Insert 2012 rule RIA ref, EPA–420–R–12–016.

greater implementation and pace of technology penetration through MY2026 using existing GHG reduction technologies. In addition, as we discuss further below, our assessment shows that a large portion of the current fleet (MY2021 vehicles), across a wide range of vehicle segments, already meets their proposed MY2023 footprint-based CO_2 targets.

The availability of current models across a range of vehicle segments meeting the standards is notable because EPA recognizes that auto design and development is a multi-year process, which imposes some constraints on the ability of manufacturers to immediately redesign vehicles with new technologies. However, EPA also understands that this multi-year process means that the industry's product plans developed in response to EPA's 2012 GHG standards rulemaking for MYs 2017–2025 has largely continued, notwithstanding the SAFE rule that was published on April 30, 2020 and that did not relax standards until MY 2021. In their past comments on EPA's light-duty GHG programs, some automakers broadly stated that they generally require about five years to design, develop, and produce a new vehicle model.[133] Under that schedule, it would follow that in most cases the vehicles that automakers will be selling during the first years of the proposed MY 2023–26 program were already designed under the original, more stringent GHG standards finalized in 2012 for those model years. At the time of this proposal, the relaxed GHG standards under the SAFE rule have been in place for little more than one year. During this time, the ability of the industry to commit to revised plans based on the SAFE rule's relaxed standards, especially for MYs 2023 and later, has been highly uncertain in light of pending litigation,[134] and concern was regularly expressed across the auto industry over the uncertain future of the SAFE standards. In fact, due in part to this uncertainty, five automakers voluntarily agreed to more stringent national emission reduction targets under the California Framework Agreements (discussed further below). Therefore, the automakers' own past comments regarding product plan development and the regulatory and litigation history of the GHG standards since 2012 support EPA's expectation that automakers remain largely on track in terms of technological readiness within their product plans to meet the approximate trajectory of increasingly stringent standards initially promulgated in 2012. Although we do not believe that automakers have significantly changed their product plans in response to the SAFE final rule issued in 2020, any that did would have done so relatively recently and there is reason to expect that, for any automakers that changed their plans after the SAFE rule, the automakers' earlier plans could be reinstated or adapted with little change. We also note that some automakers may have adopted product plans to overcomply with the prior, more stringent standards, with the intention of selling credits to other automakers. For these automakers, the proposed standards of this rule, if adopted, would reduce or eliminate the sudden disruption to product plans caused by the SAFE rule. EPA invites comment on the impact of EPA's current and recent rulemakings on automakers' product plans. It is important to note that we have considered the need for manufacturers to transition from the SAFE standards (or the California Framework emission reduction targets) to standards that are closer in stringency to the 2012 standards and we have structured the proposed standards (including the proposed footprint curves as well as the combination of flexibility and credit options) to be less stringent than the 2012 standards for model years 2023, 2024, and 2025.

EPA considers this an important aspect of its analysis that mitigates concerns about lead time for manufacturers to meet the proposed standards beginning with the 2023 model year. We see no reason to expect that the major GHG-reducing technologies that automakers have already developed and introduced, or have already been planning for near-term implementation, will not be available for model year 2023–2026 vehicles. Thus, in contrast to the situation that existed prior to EPA's adoption of the initial light-duty GHG standards in the 2012 rule, automakers now have had the benefit of at least 8 to 9 years of planning and development in preparation for meeting the proposed standards.

Another important factor in considering the feasibility of the proposed standards is the fact that five automakers voluntarily entered into the California Framework Agreements with the California Air Resources Board, first announced in July 2019, to meet more stringent GHG emission reduction targets nationwide than the relaxed standards in the SAFE rule.[135] These voluntary actions by automakers that collectively represent approximately one-third of the U.S. vehicle market speak directly to the feasibility of meeting standards at least as stringent as the emission reduction targets under the California Framework Agreements. As discussed in Section II.A.5, the California Framework Agreements were a key consideration in our development and assessment of the proposed EPA standards.

It is important to note that our conclusion that the proposed program is technologically feasible is based in part on a projection that the standards will be met largely with the kinds of advanced gasoline vehicle technologies already in place in vehicles within today's fleet and does not rely on a significant penetration of electric vehicles into the fleet during the 2023–2026 model years. As discussed above, EPA modeled auto manufacturers' decisions in choosing among available emission reduction technologies to incorporate in their vehicles, taking into account both the projected costs and effectiveness of the technologies. This updated analysis is consistent with EPA's past analyses of standards similar to those proposed in this notice, see Section III.B and Chapter 2 of the DRIA. The analysis demonstrates that a wide variety of emission reducing technologies are already available for manufacturers to incorporate into their gasoline vehicles within the time frame of the proposed standards.

We recognize that although the technology penetration rates that we project in this rulemaking are generally similar to the technology penetration rates that we projected in the SAFE rulemaking, in the SAFE rulemaking EPA concluded that the projected level of advanced technologies was ''too high from a consumer-choice perspective'' and ultimately could lead to automakers changing the vehicle types they offer.[136] EPA currently does not believe this is an accurate assessment or one that deserves weight that could overcome EPA's expert assessment of the appropriate standards under section 202 of the CAA. Rather, EPA's judgment is that the history of the significant developments in automotive offerings over the last ten years supports the conclusion that automakers are capable of deploying a

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[133] For example, in its comments on the 2012 rule, Ford stated that manufacturers typically begin to firm up their product plans roughly five years in advance of actual production. (Docket OAR–2009–0472–7082.1, p. 10.)

[134] *Competitive Enterprise Institute* v. *NHTSA*, D.C. Cir. No. 20–1145 (and consolidated cases brought by several states, localities, environmental and public organizations, and others), filed on May 1, 2020 and later dates.

[135] *https://ww2.arb.ca.gov/resources/documents/framework-agreements-clean-cars* (last updated on May 22, 2021).

[136] 85 FR 25116.

wide range of advanced technologies across the entire vehicle fleet, and that consumers remain interested and willing to purchase vehicles with advanced technologies. Reinforcing this updated judgement, the recent announcements of BEV light-duty trucks and the introduction of hybrid minivans and pickups exemplify such a trend, and EPA sees no reason why the standards proposed in this rule would fundamentally alter it.

Our updated analysis projects that about 8 percent of vehicles meeting the MY 2026 proposed standards would be EV/PHEVs (See Section III.B.3). Given manufacturers' public announcements about their ambitious plans to transition fleets to electrified vehicles, we believe it is possible that an even higher percentage of the industry-wide fleet could be electrified during the time period of our proposed model year 2023–2026 standards. Moreover, EPA is committed to encouraging the rapid development and broad acceptance of zero-emission vehicles, and we are proposing incentives to support this transition (see Section II.B.2). Any acceleration in electric vehicle penetration would be beneficial and would further expand the technology choices available to manufacturers to meet the proposed standards.

2. Opportunities Provided Through Credits and Incentives Provisions

In considering feasibility of the proposed standards EPA also considers the impact of available compliance flexibilities on automakers' compliance options. As we discuss above, the advanced technologies that automakers are continuing to incorporate in vehicle models today directly contribute to each company's compliance plan (*i.e.,* these vehicle models have lower GHG emissions). In addition, automakers widely utilize the program's established ABT provisions which provide a variety of flexible paths to plan compliance (See more detail in Section II.A.4). EPA's annual Automotive Trends Report illustrates how different automakers have chosen to make use of the GHG program's various credit features.[137] It is clear that manufacturers are widely utilizing the various credit programs available, and we have every expectation that manufacturers will continue to take advantage of the compliance flexibilities and crediting programs to their fullest extent, thereby providing them with additional powerful tools in finding the lowest cost compliance solutions in light of the proposed revised standards.

The GHG credit program was designed to recognize that automakers typically have a multi-year redesign cycle and not every vehicle will be redesigned every year to add GHG-reducing technology. Moreover, when GHG-reducing technology is added, it will generally not achieve emissions reductions corresponding exactly to a single year-over-year change in stringency of the standards. Instead, in any given model year, some vehicles will be ''credit generators,'' over-performing compared to the footprint-based CO_2 target in that model year, while other vehicles will be ''debit generators'' and under-performing against their footprint-based targets. Together, an automaker's mix of credit-generator and debit-generator vehicles contribute to its sales-weighted fleet average CO_2 performance, compared to its standard, for that year. If a manufacturer's sales-weighted fleet CO_2 performance is better than its fleet average standard at the end of the model year, those credits can be banked for the automaker's future use in certain years (under the credit carry-forward provisions) or sold to other manufacturers (under the credit trading provisions). Likewise, if a manufacturer's sales-weighted fleet CO_2 performance falls short of its fleet average standard at the end of a model year, the automaker can use banked credits or purchase credits to meet the standard. Furthermore, in recognition of the possibility that a manufacturer might comply with a standard for a given model year with credits earned in a future model year (under the allowance for ''credit carryback''), a manufacturer may also choose to carry a deficit forward up to three years before showing compliance with that model year.

EPA has examined manufacturer certification data to assess the extent to which model year 2021 vehicles already being produced and sold today would be credit generators compared to the proposed model year 2023 targets (accounting for projected off-cycle and air conditioning credits). As detailed in Chapter 2.4 of the DRIA, automakers are selling approximately 216 vehicle models (60 percent of them are advanced gasoline technology vehicles) that would be credit generators compared to the proposed model year 2023 targets, and they appear in nearly all light-duty vehicle market segments. This information supports our conclusion about the feasibility of vehicles with existing technologies meeting the proposed MY2023 standards. We also considered the ability of MY2021 vehicles to generate credits based on the MY2021 and MY2022 standards relaxed in the SAFE rule. Of the 1370 distinct MY2021 vehicle models, EPA's analysis (DRIA, Chapter 2.4) indicates that 355 of these models are credit generators for MY2021, with most of those also generating credits for the MY2022 SAFE standards (25 percent of today's new vehicle fleet offerings). This represents an opportunity for manufacturers to build their credit banks for both MY 2021 and MY2022 and carry those credits forward to help meet the MY2023–2026 proposed standards. These data demonstrate the opportunities for manufacturers to sell more of the credit-generator vehicles as another available strategy to generate credits that will help them comply with the proposed model year 2023 and later standards. Our analysis clearly shows this could be done within vehicle segments to maintain consumer choice (we would not expect that overall car/truck fleet mix would shift), as credit-generating vehicles exist across vehicle segments, representing 95 percent of vehicle sales. Under the fleet-average based standards, manufacturers have multiple feasible paths to compliance, including varying sales volumes of credit generating vehicles,[138] adopting GHG-reducing technologies, and implementing other credit and incentive provisions including those proposed in this notice.

EPA further considered the issue of generating credits against the MY2021 and MY2022 SAFE standards in the context of lead time. In discussions during development of this proposed rule, some stakeholders suggested that EPA should limit automakers' ability to generate credits against the relaxed SAFE standards or discount the value of such credits. These stakeholders argue that the nominal 1.5 percent year-over-

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[137] ''The 2020 EPA Automotive Trends Report, Greenhouse Gas Emissions, Fuel Economy, and Technology issue 1975,'' EPA-420-R-21-003 January 2021.

[138] *E.g.,* When fuel economy standards were not footprint-based, less efficient vehicles were priced higher than more efficient vehicles to encourage sales of the latter. Austin, D., and T. Dinan (2004). ''Clearing the air: The costs and consequences of higher CAFE standards and increased gasoline taxes.'' Journal of Environmental Economics and Management 50: 562–582. Greene, D., P. Patterson, M. Singh, and J. Li (2005). ''Feebates, rebates, and gas-guzzler taxes: A study of incentives for increased fuel economy.'' Energy Policy 33: 757–775 found that automakers were more likely to add technology than use pricing mechanisms to achieve standards. Whitefoot, K., M. Fowlie, and S. Skerlos (2017). ''Compliance by Design: Influence of Acceleration Trade-offs on CO_2 Emissions and Costs of Fuel Economy and Greenhouse Gas Regulations.'' Environmental Science and Technology 51: 10307–10315 find evidence consistent with automakers using trade-offs with acceleration as yet another path to comply with fuel economy standards.

year stringency increase of the SAFE standards barely keeps up with a ''business as usual'' scenario of industry GHG emissions improvements.[139] EPA has considered that argument. EPA also considered the recent performance of the auto industry in meeting the GHG standards; in MY2019 the industry-wide average performance was 7 g/mi above the industry-wide average standard and compliance was achieved by many manufacturers through applying banked credits.[140] In light of the implementation timeframe of the proposed revised standards beginning in model year 2023, we are proposing to continue allowing manufacturers to generate credits against the SAFE standards in model years 2021 and 2022. We are not proposing to shorten the existing 5-year credit carry-forward provision for credits generated in model years 2021 and 2022, so those credits can be carried forward under the existing regulations to facilitate the transition from the SAFE standards to the proposed more stringent standards. However, EPA seeks comment on whether there should be any restrictions placed on credits generated in model years 2021 and 2022, for example, discounting of MY2021 and MY2022 credits, given the relaxed stringency of the SAFE standards in those model years.

In addition, EPA is proposing a targeted set of extended credit and compliance flexibility options for manufacturers, specifically designed to further address any potential concerns of manufacturers about stringency and lead time under the proposed standards (as explained in detail in Section II.B.3 and II.C). These proposals include a limited extension of credit carry-forward, such that credits from model years 2016–2020 would be available to carry forward for one (or two, in the case of 2016 credits) additional model year(s) for compliance in model years 2023–2026; an extension of the off-cycle credit menu cap from 10 grams/mile to 15 grams/mile to provide additional credit to manufacturers who install technologies that reduce GHG emissions that are not captured on EPA's GHG certification tests; and two forms of incentive credits for applying advanced technologies in the manufacturer's vehicle fleet (i.e., an extension of incentive multipliers for EV, PHEV and FCV vehicles, and extra credits for full-size pickup trucks that utilize strong hybrid technology or achieve similar performance-based GHG reductions). Collectively, these proposed flexibilities provide additional strategies manufacturers can use to smooth their path to compliance with the proposed revised standards. In fact, these additional credits and incentives provisions were an important factor in EPA's consideration of the appropriate level of stringency for this proposal, and they provide additional support for our consideration of revised standards even more stringent than if we were not including these provisions in the proposed program.

Just as the fleet average standard approach of the light duty vehicle GHG program allows manufacturers to design a compliance strategy relying on the sale of both credit-generating vehicles and debit generating vehicles in a single year, the credit banking and trading provisions of the program allow manufacturers to design a compliance strategy relying on overcompliance and undercompliance in different years, or even by different manufacturers. Credit trading is a compliance flexibility provision that allows one vehicle manufacturer to purchase credits from another, accommodating the ability of manufacturers to make strategic choices in planning for and reacting to normal fluctuations in an automotive business cycle. When credits are available for less than the marginal cost of compliance, EPA would anticipate that an automaker might choose to adopt a compliance strategy relying on credits.[141] As shown in the most recent EPA Trends Report, more than 10 vehicle firms collectively have participated in 70 credit trading transactions since the inception of the EPA program through Model Year 2019, including many of the largest automotive firms.[142] EPA does not believe that the fact that automakers have adopted a compliance strategy relying on credits (whether banked or purchased) is per se evidence that standards are not appropriate under section 202.

EPA recognizes that several industry stakeholders suggested in comments on the MTE and SAFE rule that underperformance compared to CO_2 targets indicated the standards were overly stringent, EPA previously stated that a declining credit balance indicated future compliance would be more difficult, and EPA was taking into consideration the unwillingness of manufacturers to design a compliance strategy around purchasing credits. However, as explained above, EPA does not believe a declining credit balance is evidence the standards are infeasible or less feasible than anticipated. EPA believes the more accurate view is that manufacturers are able and willing to purchase credits, as well as use banked credits, as part of their compliance strategies and that significant use of credits for compliance is indicative of EPA's flexibilities working as intended, to offer a wide array of compliance strategies which reduce overall costs of compliance.

In summary, there is ample evidence that, in addition to the demonstration of technological feasibility resulting from the ''head start'' that automakers have toward complying with the proposed standards, there are a wide range of credit and flexibility strategies, as well as fleet mix strategies, that manufacturers can marshal to enable them to comply with the proposed standards.

B. Consideration of Vehicle Costs of Compliance

In addition to technological feasibility and lead time, EPA has considered the cost for the auto industry to comply with the proposed revised standards. See section III.B and Chapter 2 of the DRIA for our analysis of compliance costs. As shown in Section III.B.2 and Chapter 4.1.2 of the DRIA, the average per-vehicle cost for a MY2026 vehicle is $1,044 compared to the No Action scenario. Average per-vehicle costs rise from $465 in MY2023 to $771 in MY2025. The $1,044 average per-vehicle cost is consistent with prior EPA analyses (see DRIA Chapter 1.2). EPA has also evaluated costs by manufacturer (see Section III.B.2) and finds the range of costs to be similarly consistent with findings from prior analyses.

The estimated costs to meet the proposed standards are lower than those projected in the 2012 rule, which EPA estimated at about $1,200 (see DRIA Table 1–4). EPA found in the 2012 rule that these (higher) costs were reasonable, even without considering

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[139] We note that the 2020 SAFE FRM presented a 0 percent year-over-year alternative for MYs 2021–2026. In that scenario with no stringency change, the modeled fleet improved fuel economy by 0.9 percent per year from 38.3 mpg in 2021 to 40.0 mpg in 2026. (see 2020 SAFE FRIA, Table I–19, Alternative 1)

[140] Trends Report, Figure ES–8.

[141] ''FCA historically pursued compliance with fuel economy and greenhouse gas regulations in the markets where it operated through the most cost effective combination of developing, manufacturing and selling vehicles with better fuel economy and lower GHG emissions, purchasing compliance credits, and, as allowed by the U.S. federal Corporate Average Fuel Economy (''CAFE'') program, paying regulatory penalties. The cost of each of these components of FCA's strategy has increased and is expected to continue to increase in the future. The compliance strategy for the combined company is currently being assessed by Stellantis management.'' Stellantis N.V. (2020). ''Annual Report and Form 20–F for the year ended December 31, 2020.''

[142] EPA 2020 Trends Report, page 110 and Figure 5.15.

the fuel savings, which more than offsets these costs. See 77 FR 62663–62665, 62880, and 62922. This decrease in estimated per-vehicle cost since the 2012 rule is not surprising—technology to achieve environmental improvements has often proved to be less costly than EPA's initial estimates.[143]

As part of these cost estimates, we project significant increases in the use of advanced gasoline technologies (including mild and strong hybrids), comprising more than 92 percent of the fleet. (See Section III.B.3). EPA has considered the feasibility of the standards under several different assumptions about future fuel prices, technology application or credit trading (see DRIA Chapters 4 and 10), which shows very small variations in average per-vehicle cost or technology penetration mix. Our conclusion that there are multiple ways the MY2023–2026 standards can be met given the wide range of technologies at reasonable cost, and predominantly with advanced gasoline engine and vehicle technologies, holds true across all these scenarios.

These cost estimates are in the same range as EPA's earlier analyses of similarly stringent GHG standards including the model year 2023 and later timeframe. (See Chapter 1 of the DRIA). EPA concludes that the per-vehicle costs of the proposed standards are reasonable.

C. Consideration of Impacts on Consumers

Another important consideration for EPA is the impact of the proposed standards on consumers. EPA concludes that the proposed standards would be beneficial for consumers because the lower operating costs from significant fuel savings would offset the upfront vehicle costs. Total fuel savings for consumers through 2050 are estimated at $120 billion to $250 billion (7 percent and 3 percent discount rates, see Section VII.I, Table 40). Thus, the proposal would result in significant savings for consumers, as further described in Section VII.J.

The Administrator also carefully considered the affordability impacts of these proposed standards, especially considering Executive Order 14008 and EPA's increasing focus on environmental justice and equity. EPA examined the impacts of the proposed standards on the affordability of new and used cars and trucks in Section VII.M of this preamble and Chapter 8.3 of the DRIA. Because lower-income households spend more on gasoline than on vehicle purchases, the effects of reduced operating costs may be especially important for these households.

EPA recognizes that in the SAFE rulemaking we placed greater weight on the upfront costs of vehicles, and little weight on total cost of ownership. In part, that rulemaking explained that approach on the ground that ''[n]ew vehicle purchasers are not likely to place as much weight on fuel savings that will be realized by subsequent owners.''[144] However, in light of changes in policy priorities (including concern about accounting for benefits to lower-income households), EPA now believes in assessing the benefits of these standards it is more appropriate to consider the total fuel savings of the vehicle, over its lifetime, including those fuel savings that may accrue to later owners. Disregarding those benefits, which often accrue to lower income households, who more often purchase used cars, would provide a less accurate picture of total benefits to society. Likewise, EPA has reconsidered the weight placed in the SAFE rulemaking on promoting fleet turnover as a standalone factor and is now considering the influence of turnover in the context of the full range effects of the proposed standards. While recognizing that standards can influence purchasing decisions, EPA currently believes that, for the range of appropriate emissions standards, the emissions reductions from more stringent standards far outweigh any temporary effect from delayed purchases.

D. Consideration of Emissions of GHGs and Other Air Pollutants

An essential factor that EPA considered in determining the appropriate level of the proposed standards is the reductions in emissions that would result from the program. This primarily includes reductions in vehicle GHG emissions, given the increased urgency of the climate crisis. We also considered the effects of the proposed standards on criteria pollutant and air toxics emissions and associated public health and welfare impacts.

The GHG emissions reductions from our proposed standards are projected to exceed 2,200 MMT of CO_2, 2.7 MMT of CH_4 and 71,000 metric tons of N_2O, as the fleet turns over year-by-year to new vehicles that meet the proposed standards, in an analysis through 2050. See Section IV.A, Table 29. The monetized benefit of these GHG reductions is estimated at $22 billion to $280 billion across a range of discount rates and values for the social cost of carbon (see Section VII.I). These GHG reductions are important to continued progress in addressing climate change. In fact, EPA believes that we will need to achieve far deeper GHG reductions from the light-duty sector in future years beyond the compliance timeframe for the proposed standards, which is why we will be initiating a rulemaking in the near future to establish more stringent standards after model year 2026.

The criteria pollutant emissions reductions expected to result from the proposed standards are also a factor considered by the Administrator. The proposed standards would result in emissions reductions of some criteria pollutants and air toxics and associated benefits for public health and welfare. Public health benefits are estimated to total $3.3 billion to $8 billion (7 percent and 3 percent discount rates, see Section VII.H, Table 38). EPA finds that this proposal is important in reducing the public health impacts of air pollution.

E. Consideration of Energy, Safety and Other Factors

EPA also evaluated the impacts of the proposed standards on energy, in terms of fuel consumption and energy security. This proposal is projected to reduce U.S. gasoline consumption by 291 million barrels through 2050 (see Section VII.C). EPA considered the impacts of this projected reduction in fuel consumption on energy security, specifically the avoided costs of macroeconomic disruption (See Section VII.F). We estimate the energy security benefits of the proposal in 2050 at $6.1 billion to $13 billion (7 percent and 3 percent discount rate, see Section VII.H. Table 37). EPA considers this proposal to be beneficial from an energy security perspective.

Section 202(a)(4)(A) of the CAA specifically prohibits the use of an emission control device, system or element of design that will cause or contribute to an unreasonable risk to public health, welfare, or safety. EPA has a long history of considering the safety implications of its emission standards,[145] up to and including the more recent light-duty GHG regulations: The 2010 rule which established the MY2012–2016 light-duty vehicle GHG

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[143] *Anderson, John F and Sherwood, ''Comparison of EPA and Other Estimates of Mobile Source Rule Costs to Actual Price Changes,'' SAE paper 2003–1–1980.*

[144] 85 FR 25114.

[145] See, e.g., 45 FR 14496, 14503 (1980) (''EPA would not require a particulate control technology that was known to involve serious safety problems.'').

standards, the 2012 rule which first established MY2017–2025 light-duty vehicle GHG standards, the MTE 2016 Proposed Determination and the 2020 SAFE rule. The relationship between GHG emissions standards and safety is multi-faceted, and can be influenced not only by control technologies, but also by consumer decisions about vehicle ownership and use. EPA has estimated the impacts of this proposal on safety by accounting for changes in new vehicle purchase, changes in vehicle scrappage, fleet turnover, and VMT, and changes in vehicle weight as an emissions control strategy. EPA finds that under this proposal, the estimated risk of fatal and non-fatal injuries per distance traveled will remain virtually unchanged (see Section VII.H). This proposal also projects that as the costs of driving declines due to the improvement in fuel economy, consumers overall will choose to drive more miles (this is the ''VMT rebound'' effect). As a result of this personal decision by consumers to drive more due to the reduce cost of driving, EPA also projects this will result in an increase in accidents, injuries, and fatalities. EPA recognizes that in the SAFE rulemaking EPA placed emphasis on the estimated total number of fatal and non-fatal injuries. However, EPA currently believes it is more appropriate to consider the risk of injuries per mile traveled. EPA requests comment on what role these negative impacts due to consumers' decision to drive additional miles should play in EPA's standard-setting decision-making.

F. Balancing of Factors Under CAA 202(a)

Under section 202(a) EPA has statutory authority providing considerable discretion in setting or revising vehicle emission standards with adequate lead time for the development and application of technology to meet the standards. EPA's proposed standards properly implement this statutory provision, as discussed above. As discussed throughout this preamble, the emission reduction technologies needed to meet the proposed standards are already available at reasonable cost, and a significant fraction of new vehicles today already meets these standards. Moreover, the flexibilities already available under EPA's existing regulations, including fleet average standards and the ABT program—in effect enabling manufacturers to spread the compliance requirement for any particular model year across multiple model years—and the additional flexibilities being proposed in this notice further support EPA's conclusion that the proposed standards provide sufficient time for the development and application of technology, giving appropriate consideration to cost.

EPA recognizes that the cost and technology penetration estimates in this rule are similar to the estimates in the SAFE rulemaking and that the Administrator is balancing the factors considered differently than in the SAFE rule to reach his conclusion about what standards are appropriate to propose. In the SAFE rulemaking, EPA promulgated relaxed GHG standards that were projected to result in increases in GHG and criteria pollutant emissions and adverse public health impacts (e.g., increases in premature mortality and illnesses due to increased air pollution). The SAFE rulemaking was the most significant weakening of mobile source emissions standards in EPA's history. It is particularly notable that the rationale for the revision was not that the standards had turned out to be technologically infeasible or, even that they would impose unexpectedly high costs on society. As we have noted, the estimated costs for more stringent standards in the SAFE rulemaking were not significantly different from the costs estimated in 2012, or for this rulemaking. Rather, in balancing the factors under consideration for the SAFE rulemaking, EPA placed greatest weight on reducing the cost of compliance on the regulated industry and the upfront (but not total) cost to consumers, and placed little weight on reductions in GHGs and other pollutants, contrary to EPA's traditional approach to adopting standards under section 202.

Although EPA continues to believe that the Administrator has significant discretion to weigh various factors under Section 202, the Administrator now notes that the purpose of adopting standards under that provision of the Clean Air Act is to address air pollution that may reasonably be anticipated to endanger public health and welfare and that reducing air pollution has traditionally been the focus of such standards. In this action, the Administrator is proposing more stringent standards based on a balancing of the factors under consideration different from that in the SAFE rulemaking, a balancing that the Administrator believes is more consistent with Congressional intent and the goals of the Clean Air Act.[146] Taking into consideration the importance of reducing GHG emissions and the primary purpose of CAA section 202 to reduce the threat posed to human health and the environment by air pollution, the Administrator finds it is appropriate to place greater weight on reducing emissions and to adopt standards that, when implemented, would result in significant reductions of light duty vehicle emissions both the near term and over the longer term. As discussed above and the DRIA Chapter 1.2.2, EPA has updated the analyses for this rule. The updated analysis shows several key analytical results that are similar to those from the SAFE final rule. EPA concludes that the Administrator's current approach to considering the relevant factors would fully support the proposed standards even if they were based solely on the technical record and conclusions that were used to set standards in the final SAFE rule.

Finally, EPA estimates net benefits of this proposal in 2050 at $93 billion to $150 billion (7 percent and 3 percent discount rates, with 3 percent SC–GHG) (see Section VII.H). In comparison, the SAFE rule estimated net benefits at $16.1 billion to negative $13.1 billion (7 percent and 3 percent discount rates, respectively)—in other words, the SAFE rule estimated net costs to society under a 3 percent discount rate. Our conclusion that the estimated benefits considerably exceed the estimated costs of the proposed program reinforces our view that the proposed standards represent an appropriate weighing of the statutory factors and other relevant considerations.

In summary, after consideration of a number of relevant factors, given the technical feasibility of the proposed standards, the moderate costs per vehicle, the savings to consumers in fuel costs over the lifetime of the vehicle, the very significant reductions in GHG emissions and fuel consumption, and the significantly greater quantified benefits compared to quantified costs, EPA believes that the proposed standards are appropriate under EPA's section 202(a) authority.

VII. What are the estimated cost, economic, and other impacts of the proposal?

This Section VII discusses EPA's assessment of a variety of impacts related to the proposed standards, including impacts on vehicle sales, fuel

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[146] See, e.g., CAA sections 101(a)(2) (finding that ''the increasing use of motor vehicles[ ] has resulted in mounting dangers to the public health and welfare''); 101(b)(1) (declaring one purpose of the CAA is ''to protect and enhance the quality of the Nation's air resources, so as to promote the public health and welfare''); 101(c) (''a primary goal of this chapter is to encourage or otherwise promote reasonable Federal . . . actions . . . for pollution prevention'').

consumption, energy security, additional driving, and safety. It presents an overview of EPA's estimates of GHG reduction benefits and non-GHG health impacts. This Section VII presents a summary of aggregate costs, drawing from the per-vehicle cost estimates presented in Section III, and estimated program benefits. Finally, the section discusses EPA's assessment of the potential impacts on consumers and employment impacts. The DRIA presents further details of the analyses presented in this Section VII.

A. Conceptual Framework for Evaluating Consumer Impacts

A significant question in analyzing consumer impacts from vehicle GHG standards has been why there have appeared to be existing technologies that, if adopted, would reduce fuel consumption enough to pay for themselves in short periods, but which were not widely adopted. If the benefits to vehicle buyers outweigh the costs to those buyers of the new technologies, conventional economic principles suggest that automakers would provide them, and people would buy them. Yet engineering analyses have identified a number of technologies whose costs are quickly covered by their fuel savings, such as downsized-turbocharged engines, gasoline direct injection, and improved aerodynamics, that were not widely adopted before the issuance of standards, but which were adopted rapidly afterwards.[147] Why did markets fail, on their own, to adopt these technologies? This question, termed the ''energy paradox'' or ''energy efficiency gap,'' [148] has been discussed in detail in previous rulemakings.[149] As discussed in more detail in DRIA Chapter 8.1.1, EPA has evaluated whether the efficiency gap exists, as well as potential explanations for why the gap might exist.

Whether the efficiency gap exists depends on the assessment of fuel savings relative to technology costs and ''hidden costs,'' i.e., any adverse effects on other vehicle attributes. In the Midterm Evaluation,[150] EPA evaluated both the costs and the effectiveness for reducing fuel consumption (and GHG emissions) of technologies used to meet the emissions standards to date; the agency found that the estimates used in the original rulemakings were generally correct.

EPA also examined the relationship between the presence of fuel-saving technologies and negative evaluations of vehicle operating characteristics, such as performance and noise, in auto reviews and found that the presence of the technologies was more often correlated with positive evaluations than negative ones.[151] Preliminary work with data from recent purchasers of new vehicles found similar results.[152] While these studies cannot prove that the technologies pose no problems to other vehicle attributes, they suggest that it is possible to implement the technologies without imposing hidden costs.

EPA has also evaluated the relationship between performance and fuel economy, in light of research arguing that fuel consumption must come at the expense of other vehicle attributes.[153] Research in progress from Watten et al. (2021) [154] distinguishes between technologies that improve, or do not adversely affect, both performance and fuel economy and technologies that reduce engine displacement, which does trade off improved fuel economy for performance. Following Moskalik et al. (2018),[155] Watten et al. observe that the ''marginal rate of attribute substitution'' between power and fuel economy has changed substantially over time. In particular, it has become relatively more costly to improve efficiency by reducing power, and relatively less costly to add technologies that improve efficiency. These technology improvements do not reduce power and in some cases may enhance it. It supports the concept that automakers take consumer preferences into account in identifying where to add technology.

EPA cannot reject the observation that the energy efficiency gap has existed for light-duty vehicles—that is, it appears that markets on their own have not led to adoption of a number of technologies whose fuel savings quickly outweigh the costs in the absence of standards. As discussed in DRIA Chapter 8.1.1.2, EPA has previously identified a number of hypotheses to explain this apparent market failure.[156] Some relate to consumer behavior, such as putting little emphasis on future fuel savings compared to up-front costs (a form of ''myopic loss aversion''), not having a full understanding of potential cost savings, or not prioritizing fuel consumption in the complex process of selecting a vehicle. Other potential explanations relate to automaker behaviors that grow out of the large fixed costs of investments involved with switching to new technologies, as well as the complex and uncertain processes involved in technological innovation and adoption.

It is challenging to identify which of these hypotheses for the efficiency gap explain its apparent existence. On the consumer side, EPA has explored the evidence on how consumers evaluate fuel economy in their vehicle purchase decisions.[157] As noted, there does not

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[147] U.S. Environmental Protection Agency (2021). 2020 EPA Automotive Trends Report: Greenhouse Gas Emissions, Fuel Economy, and Technology since 1975, Chapter 4. EPA–420–R–21–003, *https://www.epa.gov/automotive-trends/download-automotive-trends-report#Full%20Report,* accessed 4/15/2021.

[148] Jaffe, A.B., and Stavins, R.N. (1994). ''The Energy Paradox and the Diffusion of Conservation Technology.'' Resource and Energy Economics 16(2): 91–122.

[149] 75 FR 25510–25513; 77 FR 62913–62917; U.S. Environmental Protection Agency (2016), Proposed Determination on the Appropriateness of the Model Year 2022–2025 Light-Duty Vehicle Greenhouse Gas Emissions Standards under the Midterm Evaluation, EPA–420–R–16–020, Appendix B.1.2; 85 FR 24603–24613.

[150] *https://www.epa.gov/regulations-emissions-vehicles-and-engines/midterm-evaluation-light-duty-vehicle-greenhouse-gas.*

[151] Helfand, G., et al. (2016). ''Searching for Hidden Costs: A Technology-Based Approach to the Energy Efficiency Gap in Light-Duty Vehicles.'' Energy Policy 98: 590–606; Huang, H., et al. (2018). ''Re-Searching for Hidden Costs: Evidence from the Adoption of Fuel-Saving Technologies in Light-Duty Vehicles.'' Transportation Research Part D 65: 194–212.

[152] Huang, H., G. Helfand, and K. Bolon (2018a). ''Consumer Satisfaction with New Vehicles Subject to Greenhouse Gas and Fuel Economy Standards.'' Presentation at the Society for Benefit-Cost Analysis annual conference, March. *https://benefitcostanalysis.org/docs/G.4_Huang_Slides.pdf,* accessed 4/7/2021.

[153] Knittel, C.R. (2011). ''Automobiles on Steroids: Product Attribute Trade-Offs and Technological Progress in the Automobile Sector.'' American Economic Review 101(7): pp. 3368–3399; Klier, T. and Linn, J. (2016). ''The Effect of Vehicle Fuel Economy Standards on Technology Adoption.'' Journal of Public Economics 133: 41–63; McKenzie, D. and Heywood, J. B. (2015). ''Quantifying efficiency technology improvements in U.S. cars from 1975–2009.'' Applied Energy 157: 918–928.

[154] Watten, A., S. Anderson, and G. Helfand (2021). ''Attribute Production and Technical Change: Rethinking the Performance and Fuel Economy Trade-off for Light-duty Vehicles.'' Working paper.

[155] Moskalik, A., K. Bolon, K. Newman, and J. Cherry (2018). ''Representing GHG Reduction Technologies in the Future Fleet with Full Vehicle Simulation.'' SAE Technical Paper 2018–01–1273. doi:10.4271/2018–01–1273.

[156] 75 FR 25510–25513; 77 FR 62913–62917; U.S. Environmental Protection Agency (2016), Proposed Determination on the Appropriateness of the Model Year 2022–2025 Light-Duty Vehicle Greenhouse Gas Emissions Standards under the Midterm Evaluation, EPA–420–R–16–020, Appendix B.1.2; 85 FR 24603–24613.

[157] U.S. Environmental Protection Agency (2010). ''How Consumers Value Fuel Economy: A Literature Review.'' EPA–420–R–10–008, *https://cfpub.epa.gov/si/si_public_file_download.cfm?p_download_id=499454&Lab=OTAQ* (accessed 4/15/2021); U.S. Environmental Protection Agency (2018). ''Consumer Willingness to Pay for Vehicle Attributes: What is the Current State of Knowledge?'' EPA–420–R–18–016, *https://cfpub.epa.gov/si/si_public_file_download.cfm?p_download_id=536423&Lab=OTAQ* (accessed 4/15/2021); Greene, D., A. Hossain, J. Hofmann, G.

Continued

appear to be consensus in that literature on that behavior; the variation in estimates is very large. Even less research has been conducted on producer-side behavior. The reason there continues to be limited adoption of cost-effective fuel-saving technologies before the implementation of more stringent standards remains an open question. Yet, more stringent standards have been adopted without apparent disruption to the vehicle market after they become effective.[158]

B. Vehicle Sales Impacts

As discussed in Section III.A EPA utilized the CCEMS model for this analysis. The FRIA for the SAFE rule (starting p. 871) describes the approach used in the model for estimating vehicle sales impacts. First, it projects future new vehicle sales in the reference case based on projections of macroeconomic variables. Second, it applies an elasticity of −1 (that is, a one percent increase in price produces a one percent decrease in the quantity sold) to the change in net price, where net price is the difference in technology costs less an estimate of the change in fuel costs over 2.5 years. This approach assumes that both automakers and vehicle buyers take into consideration the fuel savings that buyers might expect to accrue over the first 2.5 years of vehicle ownership.

As discussed in Section VII.C, and in more detail in DRIA Chapter 8.1.1.2, there does not yet appear to be consensus around the role of fuel consumption in vehicle purchase decisions, and the assumption that 2.5 years of fuel consumption is the right number for both automakers and vehicle buyers deserves further evaluation. As noted there, Greene et al. (2018) provides a reference value of $1,150 for the value of reducing fuel costs by $0.01/mile over the lifetime of an average vehicle; for comparison, 2.5 years of fuel savings is only about 30 percent of that value, or about $334.[159] This $334 is within the large standard deviation in Greene et al. (2018) for the willingness to pay to reduce fuel costs, but it is far lower than both the mean of $1,880 (160 percent of that value) and the median of $990 (85 percent of that value) per one cent per mile in the paper. On the other hand, the 2015 NAS report (cited in the 2021 NAS report) observed that automakers ''perceive that typical consumers would pay upfront for only one to four years of fuel savings'' (pp. 9–10),[160] a range of values within that identified in Greene et al. (2018) for consumer response, but well below the median or mean. Thus, it appears possible that automakers operate under a different perception of consumer willingness to pay for additional fuel economy than how consumers actually behave. The CCEMS model does not differentiate between automaker perception and consumer perception of the value of additional fuel economy in its sales modeling.

In addition, setting the elasticity of demand at −1 in the SAFE FRIA was based on literature more than 25 years old. EPA is currently working to review more recent estimates of the elasticity of demand for new vehicles. A smaller elasticity would not change the direction of sales effects, but it would reduce the magnitude of the effects.

The CCEMS model also makes use of a dynamic fleet share model (SAFE FRIA p. 877) that estimates, separately, the shares of passenger cars and light trucks based on vehicle characteristics, and then adjusts them so that the market shares sum to one. The model also includes the effects of the standards on vehicle scrappage based on a statistical analysis (FRIA starting p. 926). The model looks for associations between vehicle age, change in new vehicle prices, fuel prices, cost per mile of driving, and macroeconomic measures and the scrappage rate, with different equations for cars, SUVs/vans, and pickups. EPA's project to review new vehicle demand elasticities also includes a review of the literature on the relationship between new and used vehicle markets and scrappage.

For this proposal, EPA is maintaining these assumptions for its modeling. We also examine a sensitivity case using an elasticity of −0.4. We hope to complete our work on both the vehicle demand elasticity and scrappage in time to be able to consider it for use in analyses that will be developed for the final rule.

With the modeling assumptions that both automakers and vehicle buyers consider 2.5 years of future fuel consumption in the purchase decision and that the demand elasticity is −1, vehicle sales would decrease by roughly 2 percent compared to sales in the SAFE rule, as discussed in more detail in DRIA Chapter 8.1.4. In contrast, when modeled using a demand elasticity of −0.4, sales decrease by between 0.5 and 1 percent. If, however, automakers underestimate consumers' valuation of fuel economy, then sales may increase relative to the baseline under the proposed standards.

C. Changes in Fuel Consumption

The proposed standards will reduce not only GHG emissions but also fuel consumption. Reducing fuel consumption is a significant means of reducing GHG emissions from the transportation fleet. Table 46 shows the estimated fuel consumption changes under the proposed standards relative to the No Action scenario and include rebound effects, credit usage and advanced technology multiplier use.

The largest changes in fuel consumption come from gasoline, which follows from our projection that improvements to gasoline vehicles will be the primary way that manufacturers meet the proposed standards. By 2050, our proposal would reduce gasoline consumption by more than 290 million barrels—a nearly 10 percent reduction in U.S. gasoline consumption. Since only about 8 percent of the fleet is projected to be either EV or PHEV by MY2026 to meet the proposed standards, we project smaller changes in the electricity to fuel these vehicles.

Helfand, and R. Beach (2018). ''Consumer Willingness to Pay for Vehicle Attributes: What Do We Know?'' Transportation Research Part A 118: 258–279.

[158] ''The 2020 EPA Automotive Trends Report, Greenhouse Gas Emissions, Fuel Economy, and Technology since 1975,'' EPA–420–R–21–003 January 2021. See Table 2–1 for total vehicle production by model year.

[159] See Greene et al. (2018), Footnote 157. Greene et al. (2018) cite a ballpark value of reducing driving costs by $0.01/mile as $1150, but does not provide enough detail to replicate their analysis perfectly. The 30% estimate is calculated by assuming, following assumptions in Greene et al. (2018), that a vehicle is driven 15,000 miles per year for 13.5 years, 10% discount rate. Those figures produce a ''present value of miles'' of 108,600; thus, a $0.01/mile change in the cost of driving would be worth $1086. In contrast, saving $0.01/mile for 2.5 years using these assumptions is worth about $318, or 29% of the value over 13.5 years. Multiplying Greene et al.'s 29 percent to $1150 = $334.

[160] National Research Council (2015). Cost, Effectiveness, and Deployment of Fuel Economy Technologies for Light-Duty Vehicles. Washington, DC: The National Academies Press. *https://doi.org/10.17226/21744,* p. 9–10.

TABLE 46—CHANGE IN FUEL CONSUMPTION FROM THE LIGHT-DUTY FLEET

	Gasoline (million barrels)	Percent of 2020 U.S. consumption	Electricity (gigawatt hours)	Percent of 2020 U.S. consumption
2023	−9	−0.3	929	0.0
2026	−43	−1.5	6,798	0.2
2030	−124	−4.2	19,017	0.5
2035	−211	−7.2	30,735	0.8
2040	−263	−8.9	38,228	1.0
2050	−291	−9.9	48,122	1.3

NOTES: One barrel (BBL) contains 42 gallons of gasoline; according to the Energy Information Administration (EIA), US gasoline consumption in 2020 was 123.49 billion gallons (see https://www.eia.gov/tools/faqs/faq.php?id=23&t=10, last accessed July 19, 2021), roughly 16 percent less (due to the coronavirus pandemic) than the highest consumption on record (2018). According to the Department of Energy, there are 0.031 kWh of electricity per gallon gasoline equivalent, the metric reported by the CCEMS model for electricity consumption and used here to convert to kWh. According to statista.com, the US consumed 3,802 terawatt hours of electricity in 2020.

With changes in fuel consumption come associated changes in the amount of time spent refueling vehicles. Consistent with the assumptions used in the SAFE FRM (and presented in Table 47), the costs of time spent refueling are calculated as the total amount of time the driver of a typical vehicle would spend refueling multiplied by the value of their time. If less time is spent refueling vehicles under the proposed standards, then a refueling time savings would be incurred.

TABLE 47—CCEMS INPUTS USED TO ESTIMATE REFUELING TIME COSTS

	Cars	Vans/SUVs	Pickups
Fixed Component of Average Refueling Time in Minutes (by Fuel Type)			
Gasoline	3.5	3.5	3.5
Ethanol − 85	3.5	3.5	3.5
Diesel	3.5	3.5	3.5
Electricity	3.5	3.5	3.5
Hydrogen	0	0	0
Compressed Natural Gas	0	0	0
Average Tank Volume Refueled	65	65	65
Value of Travel Time per Vehicle (2018 $/hour)	20.46	20.79	20.79

D. Greenhouse Gas Emission Reduction Benefits

EPA estimated the climate benefits for this proposed rulemaking using measures of the social cost of three GHGs: Carbon, methane, and nitrous oxide. While the program also accounts for reduction in HFCs through the AC credits program, EPA has not quantified the associated emission reductions. The social cost of each gas (i.e., the social cost of carbon (SC–CO2), methane (SC–CH4), and nitrous oxide (SC–N2O)) is the monetary value of the net harm to society associated with a marginal increase in emissions in a given year, or the benefit of avoiding that increase. Collectively, these values are referenced as the ''social cost of greenhouse gases'' (SC–GHG). In principle, SC–GHG includes the value of all climate change impacts, including (but not limited to) changes in net agricultural productivity, human health effects, property damage from increased flood risk and natural disasters, disruption of energy systems, risk of conflict, environmental migration, and the value of ecosystem services. The SC–GHG therefore, reflects the societal value of reducing emissions of the gas in question by one metric ton.

We estimate the global social benefits of CO2, CH4, and N2O emission reductions expected from this proposed rule using the SC–GHG estimates presented in the February 2021 Technical Support Document (TSD): Social Cost of Carbon, Methane, and Nitrous Oxide Interim Estimates under E.O. 13990 (IWG 2021). These SC–GHG estimates are interim values developed under E.O. 13990 for use in benefit-cost analyses until an improved estimate of the impacts of climate change can be developed based on the best available climate science and economics. As discussed in Section 3.3 of the RIA, these interim SC–GHG estimates have a number of limitations, including that the models used to produce them do not include all of the important physical, ecological, and economic impacts of climate change recognized in the climate-change literature and that several model input assumptions are outdated. As discussed in the February 2021 TSD, the Interagency Working Group on the Social Cost of Greenhouse Gases (IWG) finds that, taken together, the limitations suggest that these SC–GHG estimates likely underestimate the damages from GHG emissions. The IWG is currently working on a comprehensive update of the SC–GHG estimates (to be released by January 2022 under E.O. 13990) taking into consideration recommendations from the National Academies of Sciences, Engineering and Medicine, recent scientific literature, public comments received on the February 2021 TSD and other input from experts and diverse stakeholder groups. We request comment on this approach to estimating social benefits of GHG in this rulemaking in light of the ongoing interagency process. See Section VII.I for a summary of the monetized GHG benefits and Section 3.3 of the RIA for more on the application of SC–GHG estimates.

E. Non-Greenhouse Gas Health Impacts

It is important to quantify the health and environmental impacts associated with the proposed program because a failure to adequately consider ancillary impacts could lead to an incorrect assessment of a program's costs and benefits. Moreover, the health and other impacts of exposure to criteria air pollutants and airborne toxics tend to occur in the near term, while most effects from reduced climate change are likely to occur over a time frame of several decades or longer. Ideally, human health benefits would be estimated based on changes in ambient $PM_{2.5}$ and ozone as determined by full-scale air quality modeling. However, the projected non-GHG emissions impacts associated with the proposal would be expected to contribute to very small changes in ambient air quality (see Preamble Section V.C for more detail).

In lieu of air quality modeling, we use a reduced-form benefit-per-ton (BPT) approach to inform our assessment of health impacts, which is conceptually consistent with EPA's use of BPT estimates in several previous RIAs.[161] [162] In this approach, the $PM_{2.5}$-related BPT values are the total monetized human health benefits (the sum of the economic value of the reduced risk of premature death and illness) that are expected from reducing one ton of directly-emitted $PM_{2.5}$ or $PM_{2.5}$ precursor such as NO_X or SO_2. We note, however, that the complex, non-linear photochemical processes that govern ozone formation prevent us from developing reduced-form ozone BPT values. This is an important limitation to recognize when using the BPT approach.

For tailpipe emissions, we apply national $PM_{2.5}$-related BPT values that were recently derived for the ''Onroad Light Duty Vehicle'' sector.[163] The onroad light-duty vehicle BPT values were derived using detailed mobile sector source-apportionment air quality modeling, and apply EPA's existing method for using reduced-form tools to estimate $PM_{2.5}$-related benefits.[164] [165] Compared to values that EPA has used in the past,[166] these BPT values provide better resolution by mobile sector and geographic area, two features that make them especially useful for quantifying the benefits of reducing emissions from the onroad light-duty sector.

To monetize the $PM_{2.5}$-related impacts of upstream emissions, we apply BPT values that were developed for the refinery sector.[167] While total upstream emissions also include electricity generating unit sources, petroleum extraction, storage and transport sources, as well as sources upstream from the refinery, the modeling tool used to support this analysis only provides estimates of upstream emissions impacts aggregated across all sources. Furthermore, we assume the majority of upstream emission reductions associated with the proposal would be related to domestic onsite refinery emissions and domestic crude production, because the fleet penetration of electric vehicles attributed to the proposed standards is relatively small (i.e., the change in electric vehicle penetration is projected to change from 4 percent in the No Action case to 8 percent under the proposed standards). We therefore believe for purposes of this proposed rule it is appropriate to apply the refinery values to all upstream emissions. We solicit comment on this approach and any alternative approaches that we should adopt for the final rule.

EPA bases its benefits analyses on peer-reviewed studies of air quality and health effects and peer-reviewed studies of the monetary values of public health and welfare improvements. Very recently, EPA updated its approach to estimating the benefits of changes in $PM_{2.5}$ and ozone.[168] [169] These updates were based on information drawn from the recent 2019 $PM_{2.5}$ and 2020 Ozone Integrated Science Assessments (ISAs), which were reviewed by the Clean Air Science Advisory Committee (CASAC) and the public.[170] [171] Unfortunately, EPA has not had an opportunity to update its BPT estimates to reflect these updates in time for this proposal. Instead, we use $PM_{2.5}$ BPT estimates that are based on the review of the 2009 PM ISA [172] and include a mortality risk estimate derived from the Krewski et al. (2009) [173] analysis of the American Cancer Society (ACS) cohort and nonfatal illnesses consistent with benefits analyses performed for the analysis of the final Tier 3 Vehicle Rule,[174] the final 2012 PM NAAQS Revision,[175] and the final 2017–2025 Light-duty Vehicle GHG Rule.[176] We expect this lag in updating our BPT

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[161] U.S. Environmental Protection Agency (U.S. EPA). 2012. Regulatory Impact Analysis for the Final Revisions to the National Ambient Air Quality Standards for Particulate Matter. EPA452/R–12–003. Office of Air Quality Planning and Standards, Health and Environmental Impacts Division, Research Triangle Park, NC. December. Available at: *http://www.epa.gov/ttnecas1/regdata/RIAs/finalria.pdf.*

[162] U.S. Environmental Protection Agency (U.S. EPA). 2014. Regulatory Impact Analysis for the Proposed Carbon Pollution Guidelines for Existing Power Plants and Emission Standards for Modified and Reconstructed Power Plants. EPA–542/R–14–002. Office of Air Quality Planning and Standards, Research Triangle Park, NC. June. Available at *http://www.epa.gov/ttnecas1/regdata/RIAs/111dproposalRIAfinal0602.pdf.*

[163] Wolfe, P.; Davidson, K.; Fulcher, C.; Fann, N.; Zawacki, M.; Baker, K. R. 2019. Monetized Health Benefits Attributable to Mobile Source Emission Reductions across the United States in 2025. Sci. Total Environ. 650, 2490–2498. https://doi.org/10.1016/J.SCITOTENV.2018.09.273. Also see *https://www.epa.gov/benmap/mobile-sector-source-apportionment-air-quality-and-benefits-ton.*

[164] Zawacki, M.; Baker, K. R.; Phillips, S.; Davidson, K.; Wolfe, P. 2018. Mobile Source Contributions to Ambient Ozone and Particulate Matter in 2025. Atmos. Environ. 188, 129–141.

[165] Fann, N.; Fulcher, C. M.; Baker, K. 2013. The Recent and Future Health Burden of Air Pollution Apportioned across U.S. Sectors. Environ. Sci. Technol. 47 (8), 3580–3589. *https://doi.org/10.1021/es304831q.*

[166] US EPA, 2018. Technical Support Document: Estimating the Benefit per Ton of Reducing $PM_{2.5}$ Precursors from 17 Sectors. 2018. Office of Air Quality Planning and Standards. Research Triangle Park, NC.

[167] U.S. Environmental Protection Agency (U.S. EPA). 2018. Technical Support Document: Estimating the Benefit per Ton of Reducing $PM_{2.5}$ Precursors from 17 Sectors. 2018. Office of Air Quality Planning and Standards. Research Triangle Park, NC.

[168] U.S. Environmental Protection Agency (U.S. EPA). 2021. Regulatory Impact Analysis for the Final Revised Cross-State Air Pollution Rule (CSAPR) Update for the 2008 Ozone NAAQS. EPA–452/R–21–002. March.

[169] U.S. Environmental Protection Agency (U.S. EPA). 2021. Estimating $PM_{2.5}$- and Ozone-Attributable Health Benefits. Technical Support Document (TSD) for the Final Revised Cross-State Air Pollution Rule Update for the 2008 Ozone Season NAAQS. EPA–HQ–OAR–2020–0272. March.

[170] U.S. Environmental Protection Agency (U.S. EPA). 2019. Integrated Science Assessment (ISA) for Particulate Matter (Final Report, 2019). U.S. Environmental Protection Agency, Washington, DC, EPA/600/R–19/188, 2019.

[171] U.S. Environmental Protection Agency (U.S. EPA). 2020. Integrated Science Assessment (ISA) for Ozone and Related Photochemical Oxidants (Final Report). U.S. Environmental Protection Agency, Washington, DC, EPA/600/R–20/012, 2020.

[172] U.S. Environmental Protection Agency (U.S. EPA). 2009. Integrated Science Assessment for Particulate Matter (Final Report). EPA–600–R–08–139F. National Center for Environmental Assessment—RTP Division, Research Triangle Park, NC. December. Available at: *http://cfpub.epa.gov/ncea/cfm/recordisplay.cfm?deid=216546.*

[173] Krewski D., M. Jerrett, R.T. Burnett, R. Ma, E. Hughes, Y. Shi, et al. 2009. Extended Follow-Up and Spatial Analysis of the American Cancer Society Study Linking Particulate Air Pollution and Mortality. HEI Research Report, 140, Health Effects Institute, Boston, MA.

[174] U.S. Environmental Protection Agency. (2014). Control of Air Pollution from Motor Vehicles: Tier 3 Motor Vehicle Emission and Fuel Standards Final Rule: Regulatory Impact Analysis, Assessment and Standards Division, Office of Transportation and Air Quality, EPA–420–R–14–005, March 2014. Available on the internet: *http://www3.epa.gov/otaq/documents/tier3/420r14005.pdf.*

[175] U.S. Environmental Protection Agency. (2012). *Regulatory Impact Analysis for the Final Revisions to the National Ambient Air Quality Standards for Particulate Matter,* Health and Environmental Impacts Division, Office of Air Quality Planning and Standards, EPA–452–R–12–005, December 2012. Available on the internet: *http://www3.epa.gov/ttnecas1/regdata/RIAs/finalria.pdf.*

[176] U.S. Environmental Protection Agency (U.S. EPA). (2012). Regulatory Impact Analysis: Final Rulemaking for 2017–2025 Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards, Assessment and Standards Division, Office of Transportation and Air Quality, EPA–420–R–12–016, August 2012. Available on the internet at: *http://www3.epa.gov/otaq/climate/documents/420r12016.pdf.*

estimates to have only a minimal impact on total PM benefits, since the underlying mortality risk estimate based on the Krewski study is identical to an updated $PM_{2.5}$ mortality risk estimate derived from an expanded analysis of the same ACS cohort.[177] The Agency is currently working to update its BPT estimates to reflect these recent updates for use in future rulemaking analyses. More information on the BPT approach to valuing PM-related benefits can be found in RIA Chapter 7.2 that accompanies this proposal.

The PM-related BPT estimates used in this analysis are provided in Table 48. We multiply these BPT values by projected national changes in NO_X, SO_2 and directly-emitted $PM_{2.5}$, in tons, to estimate the total $PM_{2.5}$-related monetized human health benefits associated with the proposed program. As the table indicates, these values differ among pollutants and depend on their original source, because emissions from different sources can result in different degrees of population exposure and resulting health impacts. The BPT values for emissions of non-GHG pollutants from both onroad light-duty vehicle use and upstream sources such as fuel refineries will increase over time. These projected increases reflect rising income levels, which increase affected individuals' willingness to pay for reduced exposure to health threats from air pollution. The BPT values also reflect future population growth and increased life expectancy, which expands the size of the population exposed to air pollution in both urban and rural areas, especially among older age groups with the highest mortality risk.[178]

TABLE 48—$PM_{2.5}$-RELATED BENEFIT-PER-TON VALUES

[2018$] [a]

Year	Onroad light duty vehicles [b]			Upstream Sources[c]		
	Direct $PM_{2.5}$	SO_2	NO_X	Direct $PM_{2.5}$	SO_2	NO_X
Estimated Using a 3 Percent Discount Rate						
2020	$600,000	$150,000	$6,400	$380,000	$81,000	$8,100
2025	660,000	170,000	6,900	420,000	90,000	8,800
2030	740,000	190,000	7,600	450,000	98,000	9,600
2035	830,000	210,000	8,400			
2040	920,000	230,000	9,000			
2045	1,000,000	250,000	9,600			
Estimated Using a 7 Percent Discount Rate						
2020	540,000	140,000	5,800	350,000	74,000	7,300
2025	600,000	150,000	6,200	380,000	80,000	7,900
2030	660,000	170,000	6,800	410,000	88,000	8,600
2035	750,000	190,000	7,500			
2040	830,000	210,000	8,200			
2045	900,000	230,000	8,600			

Notes:

[a] The benefit-per-ton estimates presented in this table are based on estimates derived from the American Cancer Society cohort study (Krewski et al., 2009). They also assume either a 3 percent or 7 percent discount rate in the valuation of premature mortality to account for a twenty-year segmented premature mortality cessation lag.

[b] Benefit-per-ton values for onroad light duty vehicles were estimated for the years 2020, 2025, 2030, 2035, 2040, and 2045. We hold values constant for intervening years (e.g., the 2020 values are assumed to apply to years 2021–2024; 2025 values for years 2026–2029; and 2045 values for years 2046 and beyond).

[c] Benefit-per-ton values for upstream sources were estimated only for the years 2020, 2025 and 2030. We hold values constant for intervening years and 2030 values are applied to years 2031 and beyond.

[d] We assume for the purpose of this analysis that total ''upstream emissions'' are most appropriately monetized using refinery sector benefit per-ton values.

The monetized $PM_{2.5}$ health impacts of the proposed standards are presented in Table 54. Using $PM_{2.5}$-related BPT estimates to monetize the non-GHG impacts of the proposed standards omits ozone-related impacts, unquantified PM-related health impacts, as well as other impacts associated with reductions in exposure to air toxics, ecosystem benefits, and visibility improvement. Section V of this preamble provides a qualitative description of both the health and environmental effects of the non-GHG pollutants impacted by the proposed program.

F. Energy Security Impacts

This proposal is designed to require reductions in the GHG emissions of light-duty vehicles (LDV) and thereby reduce fuel consumption. In turn, this proposed LDV GHG (2023–2026) proposal would help to reduce U.S. petroleum imports. A reduction of U.S. petroleum imports reduces both financial and strategic risks caused by potential sudden disruptions in the supply of imported petroleum to the U.S., thus increasing U.S. energy security.

In order to understand the energy security implications of reducing U.S. oil imports, EPA has worked with Oak Ridge National Laboratory (ORNL), which has developed approaches for evaluating the social costs and energy security implications of oil use. When conducting this analysis, ORNL considers the full cost of importing petroleum into the U.S. The full economic cost (*i.e.,* oil security premiums, as labeled below) is defined to include two components in addition

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[177] Turner, MC, Jerrett, M, Pope, A, III, Krewski, D, Gapstur, SM, Diver, WR, Beckerman, BS, Marshall, JD, Su, J, Crouse, DL and Burnett, RT (2016). Long-term ozone exposure and mortality in a large prospective study. Am J Respir Crit Care Med 193(10): 1134–1142.

[178] For more information about income growth adjustment factors and EPA's population projections, please refer to the following: *https://www.epa.gov/sites/production/files/2015-04/documents/benmap-ce_user_manual_march_2015.pdf.*

to the purchase price of petroleum itself. These are: (1) The higher costs/benefits for oil imports resulting from the effect of changes in U.S. demand on the world oil price (*i.e.,* the ''demand'' or ''monopsony'' costs/benefits); and (2) the risk of reductions in U.S. economic output and disruption to the U.S. economy caused by sudden disruptions in the supply of imported oil to the U.S. (*i.e.,* the avoided macroeconomic disruption/adjustment costs).

For this proposed rule, EPA is using oil security premiums estimated using ORNL's methodology, which incorporates oil price projections and energy market and economic trends from the EIA's Annual Energy Outlook (AEO). For this analysis, we are using oil security premiums based on AEO 2018, but for the final rule we intend to update this analysis to AEO 2021. We only consider the avoided macroeconomic disruption/adjustment costs oil security premiums (*i.e.,* labeled macroeconomic oil security premiums below), since the monopsony impacts of this proposed rule are considered transfer payments. See previous EPA GHG vehicle rules for a discussion of the monopsony oil security premiums.[179] In addition, EPA and ORNL have worked together to revise the oil security premiums based upon recent energy security literature (see Chapter 3.2.5 of the DRIA accompanying this proposed rule for how the macroeconomic oil security premiums have been updated based upon a review of recent energy security literature on this topic). We do not consider military cost impacts from this proposed rule due to methodological issues in quantifying these impacts (see Chapter 3.2.3 of the DRIA for a review of the literature on the military costs impacts of U.S. oil import reductions).

To calculate the energy security benefits of this proposed rule, EPA is using the ORNL oil security premium methodology with: (1) Estimated oil savings calculated by EPA and (2) an oil import reduction factor of 91 percent, which shows how much U.S. oil imports are reduced from changes in U.S. oil consumption. Each of these assumptions is discussed in more detail in Chapter 3.2 of the accompanying DRIA. Below EPA presents the macroeconomic oil security premiums used for the proposed standards for selected years from 2023–2050 in Table 49.

TABLE 49—MACROECONOMIC OIL SECURITY PREMIUMS FOR SELECTED YEARS FROM 2023–2050

[2018$/Barrel] *

Year (range)	Macroeconomic oil security premiums (range)
2023	$3.63 ($1.22–$6.13)
2026	$3.78 ($1.17–$6.37)
2030	$3.99 ($1.13–$6.74)
2035	$4.30 ($1.14–$7.35)
2040	$4.66 ($1.26–$7.96)
2050	$5.57 ($1.89–$9.53)

* Top values in each cell are the midpoints, the values in parentheses are the 90 percent confidence intervals.

G. Impacts of Additional Driving

As discussed in Chapter 3.1 of the RIA, the assumed rebound effect might occur when an increase in vehicle fuel efficiency encourages people to drive more as a result of the lower cost per mile of driving. Along with the safety considerations associated with increased vehicle miles traveled (described in Section VII.H of this preamble), additional driving can lead to other costs and benefits that can be monetized.

The increase in travel associated with the rebound effect produces additional benefits to vehicle drivers, which reflect the value of the added (or more desirable) social and economic opportunities that become accessible with additional travel. Consistent with assumptions used in the SAFE FRM, this analysis estimates the economic benefits from increased rebound-effect driving as the owner/operator surplus from the additional accessibility it provides.

The equation for the calculation of the Drive Value:

$$\mathit{Drive\ Value} = (1/2)\,(\mathit{VMTrebound})\,[(\$/\mathit{mile})_{\mathrm{NoAction}} - (\$/\mathit{mile})_{\mathrm{Action}}]$$

The economic value of the increased owner/operator surplus provided by added driving is one half of the product of the decline in vehicle operating costs per vehicle-mile and the resulting increase in the annual number of miles driven. Because it depends on the extent of improvement in fuel consumption, the value of benefits from increased vehicle use changes by model year and varies among alternative standards.

In contrast to the benefits of additional driving are the costs associated with that driving. If net operating costs of the vehicle decline, then we expect a positive rebound effect. Increased vehicle use associated with a positive rebound effect also contributes to increased traffic congestion and highway noise. Depending on how the additional travel is distributed throughout the day and where it takes place, additional vehicle use can contribute to traffic congestion and delays by increasing traffic volumes on facilities that are already heavily traveled during peak periods. These added delays impose higher costs on other road users in the form of increased travel time and operating expenses. Because drivers do not take these external costs into account in deciding when and where to travel, they must be accounted for separately as a cost of the added driving associated with the rebound effect.

EPA relies on estimates of congestion and noise costs developed by the Federal Highway Administration to estimate the increased external costs caused by added driving due to the rebound effect. EPA employed estimates from this source previously in the analysis accompanying the light-duty 2010 and 2012 vehicle rulemakings and the 2016 Draft TAR and Proposed Determination. We continue to find them appropriate for this analysis after reviewing the procedures used by FHWA to develop them and considering other available estimates of these values.

FHWA's congestion cost estimates focus on freeways because non-freeway effects are less serious due to lower traffic volumes and opportunities to re-route around the congestion. EPA, however, applied the congestion cost to the overall VMT. The results of this analysis potentially overestimate the congestions costs associated with increased vehicle use, and thus lead to a conservative estimate of net benefits.

EPA has used FHWA's ''Middle'' estimates for marginal congestion and noise costs caused by increased travel from vehicles. This approach is consistent with the methodology used in our prior analyses. The values used are shown in Table 50.

These congestion costs differ from those used in the SAFE FRM and, as stated, are consistent with those used in the 2016 Draft TAR and the 2016 Proposed Determination. For this proposal, EPA has chosen not to adopt the approach from the SAFE FRM where scaling factors were used to adjust the underlying FHWA congestion cost estimates. In particular, EPA now finds that scaling the marginal per-mile congestion costs by the change in VMT per lane-mile on U.S. highways from 1997 to 2017 does not account for changes in average speeds and improved road design, and may have the potential to over-estimate costs. We

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[179] See Energy Security Impacts. Effect of Oil Use on the Long-Run Oil Price. Section 10. 5.2.1. pp.10–25. 2016. 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.

are continuing to use the FHWA congestion estimates without scaling, consistent with the SAFE NPRM and prior EPA rulemakings, and adjusting to measure in 2018 dollars. EPA invites comments on the congestion cost values and methodology.

TABLE 50—COSTS ASSOCIATED WITH CONGESTION AND NOISE

[2018 Dollars per vehicle mile]

	Passenger cars	Van/SUVs	Pickups
Congestion	0.0634	0.0634	0.0566
Noise	0.0009	0.0009	0.0009

H. Safety Considerations in Establishing GHG Standards

Consistent with previous light-duty GHG analyses, EPA has assessed the potential of the proposed MY 2023–2026 standards to affect vehicle safety. EPA applied the same historical relationships between mass, size, and fatality risk that were established and documented in the SAFE rulemaking. These relationships are based on the statistical analysis of historical crash data, which included an analysis performed by using the most recently available crash studies based on data for model years 2007 to 2011. EPA used the findings of this analysis to estimate safety impacts of the modeled mass reductions over the lifetimes of new vehicles in response to MY 2023–2026 standards. As in initially promulgating the GHG standards, the MTE Proposed Determination and this proposal, EPA's assessment is that manufacturers can achieve the MY 2023–2026 standards while using modest levels of mass reduction as one technology option among many. On the whole, EPA considers safety impacts in the context of all projected health impacts from the proposal including public health benefits from the projected reductions in air pollution.

The projected change in risk of fatal and non-fatal injuries is influenced by changes in fleet mix (car/truck share), vehicle scrappage rates, distribution of VMT among vehicles in the fleet and vehicle mass. Because the empirical analysis described previously did not produce any mass-safety coefficients with a statistically significant difference from zero, we analyzed safety results over the range of coefficient values. We project that the effect of the proposed standards on annual fatalities per billion miles driven ranges from a decrease of 0.25 percent to an increase of 0.38 percent, with a central estimate of a 0.07 percent increase.[180]

In addition to changes in risk, EPA also considered the projected impact of the proposed standards on the absolute number of fatal and non-fatal injuries. The majority of the fatalities projected would result from the projected increased driving—*i.e.,* people choosing to drive more due to the lower operating costs of more efficient vehicles. Our cost-benefit analysis accounts for both the value of this additional driving and its associated risk, which we assume are considerations in the decision to drive. The risk valuation associated with this increase in driving partially offsets the associated increase in societal costs due to increased fatalities and non-fatal injuries.

This analysis projects that there will be an increase in vehicle miles traveled (VMT) under the proposed standards of 449 billion miles compared to the No Action scenario through 2050 (an increase of about 0.5 percent). EPA estimates that vehicle safety, in terms of risk measured as the total fatalities per the total distance traveled over this period, will remain almost unchanged at 4.642 fatalities per billion miles under the proposal, compared to 4.640 fatalities per billion miles for the no-action scenario. EPA has also estimated, over the same 30 year period, that total fatalities will increase by 2,288, with 1,952 deaths attributed to increased driving and 336 deaths attributed to the increase in fatality risk. In other words, approximately 85 percent of the change in fatalities under these proposed standards is due to projected increases in VMT and mobility (*i.e.,* people driving more). Our analysis also considered the increase in non-fatal injuries. Consistent with the SAFE FRM, EPA assumed that non-fatal injuries scale with fatal injuries.

EPA also estimated the societal costs of these safety impacts using assumptions consistent with the SAFE FRM (see Table 51.) Specifically, we are continuing to use the cost associated with each fatality of $10.4 million. We have also continued to use a scalar of approximately 1.6 applied to fatality costs to estimate non-fatal injury costs. In addition, we have accounted for the driver's inherent valuation of risk when making the decision to drive more due to rebound. This risk valuation partially offsets the fatal and non-fatal injury costs described previously, and, consistent with the SAFE FRM, is calculated as 90 percent of the fatal and non-fatal injury costs due to rebound to reflect the fact that consumers do not fully evaluate the risks associated with this additional driving.

I. Summary of Costs and Benefits

This section presents a summary of costs, benefits, and net benefits of the proposed program. Table 51 shows the estimated annual monetized costs of the proposed program for the indicated calendar years. The table also shows the present-values (PV) of those costs and the annualized costs for the calendar years 2021–2050 using both 3 percent and 7 percent discount rates.[181] The table includes an estimate of foregone consumer sales surplus, which measures the loss in benefits attributed to consumers who would have purchased a new vehicle in the absence of the proposed standards.

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[180] These fatality risk values are the average of changes in annual risk through 2050. The range of values is based on the 5% to 95% confidence interval of mass-safety coefficients presented in the SAFE FRM.

[181] For the estimation of the stream of costs and benefits, we assume that after implementation of the proposed MY 2023–2026 standards, the 2026 standards apply to each year thereafter.

TABLE 51—COSTS ASSOCIATED WITH THE PROPOSED PROGRAM

[Billions of 2018 dollars]

Calendar year	Foregone consumer sales surplus [a] ($)	Technology costs ($)	Congestion ($)	Noise ($)	Fatality costs ($)	Non-fatal crash costs ($)	Total costs ($)
2023	0.26	6.7	0.046	0.00073	0.16	0.26	7.4
2026	0.64	15	0.19	0.003	0.61	1	18
2030	0.43	14	0.59	0.0095	0.58	0.96	17
2035	0.28	12	1	0.017	0.2	0.33	14
2040	0.21	11	1.3	0.021	−0.038	−0.062	12
2050	0.16	9.9	1.3	0.021	−0.0093	−0.015	11
PV, 3%	5.7	210	15	0.24	4.5	7.6	240
PV, 7%	3.7	130	7.3	0.12	3.4	5.6	150
Annualized, 3%	0.29	11	0.75	0.012	0.23	0.39	12
Annualized, 7%	0.3	10	0.59	0.0095	0.27	0.45	12

[a] “Foregone Consumer Sales Surplus” refers to the difference between a vehicle’s price and the buyer’s willingness to pay for the new vehicle; the impact reflects the reduction in new vehicle sales described in Section VII.B. See Section 8 of *CAFE_Model_Documentation_FR_2020.pdf* in the docket for more information.

Table 52 shows the undiscounted annual monetized fuel savings of the proposed program. The table also shows the present- and annualized-values of those fuel savings for the same calendar years using both 3 percent and 7 percent discount rates. The net benefits calculations use the aggregate value of fuel savings (calculated using pre-tax fuel prices) since savings in fuel taxes do not represent a reduction in the value of economic resources utilized in producing and consuming fuel. Note that the fuel savings shown in Table 52 result from reductions in fleet-wide fuel use and include rebound effects, credit usage and advanced technology multiplier use. Thus, fuel savings grow over time as an increasing fraction of the fleet is projected to meet the proposed standards.

TABLE 52—FUEL SAVINGS ASSOCIATED WITH THE PROPOSED PROGRAM

[Billions of 2018 dollars]

Calendar year	Retail fuel savings ($)	Fuel tax savings ($)	Pre-tax fuel savings ($)
2023	0.78	0.2	0.58
2026	3.5	0.95	2.6
2030	12	2.7	8.9
2035	21	4.4	17
2040	28	5.4	23
2050	32	5.6	26
PV, 3%	310	62	250
PV, 7%	150	32	120
Annualized, 3%	16	3.2	13
Annualized, 7%	12	2.5	9.9

Note: Electricity expenditure increases are included.

Table 53 presents estimated annual monetized benefits from non-emission sources for the indicated calendar years. The table also shows the present- and annualized-value of those benefits for the calendar years 2021–2050 using both 3 percent and 7 percent discount rates.

TABLE 53—BENEFITS FROM NON-EMISSION SOURCES

[Billions of 2018 dollars]

Calendar year	Drive value ($)	Refueling time savings ($)	Energy security benefits ($)	Total non-emission benefits ($)
2023	0.065	−0.019	0.03	0.076
2026	0.25	−0.12	0.15	0.28
2030	0.83	−0.15	0.46	1.1
2035	1.6	−0.1	0.83	2.3
2040	2.1	−0.017	1.1	3.2
2050	2.3	0.1	1.5	3.9
PV, 3%	23	−0.94	13	35
PV, 7%	11	−0.72	6.1	17
Annualized, 3%	1.2	−0.048	0.64	1.8

TABLE 53—BENEFITS FROM NON-EMISSION SOURCES—Continued

[Billions of 2018 dollars]

Calendar year	Drive value ($)	Refueling time savings ($)	Energy security benefits ($)	Total non-emission benefits ($)
Annualized, 7%	0.92	−0.058	0.49	1.4

* See Section VII.G, Section VII.C and Section VII.F for more on drive value, refueling time and energy security, respectively.

Table 54 presents estimated annual monetized benefits from non-GHG emission sources for the indicated calendar years. The table also shows the present- and annualized-values of those benefits for the calendar years 2021–2050 using both 3 percent and 7 percent discount rates.

TABLE 54—$PM_{2.5}$-RELATED EMISSION REDUCTION BENEFITS

[Billions of 2018 dollars] [a] [b]

Calendar year	Tailpipe benefits ($)		Upstream benefits ($)		Total $PM_{2.5}$-related benefits ($)	
	3% DR	7% DR	3% DR	7% DR	3% DR	7% DR
2023	−0.013	−0.012	0.029	0.027	0.016	0.015
2026	−0.047	−0.042	0.014	0.015	−0.033	−0.028
2030	0.035	0.032	0.089	0.084	0.12	0.12
2035	0.23	0.21	0.34	0.31	0.57	0.52
2040	0.46	0.41	0.48	0.44	0.94	0.85
2050	0.74	0.67	0.34	0.31	1.1	0.98
PV	4.3	1.6	4.5	2	8.8	3.6
Annualized	0.22	0.13	0.23	0.16	0.45	0.29

Notes:

[a] Note that the non-GHG impacts associated with the standards presented here do not include the full complement of health and environmental effects that, if quantified and monetized, would increase the total monetized benefits. Instead, the non-GHG benefits are based on benefit-per-ton values that reflect only human health impacts associated with reductions in $PM_{2.5}$ exposure.

[b] Calendar year non-GHG benefits presented in this table assume either a 3 percent or 7 percent discount rate in the valuation of PM-related premature mortality to account for a twenty-year segmented cessation lag. Note that annual benefits estimated using a 3 percent discount rate were used to calculate the present and annualized values using a 3 percent discount rate and the annual benefits estimated using a 7 percent discount rate were used to calculate the present and annualized values using a 7 percent discount rate.

Table 55 shows the benefits of reduced GHG emissions, and consequently the annual quantified benefits (*i.e.,* total GHG benefits), for each of the four interim social cost of GHG (SC–GHG) values estimated by the interagency working group. As discussed in the RIA Chapter 3.3, there are some limitations to the SC–GHG analysis, including the incomplete way in which the integrated assessment models capture catastrophic and non-catastrophic impacts, their incomplete treatment of adaptation and technological change, uncertainty in the extrapolation of damages to high temperatures, and assumptions regarding risk aversion.

TABLE 55—CLIMATE BENEFITS FROM REDUCTIONS IN GREENHOUSE GAS EMISSIONS

[Billions of 2018 dollars]

Calendar year	Discount rate and statistic			
	5% Average ($)	3% Average ($)	2.5% Average ($)	3% 95th percentile ($)
2023	0.063	0.21	0.31	0.63
2026	0.31	1	1.5	3
2030	1	3.2	4.6	9.5
2035	2	6	8.5	18
2040	2.8	8.1	11	25
2050	3.9	10	14	31
PV	22	91	140	280
Annualized	1.4	4.7	6.7	14

Notes:

The present value of reduced GHG emissions is calculated differently than other benefits. The same discount rate used to discount the value of damages from future emissions (SC–GHGs at 5, 3, 2.5 percent) is used to calculate the present value of SC–GHGs for internal consistency. Annual benefits shown are undiscounted values.

Table 56 presents estimated annual net benefits for the indicated calendar years. The table also shows the present and annualized value of those net benefits for the calendar years 2021–2050 using both 3 percent and 7 percent discount rates. The table includes the benefits of reduced GHG emissions (and consequently the annual net benefits) for each of the four SC–GHG values considered by EPA. We estimate that the total benefits of the proposed program far exceed the costs and would result in a net present value of benefits that ranges between $17–330 billion, depending on which SC–GHG and discount rate is assumed.

TABLE 56—NET BENEFITS (EMISSION BENEFITS + NON-EMISSION BENEFITS + FUEL SAVINGS − COSTS) ASSOCIATED WITH THE PROPOSED PROGRAM

[Billions of 2018 dollars][a][b]

Calendar year	Net benefits, with climate benefits based on 5% discount rate ($)	Net benefits, with climate benefits based on 3% discount rate ($)	Net benefits, with climate benefits based on 2.5% discount rate ($)	Net benefits, with climate benefits based on 3% discount rate, 95th percentile SC–GHG ($)
2023	−6.6	−6.5	−6.4	−6.1
2026	−14	−14	−13	−12
2030	−5.8	−3.7	−2.3	2.7
2035	7.6	12	14	24
2040	17	22	26	39
2050	23	30	34	51
PV, 3%	73	140	190	330
PV, 7%	17	86	140	270
Annualized, 3%	4.1	7.3	9.4	17
Annualized, 7%	1	4.2	6.3	14

Notes:

[a] The present value of reduced GHG emissions is calculated differently than other benefits. The same discount rate used to discount the value of damages from future emissions (SC–GHG at 5, 3, 2.5 percent) is used to calculate present value of SC–GHGs for internal consistency, while all other costs and benefits are discounted at either 3% or 7%. Annual costs and benefits shown are undiscounted values.

[b] Note that the non-GHG impacts associated with the standards presented here do not include the full complement of health and environmental effects that, if quantified and monetized, would increase the total monetized benefits. Instead, the non-GHG benefits are based on benefit-per-ton values that reflect only human health impacts associated with reductions in $PM_{2.5}$ exposure.

EPA also conducted a separate analysis of the total benefits over the model year lifetimes of the 2023 through 2026 model year vehicles. In contrast to the calendar year analysis presented in Table 51 through Table 56 the model year lifetime analysis below shows the impacts of the proposed program on vehicles produced during each of the model years 2023 through 2026 over the course of their expected lifetimes. The net societal benefits over the full lifetimes of vehicles produced during each of the four model years are shown in Table 57 and Table 58 at both 3 percent and 7 percent discount rates, respectively. Similar to the calendar year analysis, the net benefits would exceed the costs of the program.

TABLE 57—MONETIZED VEHICLE PROGRAM COSTS, FUEL SAVINGS, BENEFITS, AND NET BENEFITS ASSOCIATED WITH THE LIFETIMES OF 2023–2026 MODEL YEAR LIGHT-DUTY VEHICLES

[Billions, 2018$; 3% discount rate][a][b][c]

MY	Costs ($)	Fuel savings ($)	Benefits ($)	Net benefits ($)
Present-Values				
2023	4.8	3.6	0.89 to 4.5	−0.29 to 3.3
2024	5.9	7	1.8 to 8.8	2.8 to 9.8
2025	6.7	8.6	2 to 11	3.9 to 13
2026	8.1	13	3.6 to 17	8.8 to 22
Sum	26	33	8.2 to 41	15 to 48
Annualized-Values				
2023	0.21	0.16	0.044 to 0.19	−0.0072 to 0.14
2024	0.26	0.3	0.086 to 0.38	0.13 to 0.43
2025	0.29	0.37	0.1 to 0.46	0.18 to 0.55
2026	0.35	0.58	0.17 to 0.73	0.4 to 0.96
Sum	1.1	1.4	0.4 to 1.8	0.71 to 2.1

Notes:

[a] Model year values are discounted to 2021; the ''Sum'' represents those discounted values summed across model years.

[b] The range of benefits and net benefits reflects the low to high range of SC–GHG values. The same discount rate used to discount the value of damages from future GHG emissions is used to calculate net present value of SC–GHGs for internal consistency, while all other costs and benefits are discounted at 3 percent in this table.

[c] Note that the non-GHG impacts associated with the standards presented here do not include the full complement of health and environmental effects that, if quantified and monetized, would increase the total monetized benefits. Instead, the non-GHG benefits are based on benefit-per-ton values that reflect only human health impacts associated with reductions in $PM_{2.5}$ exposure.

TABLE 58—MONETIZED COSTS, FUEL SAVINGS, BENEFITS, AND NET BENEFITS ASSOCIATED WITH THE LIFETIMES OF 2023–2026 MODEL YEAR LIGHT-DUTY VEHICLES

[Billions, 2018$; 7% discount rate] [a b c]

MY	Costs ($)	Fuel savings ($)	Benefits ($)	Net benefits ($)
Present-Values				
2023	4.4	2.6	0.72 to 4.3	−1.1 to 2.5
2024	5.5	4.7	1.4 to 8.4	0.54 to 7.6
2025	6.1	5.5	1.6 to 10	1 to 9.7
2026	7.3	8.2	2.6 to 16	3.6 to 17
Sum	23	21	6.3 to 39	4 to 37
Annualized-Values				
2023	0.33	0.19	0.048 to 0.2	−0.089 to 0.061
2024	0.41	0.35	0.092 to 0.39	0.029 to 0.32
2025	0.45	0.41	0.1 to 0.47	0.064 to 0.43
2026	0.55	0.62	0.18 to 0.74	0.25 to 0.81
Sum	1.7	1.6	0.42 to 1.8	0.25 to 1.6

Notes:

[a] Model year values are discounted to 2021; the ''Sum'' represents those discounted values summed across model years.

[b] The range of benefits and net benefits reflects the low to high range of SC–GHG values. The same discount rate used to discount the value of damages from future GHG emissions is used to calculate net present value of SC–GHGs for internal consistency, while all other costs and benefits are discounted at 7 percent in this table.

[c] Note that the non-GHG impacts associated with the standards presented here do not include the full complement of health and environmental effects that, if quantified and monetized, would increase the total monetized benefits. Instead, the non-GHG benefits are based on benefit-per-ton values that reflect only human health impacts associated with reductions in $PM_{2.5}$ exposure.

J. Impacts on Consumers of Vehicle Costs and Fuel Savings

Although the primary purpose of this regulatory action is to reduce GHG emissions, the impact of the proposed EPA standards on consumers is an important consideration for EPA. This chapter discusses the impact of the proposed standards on consumer net costs for purchasing and fueling vehicles. For further discussion of impacts on vehicle sales, see Section VII.B; for impacts on affordability, see Section VII.M.

EPA estimates that the average cost of a new MY 2026 vehicle will increase by $1,044 due to the proposed standards, while we estimate that the average per-mile fuel cost in the first year will decrease by 0.59 cents.[182] Over time, reductions in fuel consumption will offset the increase in upfront costs. For instance, EPA estimates that, over the lifetime of a MY 2026 vehicle,[183] the reduction in fuel costs will exceed the increase in vehicle costs by $883, using a 3 percent discount rate.[184]

Another way to look at the effects on vehicle buyers is to examine how the costs are distributed among new and used vehicle owners. Because depreciation occurs over the lifetime of the vehicle, the net purchase cost to an owner will depend on the vehicle age when it was bought, and, if sold, the length of time that the vehicle was owned. A study from Argonne National Laboratory provides estimates for the depreciation of light-duty vehicles by age, as summarized in Table 59.[185] If the additional cost of fuel-saving technology depreciates at the same rates, then a person who buys a new vehicle and sells it after 5 years would incur 60 percent of the upfront costs (100 percent of the original value, less 40 percent paid back). Analogously, the person who buys the vehicle at age 5 would incur 20 percent of those costs (40 percent, less 20 percent paid back), and the purchaser of the 10-year-old vehicle would face a net 10 percent of the cost of the technology after it is sold five

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[182] See U.S. Environmental Protection Agency, ''Fuel Savings Offset to Vehicle Costs_20210610.xlsx,'' in the docket for this and the other calculations in this section. Fuel prices are based on AEO2021 and change over time; for the Reference Case, the average retail fuel price for years 2026–2036 ranged from $2.53 to $2.98/gallon (2020$) for gasoline and $0.118 to $0.119/kWh of electricity (2020$). U.S. Energy Information Administration (EIA), U.S. Department of Energy (DOE), Annual Energy Outlook, 2021. For the analysis involving 5-year ownership periods, we use the fuel costs associated with the initial year of purchase for each owner, *i.e.,* 2026, 2031, 2036. The analysis includes the program flexibilities of credit banking, fleet averaging, advanced technology multipliers, and air conditioning and off-cycle credits.

[183] The CCEMS models vehicles over a 40 year lifetime; however, it includes scrappage rates such that fewer and fewer vehicles of any vintage remain on the road year after year, and those vehicles that remain are driven fewer and fewer miles year after year.

[184] The EPA Guidelines for Preparing Economic Analysis, Chapter 6.4, suggests that a 3 percent discount rate is appropriate for calculations involving consumption, instead of the opportunity cost of capital. Here, the discount rate is applied, beginning in 2026 when the vehicle is purchased new, to the stream of fuel costs over the vehicle lifetime. U.S. Environmental Protection Agency (2010). ''Guidelines for Preparing Economic Analysis,'' Chapter 6. *https://www.epa.gov/sites/production/files/2017-09/documents/ee-0568-06.pdf,* accessed 6/14/2021.

[185] Argonne National Laboratory (2021). ''Comprehensive Total Cost of Ownership Quantification for Vehicles with Different Size Classes and Powertrains.'' ANL/ESD–21/4, Figure ES–2. *https://publications.anl.gov/anlpubs/2021/05/167399.pdf,* accessed 6/8/2021.

years later at vehicle age 15. A person purchasing a new vehicle, driving the average fleetwide VMT for the given age and facing the fuel prices used in this analysis, would face an estimated net cost of $204, shown in Table 60, which reflects fuel savings that offset 70 percent of the depreciation cost. The buyer of that 5-year-old used vehicle would see an estimated reduction in net cost—that is, a net saving—of $230, while the buyer of that same 10-year-old used vehicle would see an estimated reduction of net cost of $314. In general, the purchasers of older vehicles will see a greater portion of their depreciation costs offset by fuel savings.

TABLE 59—DEPRECIATION ESTIMATES FOR LIGHT DUTY VEHICLES

Vehicle age	1	2	3	4	5	10	15
Fraction of original value retained	0.70	0.61	0.53	0.475	0.40	0.20	0.10

Estimated by Argonne National Laboratory using Edmunds data for MY2013–2019 vehicles (see figure ES–2).[185]

TABLE 60—IMPACT OF PROPOSED STANDARDS ON DEPRECIATION AND FUEL COSTS FOR MY 2026 VEHICLE OVER 5 YEARS OF OWNERSHIP

	Vehicle depreciation plus fuel costs ($)	Portion of depreciation costs offset by fuel savings (%)
Vehicle Purchased New	204	70
Vehicle Purchased at Age 5	(230)	197
Vehicle Purchased at Age 10	(314)	365

Calculated using analysis VMT assumptions for proposed standards, using a 3% discount rate from year of purchase.

Because the use of vehicles varies widely across vehicle owners, another way to estimate the effects of the standards is to examine the ''break even'' number of miles—that is, the number of miles driven that would result in fuel savings matching the increase in up-front costs. For example, if operating costs of a MY 2026 vehicle decrease by 0.59 cents per mile due to reduced fuel consumption, the upfront costs (when purchased new) would be recovered after 177,000 miles of driving, excluding discounting.[186] As this measure makes clear, the financial effect on a new vehicle owner depends on the amount that the vehicle is driven. Mobility service providers, such as taxis or ride-sharing services, are likely to accumulate miles more quickly than most people who use their vehicles for personal use. As discussed in Section VII.M, the lower per-mile cost for these vehicles may reduce the importance of up-front costs in the charge for mobility as a service, and thus further enable use of that service.

Table 61 shows, for purchasers of different-age MY 2026 vehicles, how the degree to which fuel savings offset depreciation costs will depend on vehicle use levels.[187] Cost recovery is again higher for older vehicles, and faster for vehicles that accumulate VMT more quickly. For example, a consumer who purchases a 5-year old used MY2026 vehicle would recover their vehicle costs through fuel savings after only 31,000 miles of driving.

TABLE 61—PROPORTION OF DEPRECIATION COSTS OFFSET BY FUEL SAVINGS, FOR NEW AND USED VEHICLE PURCHASERS, FOR A MY2026 VEHICLE

		When vehicle purchased new (%)	When vehicle purchased at 5 years old (%)	When vehicle purchased at 10 years old (%)
Portion of vehicle depreciation cost offset by fuel savings (own vehicle for 5 years).	At 10,000 miles	9	32	69
	At 50,000 miles	47	161	347
	At 100,000 miles	94	322	693
Miles where fuel savings fully offset the vehicle owner's depreciation cost.	Owned vehicle for 5 years	106,000	31,000	14,000
	Owned vehicle for full remaining lifetime.	177,000	62,000	28,000

Thus, the financial effects on a vehicle buyer depend on how much that person drives, as well as whether the vehicle is bought new or used. Importantly, all people receive the

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[186] This estimate is calculated as the increase in cost, $1044, divided by the reduced per-mile cost, $0.0059, to get miles until cost is recovered.

[187] The up-front costs for each purchaser are based on the cost to the owner based on the depreciated price for the vehicle's age, with recovery of some further depreciated cost after 5 years of ownership. Cost recovery per mile is $0.0059, and is multiplied by the number of miles in the second column. The remaining columns are cost recovery divided by the relevant cost. Discounting is not used to abstract from the VMT occurring during a specified timeframe.

benefits of reduced GHG emissions, the primary focus of this rule.

K. Employment Impacts

If the U.S. economy is at full employment, even a large-scale environmental regulation is unlikely to have a noticeable impact on aggregate net employment.[188] Instead, labor would primarily be reallocated from one productive use to another, and net national employment effects from environmental regulation would be small and transitory (*e.g.,* as workers move from one job to another).[189] Affected sectors may nevertheless experience transitory effects as workers change jobs. Some workers may retrain or relocate in anticipation of new requirements or require time to search for new jobs, while shortages in some sectors or regions could bid up wages to attract workers. These adjustment costs can lead to local labor disruptions. Even if the net change in the national workforce is small, localized reductions in employment may adversely impact individuals and communities just as localized increases may have positive impacts.

If the economy is operating at less than full employment, economic theory does not clearly indicate the direction or magnitude of the net impact of environmental regulation on employment; it could cause either a short-run net increase or short-run net decrease.[190] At the level of individual companies, employers affected by environmental regulation may increase their demand for some types of labor, decrease demand for other types of labor, or for still other types, not change it at all. The uncertain direction of labor impacts is due to the different channels by which regulations affect labor demand.

Morgenstern et al. (2002) [191] decompose the labor consequences in a regulated industry facing increased abatement costs into three separate components. First, there is a demand effect caused by higher production costs raising market prices. Higher prices reduce consumption (and production), reducing demand for labor within the regulated industry. Second, there is a cost effect where, as production costs increase, plants use more of all inputs, including labor, to produce the same level of output. Third, there is a factor-shift effect where post-regulation production technologies may have different labor intensities. Other researchers use different frameworks along a similar vein.[192]

DRIA Chapter 8.2 discusses the calculation of employment impacts in the model used for this analysis. The estimates include effects on three sectors: Automotive dealers, final assembly labor and parts production, and fuel economy technology labor. The first two of these are examples of Morgenstern et al.'s (2002) demand-effect employment, while the third reflects cost-effect employment. For automotive dealers, the model estimates the hours involved in each new vehicle sale. To estimate the labor involved in final assembly, the model used average labor hours per vehicle at a sample of U.S. assembly plants, adjusted by the ratio of vehicle assembly manufacturing employment to employment for total vehicle and equipment manufacturing for new vehicles. Finally, for fuel economy technology labor, DOT calculated the average revenue per job-year for automakers.

EPA's assessment of employment impacts, in DRIA Chapter 8.2.3, using the sales assumptions of both automakers and consumers using 2.5 years of fuel consumption in vehicle decisions and a demand elasticity of −1, shows initial very small decreases in employment of 0.1 percent, followed by small positive gains (less than 1 percent) in employment due to the labor involved in producing the technologies needed to meet the proposed standards. If, instead, we use the sensitivity analysis with a demand elasticity of −0.4, employment is higher for both the no-action alternative and the proposed standards. Between the no-action alternative and the proposal, with an elasticity of −0.4, the employment impacts are positive, rising to about a 2 percent increase. If automakers underestimate consumers' valuation of fuel economy, as noted in Section VII.B, then demand-effect employment is likely to be higher, and employment impacts are likely to be more positive.

Note that these are employment impacts in the directly regulated sector, plus the impacts for automotive dealers. These do not include economy-wide labor impacts. As discussed earlier, economy-wide impacts on employment are generally driven by broad macroeconomic effects. It also does not reflect employment effects due to reduced spending on fuel consumption. Those changes may lead to some reductions in employment in gas stations, and some increases in other sectors to which people reallocate those expenditures.

Electrification of the vehicle fleet is likely to affect both the number and the nature of employment in the auto and parts sectors and related sectors, such as providers of charging infrastructure. Because this proposal projects relatively minor increases in penetration of plug-in electric vehicles, from 4.6 percent in MY 2023 to 8.4 percent in MY 2026 (see Table 42), we do not predict major changes in the composition of employment in these sectors for MYs 2023–2026. EPA will continue to assess changes in employment as electrification of the auto industry proceeds.

L. Environmental Justice

Executive Order 12898 (59 FR 7629, February 16, 1994) establishes federal executive policy on environmental justice. It directs federal agencies, to the greatest extent practicable and permitted by law, to make achieving environmental justice part of their mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of their programs, policies, and activities on minority populations and low-income populations in the United States. EPA defines environmental justice as the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies.[193]

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[188] Full employment is a conceptual target for the economy where everyone who wants to work and is available to do so at prevailing wages is actively employed. The unemployment rate at full employment is not zero.

[189] Arrow et al. (1996). ''Benefit-Cost Analysis in Environmental, Health, and Safety Regulation: A Statement of Principles.'' American Enterprise Institute, The Annapolis Center, and Resources for the Future. See discussion on bottom of p. 6. In practice, distributional impacts on individual workers can be important, as discussed later in this section.

[190] Schmalensee, Richard, and Stavins, Robert N. ''A Guide to Economic and Policy Analysis of EPA's Transport Rule.'' White paper commissioned by Excelon Corporation, March 2011.

[191] Morgenstern, R.D.; Pizer, W.A.; and Shih, J.-S. (2002). ''Jobs Versus the Environment: An Industry-Level Perspective.'' Journal of Environmental Economics and Management 43: 412–436. 2002.

[192] Berman, E. and Bui, L. T. M. (2001). ''Environmental Regulation and Labor Demand: Evidence from the South Coast Air Basin.'' Journal of Public Economics 79(2): 265–295; Deschênes, O. (2018). ''Balancing the Benefits of Environmental Regulations for Everyone and the Costs to Workers and Firms.'' IZA World of Labor 22v2. *https://wol.iza.org/uploads/articles/458/pdfs/environmental-regulations-and-labor-markets.pdf,* accessed 4/19/2021.

[193] Fair treatment means that ''no group of people should bear a disproportionate burden of environmental harms and risks, including those resulting from the negative environmental consequences of industrial, governmental and commercial operations or programs and policies.'' Meaningful involvement occurs when ''(1) potentially affected populations have an

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Executive Order 14008 (86 FR 7619, February 1, 2021) also calls on Agencies to make achieving environmental justice part of their missions ''by developing programs, policies, and activities to address the disproportionately high and adverse human health, environmental, climate-related and other cumulative impacts on disadvantaged communities, as well as the accompanying economic challenges of such impacts.'' It also declares a policy ''to secure environmental justice and spur economic opportunity for disadvantaged communities that have been historically marginalized and overburdened by pollution and under-investment in housing, transportation, water and wastewater infrastructure and health care.'' Under Executive Order 13563 (76 FR 3821), federal agencies may consider equity, human dignity, fairness, and distributional considerations, where appropriate and permitted by law.

EPA's 2016 ''Technical Guidance for Assessing Environmental Justice in Regulatory Analysis'' provides recommendations on conducting the highest quality analysis feasible, recognizing that data limitations, time and resource constraints, and analytic challenges will vary by media and regulatory context.[194]

When assessing the potential for disproportionately high and adverse health or environmental impacts of regulatory actions on minority populations, low-income populations, tribes, and/or indigenous peoples, EPA strives to answer three broad questions: (1) Is there evidence of potential EJ concerns in the baseline (the state of the world absent the regulatory action)? Assessing the baseline will allow EPA to determine whether pre-existing disparities are associated with the pollutant(s) under consideration (*e.g.,* if the effects of the pollutant(s) are more concentrated in some population groups). (2) Is there evidence of potential EJ concerns for the regulatory option(s) under consideration? Specifically, how are the pollutant(s) and its effects distributed for the regulatory options under consideration? And, (3) Do the regulatory option(s) under consideration exacerbate or mitigate EJ concerns relative to the baseline? It is not always possible to quantitatively assess these questions.

EPA's 2016 Technical Guidance does not prescribe or recommend a specific approach or methodology for conducting an environmental justice analysis, though a key consideration is consistency with the assumptions underlying other parts of the regulatory analysis when evaluating the baseline and regulatory options. Where applicable and practicable, the Agency endeavors to conduct such an analysis. Going forward, EPA is committed to conducting environmental justice analysis for rulemakings based on a framework similar to what is outlined in EPA's Technical Guidance, in addition to investigating ways to further weave environmental justice into the fabric of the rulemaking process. EPA greatly values input from EJ stakeholders and communities and looks forward to engagement as we consider the impacts of light-duty vehicle emissions.

1. GHG Impacts

In 2009, under the *Endangerment and Cause or Contribute Findings for Greenhouse Gases Under Section 202(a) of the Clean Air Act* (''Endangerment Finding''), the Administrator considered how climate change threatens the health and welfare of the U.S. population. As part of that consideration, she also considered risks to minority and low-income individuals and communities, finding that certain parts of the U.S. population may be especially vulnerable based on their characteristics or circumstances. These groups include economically and socially disadvantaged communities; individuals at vulnerable lifestages, such as the elderly, the very young, and pregnant or nursing women; those already in poor health or with comorbidities; the disabled; those experiencing homelessness, mental illness, or substance abuse; and/or Indigenous or minority populations dependent on one or limited resources for subsistence due to factors including but not limited to geography, access, and mobility.

Scientific assessment reports produced over the past decade by the U.S. Global Change Research Program (USGCRP),[195] [196] the Intergovernmental Panel on Climate Change (IPCC),[197] [198] [199] [200] and the National Academies of Science, Engineering, and Medicine [201] [202] add more evidence that

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appropriate opportunity to participate in decisions about a proposed activity [*e.g.,* rulemaking] that will affect their environment and/or health; (2) the public's contribution can influence [the EPA's rulemaking] decision; (3) the concerns of all participants involved will be considered in the decision-making process; and (4) [the EPA will] seek out and facilitate the involvement of those potentially affected'' A potential EJ concern is defined as ''the actual or potential lack of fair treatment or meaningful involvement of minority populations, low-income populations, tribes, and indigenous peoples in the development, implementation and enforcement of environmental laws, regulations and policies.'' See ''Guidance on Considering Environmental Justice During the Development of an Action.'' Environmental Protection Agency, *www.epa.gov/environmentaljustice/guidanceconsidering-environmental-justice-duringdevelopment-action.* See also *https://www.epa.gov/environmentaljustice.*

[194] ''Technical Guidance for Assessing Environmental Justice in Regulatory Analysis.'' Epa.gov, Environmental Protection Agency, *https://www.epa.gov/sites/production/files/2016-06/documents/ejtg_5_6_16_v5.1.pdf.*

[195] USGCRP, 2018: *Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II* [Reidmiller, D.R., C.W. Avery, D.R. Easterling, K.E. Kunkel, K.L.M. Lewis, T.K. Maycock, and B.C. Stewart (eds.)]. U.S. Global Change Research Program, Washington, DC, USA, 1515 pp. doi: 10.7930/NCA4.2018.

[196] USGCRP, 2016: The Impacts of Climate Change on Human Health in the United States: A Scientific Assessment. Crimmins, A., J. Balbus, J.L. Gamble, C.B. Beard, J.E. Bell, D. Dodgen, R.J. Eisen, N. Fann, M.D. Hawkins, S.C. Herring, L. Jantarasami, D.M. Mills, S. Saha, M.C. Sarofim, J. Trtanj, and L. Ziska, Eds. U.S. Global Change Research Program, Washington, DC, 312 pp. *http://dx.doi.org/10.7930/J0R49NQX.*

[197] Oppenheimer, M., M. Campos, R. Warren, J. Birkmann, G. Luber, B. O'Neill, and K. Takahashi, 2014: Emergent risks and key vulnerabilities. In: Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Field, C.B., V.R. Barros, D.J. Dokken, K.J. Mach, M.D. Mastrandrea, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea, and L.L. White (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 1039–1099.

[198] Porter, J.R., L. Xie, A.J. Challinor, K. Cochrane, S.M. Howden, M.M. Iqbal, D.B. Lobell, and M.I. Travasso, 2014: Food security and food production systems. In: Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Field, C.B., V.R. Barros, D.J. Dokken, K.J. Mach, M.D. Mastrandrea, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea, and L.L. White (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 485–533.

[199] Smith, K.R., A. Woodward, D. Campbell-Lendrum, D.D. Chadee, Y. Honda, Q. Liu, J.M. Olwoch, B. Revich, and R. Sauerborn, 2014: Human health: Impacts, adaptation, and co-benefits. In: Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Field, C.B., V.R. Barros, D.J. Dokken, K.J. Mach, M.D. Mastrandrea, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea, and L.L. White (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 709–754.

[200] IPCC, 2018: Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty [Masson-Delmotte, V., P. Zhai, H.-O. Pörtner, D. Roberts, J. Skea, P.R. Shukla, A. Pirani, W. Moufouma-Okia, C. Péan, R. Pidcock, S. Connors, J.B.R. Matthews, Y. Chen, X. Zhou, M.I. Gomis, E. Lonnoy, T. Maycock, M. Tignor, and T. Waterfield (eds.)]. In Press.

[201] National Research Council. 2011. America's Climate Choices. Washington, DC: The National Academies Press. *https://doi.org/10.17226/12781.*

[202] National Academies of Sciences, Engineering, and Medicine. 2017. Communities in Action:

the impacts of climate change raise potential environmental justice concerns. These reports conclude that poorer or predominantly non-White communities can be especially vulnerable to climate change impacts because they tend to have limited adaptive capacities and are more dependent on climate-sensitive resources such as local water and food supplies, or have less access to social and information resources. Some communities of color, specifically populations defined jointly by ethnic/racial characteristics and geographic location, may be uniquely vulnerable to climate change health impacts in the United States. In particular, the 2016 scientific assessment on the *Impacts of Climate Change on Human Health*[203] found with high confidence that vulnerabilities are place- and time-specific, lifestages and ages are linked to immediate and future health impacts, and social determinants of health are linked to greater extent and severity of climate change-related health impacts.

i. Effects on Specific Populations of Concern

Individuals living in socially and economically disadvantaged communities, such as those living at or below the poverty line or who are experiencing homelessness or social isolation, are at greater risk of health effects from climate change. This is also true with respect to people at vulnerable lifestages, specifically women who are pre- and perinatal, or are nursing; *in utero* fetuses; children at all stages of development; and the elderly. Per the Fourth National Climate Assessment, ''Climate change affects human health by altering exposures to heat waves, floods, droughts, and other extreme events; vector-, food- and waterborne infectious diseases; changes in the quality and safety of air, food, and water; and stresses to mental health and well-being.''[204] Many health conditions such as cardiopulmonary or respiratory illness and other health impacts are associated with and exacerbated by an increase in GHGs and climate change outcomes, which is problematic as these diseases occur at higher rates within vulnerable communities. Importantly, negative public health outcomes include those that are physical in nature, as well as mental, emotional, social, and economic.

To this end, the scientific assessment literature, including the aforementioned reports, demonstrates that there are myriad ways in which these populations may be affected at the individual and community levels. Individuals face differential exposure to criteria pollutants, in part due to the proximities of highways, trains, factories, and other major sources of pollutant-emitting sources to less-affluent residential areas. Outdoor workers, such as construction or utility crews and agricultural laborers, who frequently are comprised of already at-risk groups, are exposed to poor air quality and extreme temperatures without relief. Furthermore, individuals within EJ populations of concern face greater housing and clean water insecurity and bear disproportionate economic impacts and health burdens associated with climate change effects. They have less or limited access to healthcare and affordable, adequate health or homeowner insurance. Finally, resiliency and adaptation are more difficult for economically disadvantaged communities: They have less liquidity, individually and collectively, to move or to make the types of infrastructure or policy changes to limit or reduce the hazards they face. They frequently are less able to self-advocate for resources that would otherwise aid in resiliency and hazard reduction and mitigation.

The assessment literature cited in EPA's 2009 and 2016 Endangerment Findings, as well as *Impacts of Climate Change on Human Health,* also concluded that certain populations and life stages, including children, are most vulnerable to climate-related health effects. The assessment literature produced from 2016 to the present strengthens these conclusions by providing more detailed findings regarding related vulnerabilities and the projected impacts youth may experience. These assessments—including the Fourth National Climate Assessment (2018) and *The Impacts of Climate Change on Human Health in the United States* (2016)—describe how children's unique physiological and developmental factors contribute to making them particularly vulnerable to climate change. Impacts to children are expected from heat waves, air pollution, infectious and waterborne illnesses, and mental health effects resulting from extreme weather events. In addition, children are among those especially susceptible to allergens, as well as health effects associated with heat waves, storms, and floods. Additional health concerns may arise in low-income households, especially those with children, if climate change reduces food availability and increases prices, leading to food insecurity within households.

The Impacts of Climate Change on Human Health[203] also found that some communities of color, low-income groups, people with limited English proficiency, and certain immigrant groups (especially those who are undocumented) live with many of the factors that contribute to their vulnerability to the health impacts of climate change. While difficult to isolate from related socioeconomic factors, race appears to be an important factor in vulnerability to climate-related stress, with elevated risks for mortality from high temperatures reported for Black or African American individuals compared to White individuals after controlling for factors such as air conditioning use. Moreover, people of color are disproportionately exposed to air pollution based on where they live, and disproportionately vulnerable due to higher baseline prevalence of underlying diseases such as asthma, so climate exacerbations of air pollution are expected to have disproportionate effects on these communities.

Native American Tribal communities possess unique vulnerabilities to climate change, particularly those impacted by degradation of natural and cultural resources within established reservation boundaries and threats to traditional subsistence lifestyles. Tribal communities whose health, economic well-being, and cultural traditions depend upon the natural environment will likely be affected by the degradation of ecosystem goods and services associated with climate change. The IPCC indicates that losses of customs and historical knowledge may cause communities to be less resilient or adaptable.[205] The Fourth National Climate Assessment (2018) noted that while Indigenous peoples are diverse and will be impacted by the climate changes universal to all Americans, there are several ways in which climate change uniquely threatens Indigenous peoples' livelihoods and economies.[206]

Pathways to Health Equity. Washington, DC: The National Academies Press. *https://doi.org/10.17226/24624.*

[203] USGCRP, 2016: The Impacts of Climate Change on Human Health in the United States: A Scientific Assessment.

[204] Ebi, K.L., J.M. Balbus, G. Luber, A. Bole, A. Crimmins, G. Glass, S. Saha, M.M. Shimamoto, J. Trtanj, and J.L. White-Newsome, 2018: Human Health. In Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II [Reidmiller, D.R., C.W. Avery, D.R. Easterling, K.E. Kunkel, K.L.M. Lewis, T.K. Maycock, and B.C. Stewart (eds.)]. U.S. Global Change Research Program, Washington, DC, USA, pp. 539–571. doi: 10.7930/NCA4.2018.CH14.

[205] Porter et al., 2014: Food security and food production systems.

[206] Jantarasami, L.C., R. Novak, R. Delgado, E. Marino, S. McNeeley, C. Narducci, J. Raymond-Yakoubian, L. Singletary, and K. Powys Whyte, 2018: Tribes and Indigenous Peoples. In Impacts,

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In addition, there can institutional barriers to their management of water, land, and other natural resources that could impede adaptive measures.

For example, Indigenous agriculture in the Southwest is already being adversely affected by changing patterns of flooding, drought, dust storms, and rising temperatures leading to increased soil erosion, irrigation water demand, and decreased crop quality and herd sizes. The Confederated Tribes of the Umatilla Indian Reservation in the Northwest have identified climate risks to salmon, elk, deer, roots, and huckleberry habitat. Housing and sanitary water supply infrastructure are vulnerable to disruption from extreme precipitation events.

NCA4 noted that Indigenous peoples often have disproportionately higher rates of asthma, cardiovascular disease, Alzheimer's, diabetes, and obesity, which can all contribute to increased vulnerability to climate-driven extreme heat and air pollution events. These factors also may be exacerbated by stressful situations, such as extreme weather events, wildfires, and other circumstances.

NCA4 and IPCC AR5 [207] also highlighted several impacts specific to Alaskan Indigenous Peoples. Coastal erosion and permafrost thaw will lead to more coastal erosion, exacerbated risks of winter travel, and damage to buildings, roads, and other infrastructure—these impacts on archaeological sites, structures, and objects that will lead to a loss of cultural heritage for Alaska's Indigenous people. In terms of food security, the NCA discussed reductions in suitable ice conditions for hunting, warmer temperatures impairing the use of traditional ice cellars for food storage, and declining shellfish populations due to warming and acidification. While the NCA also noted that climate change provided more opportunity to hunt from boats later in the fall season or earlier in the spring, the assessment found that the net impact was an overall decrease in food security.

2. Non-GHG Impacts

In addition to significant climate change benefits, the proposed standards would also impact non-GHG emissions. In general, we expect small non-GHG emissions reductions from the combination of ''upstream'' emissions sources related to extracting, refining, transporting, and storing petroleum fuels. We also expect small increases in emissions from upstream electricity generating units (EGUs). A possible increase in emissions from coal- and NG-fired electricity generation to meet increased EV electricity demand could result in adverse EJ impacts. For on-road light duty vehicles, the proposed standards would reduce total non-GHG emissions, though we expect small increases in some non-GHG emissions in the years immediately following implementation of the proposal, followed by growing decreases in emissions in later years. This is due to our assumptions about increased ''rebound'' driving. See Table 44 for more detail on the estimated non-GHG emissions impacts of the proposal.[208] As discussed in Section I.A.3 of the Executive Summary, future EPA regulatory actions that would result in increased zero-emission vehicles and cleaner energy generation would more significantly change the non-GHG impacts of transportation and electricity generation, and those impacts will be analyzed in more detail in those future actions.

There is evidence that communities with EJ concerns are disproportionately impacted by the non-GHG emissions associated with this proposal.[209] Numerous studies have found that environmental hazards such as air pollution are more prevalent in areas where minority populations and low-income populations represent a higher fraction of the population compared with the general population.[210] [211] [212] Consistent with this evidence, a recent study found that most anthropogenic sources of PM$_{2.5}$, including industrial sources, and light- and heavy-duty vehicle sources, disproportionately affect people of color.[213]

Analyses of communities in close proximity to upstream sources, such as EGUs, have found that a higher percentage of communities of color and low-income communities live near these sources when compared to national averages.[214] Vulnerable populations near upstream refineries may experience potential disparities in pollution-related health risk from that source.[215] We expect that small increases in non-GHG emissions from EGUs and small reductions in petroleum-sector emissions would lead to small changes in exposure to these non-GHG pollutants for people living in the communities near these facilities.

There is also substantial evidence that people who live or attend school near major roadways are more likely to be of a racial minority, Hispanic ethnicity, and/or low socioeconomic status.[216] [217] We would expect that communities near roads will benefit from reductions of non-GHG pollutants as fuel efficiency improves and the use of zero-emission vehicles (such as full battery electric vehicles) increases, though increased rebound driving may offset some of these emission reductions, especially in the years immediately after finalization of the proposed standards.

Although proximity to an emissions source is a useful indicator of potential exposure, it is important to note that the impacts of emissions from both upstream and tailpipe sources are not limited to communities in close proximity to these sources. The effects of potential increases and decreases in emissions from the sources affected by this proposal might also be felt many miles away, including in communities with EJ concerns. The spatial extent of these impacts from upstream and tailpipe sources depend on a range of interacting and complex factors including the amount of pollutant emitted, atmospheric chemistry and meteorology.

Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II [Reidmiller, D.R., C.W. Avery, D.R. Easterling, K.E. Kunkel, K.L.M. Lewis, T.K. Maycock, and B.C. Stewart (eds.)]. U.S. Global Change Research Program, Washington, DC, USA, pp. 572–603. doi: 10.7930/NCA4.2018.CH15.

[207] Porter et al., 2014: Food security and food production systems.

[209] Mohai, P.; Pellow, D.; Roberts Timmons, J. (2009) Environmental justice. Annual Reviews 34: 405–430. *https://doi.org/10.1146/annurev-environ-082508-094348.*

[210] Rowangould, G.M. (2013) A census of the near-roadway population: public health and environmental justice considerations. Trans Res D 25: 59–67. *http://dx.doi.org/10.1016/j.trd.2013.08.003.*

[211] Marshall, J.D., Swor, K.R.; Nguyen, N.P (2014) Prioritizing environmental justice and equality: diesel emissions in Southern California. Environ Sci Technol 48: 4063–4068. *https://doi.org/10.1021/es405167f.*

[212] Marshall, J.D. (2000) Environmental inequality: air pollution exposures in California's South Coast Air Basin. Atmos Environ 21: 5499–5503. *https://doi.org/10.1016/j.atmosenv.2008.02.005.*

[213] C.W. Tessum, D.A. Paolella, S.E. Chambliss, J.S. Apte, J.D. Hill, J.D. Marshall, PM$_{2.5}$ polluters disproportionately and systemically affect people of color in the United States. Sci. Adv. 7, eabf4491 (2021).

[214] See 80 FR 64662, 64915–64916 (October 23, 2015).

[215] U.S. EPA (2014). Risk and Technology Review—Analysis of Socio-Economic Factors for Populations Living Near Petroleum Refineries. Office of Air Quality Planning and Standards, Research Triangle Park, North Carolina. January.

[216] Tian, N.; Xue, J.; Barzyk. T.M. (2013) Evaluating socioeconomic and racial differences in traffic-related metrics in the United States using a GIS approach. J Exposure Sci Environ Epidemiol 23: 215–222.

[217] Boehmer, T.K.; Foster, S.L.; Henry, J.R.; Woghiren-Akinnifesi, E.L.; Yip, F.Y. (2013) Residential proximity to major highways—United States, 2010. Morbidity and Mortality Weekly Report 62(3): 46–50.

In summary, we expect this proposed rule would result in both small reductions and small increases of non-GHG emissions. These effects could potentially impact communities with EJ concerns, though not necessarily immediately and not equally in all locations. For this proposal, the air quality information needed to perform a quantified analysis of the distribution of such impacts was not available. We therefore recommend caution when interpreting these broad, qualitative observations. We note that EPA intends to develop a future rule to control emissions of GHGs as well as criteria and air toxic pollutants from light-duty vehicles for model years beyond 2026. We are considering how to project air quality impacts from the changes in non-GHG emissions for that future rulemaking (see Section V.C). EPA is also seeking comment on how to conduct an EJ analysis of the non-GHG impacts associated with mobile source rulemakings, including how EV penetration in the future fleet would affect these impacts.

M. Affordability and Equity Impacts

The impacts of the proposed standards on social equity depend in part on their effects on the affordability of vehicles and transportation services, especially for lower-income households. Access to transportation improves the ability of people, including those with low income, to pursue jobs, education, health care, and necessities of daily life such as food and housing. This section discusses how these standards might affect affordability of vehicles. We acknowledge that vehicles, especially household ownership of vehicles, are only a portion of the larger issues concerning access to transportation and mobility services, which also takes into consideration public transportation and land use design. Though these issues are inextricably linked, the following discussion focuses on effects related to private vehicle ownership and use. We also acknowledge that the emissions of vehicles, both local pollutants and GHGs, can have disproportionate impacts on lower-income and minority communities; see Preamble Section I.E for further discussion of these topics. Finally, we note that social equity involves issues beyond income and affordability, including race, ethnicity, gender, gender identification, and residential location; EPA will continue to examine such impacts and seeks comment on the impact of this proposal on additional dimensions of equity.

Affordability is not a well-defined concept in academic literature. As discussed in Cassidy et al. (2016),[218] researchers have generally applied the term to necessities such as food, housing, or energy, and have identified some themes related to:

> Instead of focusing on the traditional economic concept of willingness to pay, any consideration of affordability must also consider the ability to pay for a socially defined minimum level of a good, especially of a necessity.
>
> Although the ability to pay is often based on the proportion of income devoted to expenditures on a particular good, this ratio approach is widely criticized for not considering expenditures on other possibly necessary goods, quality differences in the good, and heterogeneity of consumer preferences for the good.
>
> Assessing affordability should take into account both the short-term costs and long-term costs associated with consumption of a particular good.

As noted in Cassidy et al. (2016), there is very little literature applying the concept of affordability to transportation, much less to vehicle ownership. It is not clear how to identify a socially acceptable minimum level of transportation service. However, it seems reasonable that some minimum level of transportation services is necessary to enable households access to employment, education, and basic services such as buying food. It also seems reasonable to assume that transportation requirements vary substantially across populations and geographic locations, and it is not clear when consumption of transportation moves from being a necessity to optional. Normatively defining the minimum adequate level of transportation consumption is difficult given the heterogeneity of consumer preferences and living situations. As a result, it is challenging to define how much residual income should remain with each household after transportation expenditures. It is therefore not surprising that academic and policy literature have largely avoided attempting to define transportation affordability.

We are following the approach in the 2016 EPA Proposed Determination for the Midterm Evaluation [219] of considering four questions that relate to the effects of the LDV GHG standards on new vehicle affordability: How the standards affect lower-income households; how the standards affect the used vehicle market; how the standards affect access to credit; and how the standards affect the low-priced vehicle segment. See DRIA Chapter 8.3 for further detail.

The effects of the standards on lower-income households depend on the responses not just to up-front costs but also to the reduction in fuel and operating costs associated with the standards. These responses will affect not only the sales of new vehicles, as discussed in Sections 0 and VII.B, but also the prices of used vehicles as well as the costs associated with ride-hailing and ride-sharing services. A recent study notes that lower-income households spend more on gasoline as a proportion of their income than higher-income households.[220] In addition, the Proposed Determination, Appendix B.1.6, observed that lower-income households spend more on gasoline than on either new or used vehicles, and more on used vehicles than new ones, suggesting the importance of operating costs for these households. If the per-mile costs of services such as ride hailing and ride sharing decrease to reflect lower operating costs, those who do not own vehicles may benefit.

If sales of new vehicles decrease, then prices of used vehicles, which are disproportionately purchased by lower-income households, would be expected to increase; the reverse would happen if new vehicle sales increase. These effects in the used vehicle market also affect how long people hold onto their used vehicles. This effect, sometimes termed the ‘‘Gruenspecht effect'' after Gruenspecht (1982),[221] would lead to both slower adoption of vehicles subject to the new standards, and more use of older vehicles not subject to the new standards, with associated higher emissions, if new vehicle sales decrease. The Gruenspecht effect, therefore, may have the additional consequence of increased concentrations of older vehicles in some communities in the short term, and may delay benefits associated with advanced vehicle technologies for those communities. As discussed in Section VII.B, new vehicle

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[218] Cassidy, A., G. Burmeister, and G. Helfand. ‘‘Impacts of the Model Year 2017–2025 Light-Duty Vehicle Greenhouse Gas Emission Standards on Vehicle Affordability.'' Working paper.

[219] U.S. Environmental Protection Agency (2016). Proposed Determination on the Appropriateness of the Model Year 2022–2025 Light-Duty Vehicle Greenhouse Gas Emissions Standards under the Midterm Evaluation, Chapter 4.3.3. EPA–420–R–16–020. *https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P100Q3DO.pdf*, accessed 4/26/2021.

[220] Vaidyanathan, S., P. Huether, and B. Jennings (2021). ‘‘Understanding Transportation Energy Burdens.'' Washington, DC: American Council for an Energy-Efficient White Paper. *https://www.aceee.org/white-paper/2021-05/understanding-transportation-energy-burdens,* accessed 5/24/2021.

[221] Gruenspecht, H. (1982). ‘‘Differentiated Regulation: The Case of Auto Emissions Standards.'' American Economic Review 72: 328–331.

sales are projected to show a roughly 2 percent decrease from sales under the SAFE rule; that value depends on the uncertain assumption that vehicle buyers consider just a small share of future fuel consumption in the purchase decision. EPA is working with RTI International to understand better the connections between the new and the used vehicle market. Changes in the new vehicle market are expected not only to have immediate effects on the prices of used vehicles, but also to affect the market over time, as the supply of used vehicles in the future depends on how many new vehicles are sold.

Access to credit is a potential barrier to purchase of vehicles whose up-front costs have increased; access may also be affected by race, ethnicity, gender, gender identity, residential location, religion, or other factors. If lenders are not willing to provide financing for buyers who face higher prices, perhaps because the potential buyers are hitting a maximum on the debt-to-income ratio (DTI) that lenders are willing to accept, then those buyers may not be able to purchase new vehicles. On the other hand, some lenders give discounts on loans to purchase more fuel-efficient vehicles.[222] Subsidies exist from the federal government, and some state governments, for plug-in electric vehicles.[223] In addition, as documented in the Midterm Evaluation,[224] the DTI does not appear to be a fixed obstacle for access to finance; from 2007 to 2015, 28 percent of lower-income households and 7 percent of higher-income households who both had a DTI of over 36 percent and purchased at least one new vehicle financed their vehicle purchases.

Low-priced vehicles may be considered an entry point for people into buying new vehicles instead of used ones; automakers may seek to entice people to buy new vehicles through a low price point. It is possible that higher costs associated with proposed standards could affect the ability of automakers to maintain vehicles in this value segment. At the same time, this segment historically tended to include more fuel-efficient vehicles that assisted automakers in achieving CAFE standards.[225] The footprint-based standards, by encouraging improvements in GHG emissions and fuel economy across the vehicle fleet, reduce the need for low-priced vehicles to be a primary means of compliance with the standards. This change in incentives for the marketing of this segment may contribute to the increases in the prices of vehicles previously in this category. Low-priced vehicles still exist; the Chevrolet Spark, for example, is listed as starting at $13,400.[226] At the same time, this segment is gaining more content, such as improved entertainment systems and electric windows; they may be developing an identity as a desirable market segment without regard to their previous purpose in enabling the sales of less efficient vehicles and compliance with CAFE standards.[227] Whether this segment continues to exist, and in what form, may depend on the marketing plans of manufacturers: Whether benefits are greater from offering basic new vehicles to first-time new-vehicle buyers, or from making small vehicles more attractive by adding more desirable features to them.

New electric vehicles currently have higher up-front costs and lower operating costs than gasoline vehicles and require access to charging infrastructure that may not be readily available to many. This proposal does not project major penetration of electric vehicles in response to the proposed standards, from 3.6 percent in MY 2023 to 7.8 percent in MY 2026 (see Table 42). EPA will monitor and study affordability issues related to electric vehicles as their prevalence in the vehicle fleet increases.

In sum, as with the effects of the proposed standards on vehicle sales discussed in Section VII.B, the effects of the standards on affordability depend on two countervailing effects: The increase in the up-front costs of the vehicles, and the decrease in operating costs. The increase in up-front costs has the potential to increase the prices of used vehicles, to make credit more difficult to obtain, and to make the least expensive new vehicles less desirable compared to used vehicles. The reduction in operating costs has the potential to mitigate or reverse all these effects. Lower operating costs on their own increase mobility (see DRIA Chapter 3.1 for a discussion of rebound driving). It is possible that lower-income households may benefit more from the reduction in operating costs than the increase in up-front costs, because they own fewer vehicles per household, spend more on fuel than on vehicles on an annual basis, and those fuel expenditures represent a higher fraction of their household income.

See DRIA Chapter 8.3 for more detailed discussion of these issues.

VIII. Statutory and Executive Order Reviews

A. Executive Order 12866: ''Regulatory Planning and Review and Executive Order 13563: Improving Regulation and Regulatory Review''

This action is an economically significant regulatory action that was submitted to the Office of Management and Budget (OMB) for review. Any changes made in response to OMB recommendations have been documented in the docket. EPA prepared an analysis of the potential costs and benefits associated with this action. This analysis is in the Draft Regulatory Impact Analysis, which can be found in the docket for this rule, and is briefly summarized in Section VII of this preamble.

B. Paperwork Reduction Act

This action does not impose any new information collection burden under the PRA. OMB has previously approved the information collection activities contained in the existing regulations and has assigned OMB control number 2127–0019. This proposed rule changes the level of the existing emission standards and revises several existing credit provisions, but imposes no new information collection requirements.

C. Regulatory Flexibility Act

I certify that this action will not have a significant economic impact on a substantial number of small entities under the RFA. This action will not impose any requirements on small entities. EPA's existing regulations exempt from the GHG standards any manufacturer, domestic or foreign, meeting Small Business Administration's size definitions of small business in 13 CFR 121.201. EPA is not proposing any changes to the provisions for small businesses under this proposal, and thus they would

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[222] Helfand, Gloria (2021). ''Memorandum: Lending Institutions that Provide Discounts for more Fuel Efficient Vehicles.'' U.S. EPA Office of Transportation and Air Quality, Memorandum to the Docket.

[223] U.S. Department of Energy and U.S. Environmental Protection Agency. ''Federal Tax Credits for New All-Electric and Plug-in Hybrid Vehicles.'' *https://www.fueleconomy.gov/feg/taxevb.shtml*, accessed 4/28/2021.

[224] See Note 219, Chapter 4.3.3.4.

[225] Austin, D., and T. Dinan (2005). ''Clearing the Air: The Costs and Consequences of Higher CAFE Standards and Increased Gasoline.'' Journal of Environmental Economics and Management 50(3): 562–82; Kleit, A. (2004). ''Impacts of Long-Range Increases in the Fuel Economy (CAFE) Standard.'' Economic Inquiry 42(2): 279–294.

[226] Motortrend (2021). ''These Are the 10 Cheapest Cars You Can Buy in 2021.'' *https://www.motortrend.com/features-collections/top-10-cheapest-new-cars/*, accessed 4/28/2021; Chevrolet Spark, *https://www.chevrolet.com/cars/spark*, accessed 5/27/2021.

[227] See Note 218.

remain exempt. For additional discussion see chapter 9 of the DRIA.

D. Unfunded Mandates Reform Act

This proposed rule contains no federal mandates under UMRA, 2 U.S.C. 1531–1538, for State, local, or tribal governments. The proposed rule would impose no enforceable duty on any State, local or tribal government. This proposed rule would contain a federal mandate under UMRA that may result in expenditures of $100 million or more for the private sector in any one year. Accordingly, the costs and benefits associated with the proposed rule are discussed in Section VII and in the DRIA, which are in the docket for this rule.

This action is not subject to the requirements of section 203 of UMRA because it contains no regulatory requirements that might significantly or uniquely affect small governments.

E. Executive Order 13132: ''Federalism''

This action does not have federalism implications. It will not have substantial direct effects on the states, on the relationship between the national government and the states, or on the distribution of power and responsibilities among the various levels of government.

F. Executive Order 13175: ''Consultation and Coordination With Indian Tribal Governments''

This action does not have tribal implications as specified in Executive Order 13175. Thus, Executive Order 13175 does not apply to this action. However, EPA plans to continue engaging with our tribal stakeholders in the development of this rulemaking by offering a tribal workshop and offering government-to-government consultation upon request.

G. Executive Order 13045: ''Protection of Children From Environmental Health Risks and Safety Risks''

With respect to GHG emissions, EPA has determined that this rule will not have disproportionate impacts on children (62 FR 19885, April 23, 1997). This rule will reduce emissions of potent GHGs, which as noted earlier in Section I.E of this preamble, will reduce the effects of climate change, including the public health and welfare effects on children.

GHGs contribute to climate change and the GHG emissions reductions resulting from implementation of this proposal would further improve children's health. The assessment literature cited in EPA's 2009 and 2016 Endangerment Findings concluded that certain populations and life stages, including children, the elderly, and the poor, are most vulnerable to climate-related health effects. The assessment literature since 2016 strengthens these conclusions by providing more detailed findings regarding these groups' vulnerabilities and the projected impacts they may experience. These assessments describe how children's unique physiological and developmental factors contribute to making them particularly vulnerable to climate change. Impacts to children are expected from heat waves, air pollution, infectious and waterborne illnesses, and mental health effects resulting from extreme weather events. In addition, children are among those especially susceptible to most allergic diseases, as well as health effects associated with heat waves, storms, and floods. Additional health concerns may arise in low-income households, especially those with children, if climate change reduces food availability and increases prices, leading to food insecurity within households. More detailed information on the impacts of climate change to human health and welfare is provided in Section IV.B of this preamble.

We expect this proposed rule would, on net, result in both small reductions and small increases in non-GHG emissions that could impact children, though not necessarily immediately and not equally in all locations. However, with respect to non-GHG emissions, EPA has concluded that it is not practicable to determine whether there would be disproportionate impacts on children. EPA intends to develop another rule to further reduce emissions of GHGs from light-duty vehicles for model years beyond 2026. We are considering how to project air quality and health impacts from the changes in non-GHG emissions for that future rulemaking (see Section V.C).

H. Executive Order 13211: ''Energy Effects''

This action is not a ''significant energy action'' because it is not likely to have a significant adverse effect on the supply, distribution, or use of energy. EPA has outlined the energy effects in Table 5–7 of the Regulatory Impact Analysis (RIA), which is available in the docket for this action and is briefly summarized here.

This action proposes to reduce CO2 for passenger cars and light trucks under revised GHG standards, which will result in significant reductions of the consumption of petroleum, will achieve energy security benefits, and have no adverse energy effects. Because the GHG emission standards result in significant fuel savings, this rule encourages more efficient use of fuels. Table 5–7 in the RIA shows 291 million barrels of gasoline per year will be saved in 2050, which can be summarized as a net reduction of 797,260 barrels of gasoline per day in 2050.

I. National Technology Transfer and Advancement Act

Section 12(d) of the NTTAA, 15 U.S.C. 272 note, directs federal agencies to use voluntary consensus standards (VCSs) in their regulatory activities unless to do so would be ''inconsistent with applicable law or otherwise impractical.'' VCSs are technical standards, which include materials specifications, test methods, sampling protocols, business practices and management systems developed or adopted by voluntary consensus standards bodies (VCSBs), both domestic and international. These bodies plan, develop, establish or coordinate voluntary consensus standards using agreed-upon procedures.

In addition, the statute encourages agencies to consult with VCSBs and participate in the development of such standards when compatible with agency missions, authorities, priorities and budget resources. The use of VCSs, whenever practicable and appropriate, is intended to achieve the following goals:

- To eliminate the cost to the government of developing its own standards and decrease the cost of goods procured and the burden of complying with agency regulation;
- To provide incentives and opportunities to establish standards that serve national needs;
- To encourage long-term growth for U.S. enterprises and promote efficiency and economic competition through harmonization of standards; and
- To further the policy of reliance upon the private sector to supply government needs for goods and services.

The requirements apply to the use of VCSs in ''regulatory and procurement activities.'' Regulations that do not establish or involve technical standards do not trigger the NTTAA requirements, but it is recommended that agencies provide a brief explanation for why the NTTAA does not apply.

Note that agencies retain broad discretion in deciding when to use VCSs; however, agencies are required to justify the use of government-unique standards when potentially applicable VCSs are available. The NTTAA also does not affect the agency's authority to determine substantive standards as opposed to technical standards (see guidance from the Office of Management and Budget (OMB) at *http://www.whitehouse.gov/omb/circulars_a119.*

This rulemaking involves technical standards. The Agency conducted a search to identify potentially applicable voluntary consensus standards. For CO_2, emissions, we identified no such standards. For CO_2 emissions, EPA is therefore collecting data over the same tests that are used for the current CO_2 standards and for the CAFE program. This will minimize the amount of testing done by manufacturers, since manufacturers are already required to run these tests. For A/C credits, EPA is using the test specified in 40 CFR 1066.845. EPA knows of no voluntary consensus standard for the A/C test.

We are proposing to amend 40 CFR 86.1 to reference SAE J1711, *Recommended Practice for Measuring the Exhaust Emissions and Fuel Economy of Hybrid-Electric Vehicles, Including Plug-in Hybrid Vehicles*, Revised June 2010. The regulation already has rulemaking provisions at 40 CFR 86.1866–12(b) that include references to SAE J1711. We rely on the published procedure to describe test methods related to measuring exhaust emissions from hybrid-electric vehicles. The proposed amendment would complete the administrative steps needed to properly accomplish this incorporation by reference. The referenced recommended practice may be obtained from SAE International on the internet at *www.sae.org,* by email at *CustomerService@sae.org,* or by calling 877–606–7323 or 724–776–4970.

J. Executive Order 12898: ''Federal Actions To Address Environmental Justice in Minority Populations and Low-Income Populations''

For this proposed action, EPA is only able to qualitatively evaluate the extent to which this action may result in disproportionately high and adverse human health or environmental effects on minority populations, low income populations, and/or indigenous peoples, as specified in Executive Order 12898 (59 FR 7629, February 16, 1994). With respect to GHG emissions, EPA has determined that this rule will benefit all U.S. populations, including minority populations, low-income populations and/or indigenous peoples. While this proposed rule would substantially reduce GHG emissions, future impacts of climate change are still expected in the baseline and will likely be unevenly distributed in ways that uniquely impact these communities. EPA has not quantitatively assessed these effects.

For non-GHG pollutants EPA has concluded that it is not practicable given the timing of this proposed action to determine the extent to which effects on minority populations, low-income populations and/or indigenous peoples are differentially distributed. We expect this proposed rule would result in both small reductions and small increases of non-GHG emissions that could impact communities with EJ concerns, though not necessarily immediately and not equally in all locations. It was not practicable to develop the air quality information needed to perform a quantified analysis of the distribution of such non-GHG impacts. EPA intends to develop a future rule to further reduce emissions of GHGs from light-duty vehicles for model years beyond 2026. We are considering how to project air quality impacts from the changes in non-GHG emissions for that future rulemaking (see Section V.C). EPA is taking comment on the types of effects that are important to consider from an EJ perspective as well as ways in which such effects could be quantitatively evaluated for future rulemakings. Section VII.L describes how we considered environmental justice in this action.

IX. Statutory Provisions and Legal Authority

Statutory authority for this proposed rule is found in section 202(a) (which authorizes standards for emissions of pollutants from new motor vehicles which emissions cause or contribute to air pollution which may reasonably be anticipated to endanger public health or welfare), 202(d), 203–209, 216, and 301 of the Clean Air Act, 42 U.S.C. 7521(a), 7521(d), 7522–7525, 7541–7543, 7550, and 7601.

List of Subjects

40 CFR Part 86

Environmental protection, Administrative practice and procedure, Confidential business information, Incorporation by reference, Labeling, Motor vehicle pollution, Reporting and recordkeeping requirements.

40 CFR Part 600

Environmental protection, Administrative practice and procedure, Electric power, Fuel economy, Labeling, Reporting and recordkeeping requirements.

Michael S. Regan,
Administrator.

For the reasons set out in the preamble, we propose to amend title 40, chapter I of the Code of Federal Regulations as set forth below.

PART 86—CONTROL OF EMISSIONS FROM NEW AND IN-USE HIGHWAY VEHICLES AND ENGINES

■ 1. The authority citation for part 86 continues to read as follows:

Authority: 42 U.S.C. 7401–7671q.

■ 2. Amend § 86.1 by redesignating paragraphs (g)(3) through (27) as (g)(4) through (28) and adding new paragraph (g)(3) to read as follows:

§ 86.1 Incorporation by reference.

* * * * *

(g) * * *

(3) SAE J1711, Recommended Practice for Measuring the Exhaust Emissions and Fuel Economy of Hybrid-Electric Vehicles, Including Plug-in Hybrid Vehicles, Revised June 2010, IBR approved for § 86.1866–12(b).

* * * * *

■ 3. Amend § 86.1806–17 by revising paragraph (a) introductory text to read as follows:

§ 86.1806–17 Onboard diagnostics.

* * * * *

(a) Vehicles must comply with the 2013 OBD requirements adopted for California as described in this paragraph (a). California's 2013 OBD–II requirements are part of Title 13, § 1968.2 of the California Code of Regulations, approved on July 31, 2013 (incorporated by reference in § 86.1). We may approve your request to certify an OBD system meeting a later version of California's OBD requirements if you demonstrate that it complies with the intent of this section. The following clarifications and exceptions apply for vehicles certified under this subpart:

* * * * *

■ 4. Amend § 86.1818–12 by revising paragraph (c)(2)(i) and (3)(i) to read as follows:

§ 86.1818–12 Greenhouse gas emission standards for light-duty vehicles, light-duty trucks, and medium-duty passenger vehicles.

* * * * *

(c) * * *

(2) * * *

(i) *Calculation of CO_2 target values for passenger automobiles.* A CO_2 target value shall be determined for each passenger automobile as follows:

(A) For passenger automobiles with a footprint of less than or equal to 41 square feet, the gram/mile CO_2 target value shall be selected for the appropriate model year from the following table:

TABLE 1 TO § 86.1818–12(c)(2)(i)(A)

Model year	CO_2 target value (grams/mile)
2012	244.0
2013	237.0
2014	228.0
2015	217.0
2016	206.0
2017	195.0
2018	185.0
2019	175.0
2020	166.0
2021	161.8
2022	159.0
2023	145.6
2024	138.6
2025	131.9
2026 and later	125.6

(B) For passenger automobiles with a footprint of greater than 56 square feet, the gram/mile CO_2 target value shall be selected for the appropriate model year from the following table:

TABLE 2 TO § 86.1818–12(c)(2)(i)(B)

Model year	CO_2 target value (grams/mile)
2012	315.0
2013	307.0
2014	299.0
2015	288.0
2016	277.0
2017	263.0
2018	250.0
2019	238.0
2020	226.0
2021	220.9
2022	217.3
2023	199.1
2024	189.5
2025	180.3
2026 and later	171.6

(C) For passenger automobiles with a footprint that is greater than 41 square feet and less than or equal to 56 square feet, the gram/mile CO_2 target value shall be calculated using the following equation and rounded to the nearest 0.1 grams/mile, except that for any vehicle footprint the maximum CO_2 target value shall be the value specified for the same model year in paragraph (c)(2)(i)(B) of this section:

Target $CO_2 = [a \times f] + b$

Where:

f is the vehicle footprint, as defined in § 86.1803; and a and b are selected from the following table for the appropriate model year:

TABLE 3 TO § 86.1818–12(c)(2)(i)(C)

Model year	a	b
2012	4.72	50.5
2013	4.72	43.3
2014	4.72	34.8
2015	4.72	23.4
2016	4.72	12.7
2017	4.53	8.9
2018	4.35	6.5
2019	4.17	4.2
2020	4.01	1.9
2021	3.94	0.2
2022	3.88	−0.1
2023	3.56	−0.4
2024	3.39	−0.4
2025	3.23	−0.3
2026 and later	3.07	−0.3

* * * * *

(3) * * *

(i) *Calculation of CO_2 target values for light trucks.* A CO_2 target value shall be determined for each light truck as follows:

(A) For light trucks with a footprint of less than or equal to 41 square feet, the gram/mile CO_2 target value shall be selected for the appropriate model year from the following table:

TABLE 4 TO § 86.1818–12(c)(3)(i)(A)

Model year	CO_2 target value (grams/mile)
2012	294.0
2013	284.0
2014	275.0
2015	261.0
2016	247.0
2017	238.0
2018	227.0
2019	220.0
2020	212.0
2021	206.5
2022	203.0
2023	181.1
2024	172.1
2025	163.5
2026 and later	155.4

(B) For light trucks with a footprint that is greater than 41 square feet and less than or equal to the maximum footprint value specified in the table below for each model year, the gram/mile CO_2 target value shall be calculated using the following equation and rounded to the nearest 0.1 grams/mile, except that for any vehicle footprint the maximum CO_2 target value shall be the value specified for the same model year in paragraph (c)(3)(i)(D) of this section:

Target $CO_2 = (a \times f) + b$

Where:

f is the footprint, as defined in § 86.1803; and *a and b* are selected from the following table for the appropriate model year:

TABLE 5 TO § 86.1818–12(c)(3)(i)(B)

Model year	Maximum footprint	a	b
2012	66.0	4.04	128.6
2013	66.0	4.04	118.7
2014	66.0	4.04	109.4
2015	66.0	4.04	95.1
2016	66.0	4.04	81.1
2017	50.7	4.87	38.3
2018	60.2	4.76	31.6
2019	66.4	4.68	27.7
2020	68.3	4.57	24.6
2021	68.3	4.51	21.5
2022	68.3	4.44	20.6
2023	74.0	3.97	18.4
2024	74.0	3.77	17.4
2025	74.0	3.58	16.6
2026 and later	74.0	3.41	15.8

(C) For light trucks with a footprint that is greater than the minimum footprint value specified in the table below and less than or equal to the maximum footprint value specified in the table below for each model year, the gram/mile CO_2 target value shall be calculated using the following equation and rounded to the nearest 0.1 grams/mile, except that for any vehicle footprint the maximum CO_2 target value shall be the value specified for the same model year in paragraph (c)(3)(i)(D) of this section:

$$\text{Target } CO_2 = (a \times f) + b$$

Where:

f is the footprint, as defined in § 86.1803; and *a and b* are selected from the following table for the appropriate model year:

TABLE 6 TO § 86.1818–12(c)(3)(i)(C)

Model year	Minimum footprint	Maximum footprint	a	b
2017	50.7	66.0	4.04	80.5
2018	60.2	66.0	4.04	75.0

(D) For light trucks with a footprint greater than the minimum value specified in the table below for each model year, the gram/mile CO_2 target value shall be selected for the appropriate model year from the following table:

TABLE 7 TO § 86.1818–12(c)(3)(i)(D)

Model year	Minimum footprint	CO_2 targetvalue (grams/mile)
2012	66.0	395.0
2013	66.0	385.0
2014	66.0	376.0
2015	66.0	362.0
2016	66.0	348.0
2017	66.0	347.0
2018	66.0	342.0
2019	66.4	339.0
2020	68.3	337.0
2021	68.3	329.4
2022	68.3	324.1
2023	74.0	312.1
2024	74.0	296.5
2025	74.0	281.8
2026 and later	74.0	267.8

* * * * *

■ 5. Amend § 86.1865–12 by revising paragraphs (k)(2), (3), and (6) to read as follows:

§ 86.1865–12 How to comply with the fleet average CO_2 standards.

* * * * *

(k) * * *

(2) There are no property rights associated with CO_2 credits generated under this subpart. Credits are a limited authorization to emit the designated amount of emissions. Nothing in this part or any other provision of law shall be construed to limit EPA's authority to terminate or limit this authorization through a rulemaking.

(3) Each manufacturer must comply with the reporting and recordkeeping requirements of paragraph (l) of this section for CO_2 credits, including early credits. The averaging, banking and trading program is enforceable as provided in paragraphs (k)(7)(ii), (k)(9)(iii), and (l)(1)(vi) of this section through the certificate of conformity that allows the manufacturer to introduce any regulated vehicles into U.S. commerce.

* * * * *

(6) Unused CO_2 credits generally retain their full value through five model years after the model year in which they were generated. Credits remaining at the end of the fifth model year after the model year in which they were generated may not be used to demonstrate compliance for later model years. The following particular provisions apply for passenger cars and light trucks:

(i) Unused CO_2 credits from the 2016 model year shall retain their full value through the 2023 model year. Credits from the 2016 model year that remain at the end of the 2023 model year may not be used to demonstrate compliance for later model years.

(ii) Unused CO_2 credits from the 2017 through 2020 model years shall retain their full value through six model years after the model year in which they were generated. Credits remaining from these model years after six model years may not be used to demonstrate compliance for later model years.

* * * * *

■ 6. Amend § 86.1866–12 by—

■ a. Revising paragraphs (b) introductory text and (b)(1).

■ b. Removing paragraph (b)(2)(i).

■ c. Redesignating paragraph (b)(2)(ii) as paragraph (b)(2).

■ d. Adding paragraph (c)(3).

The addition reads as follows:

§ 86.1866–12 CO_2 credits for advanced technology vehicles.

* * * * *

(b) For electric vehicles, plug-in hybrid electric vehicles, fuel cell vehicles, dedicated natural gas vehicles, and dual-fuel natural gas vehicles as those terms are defined in § 86.1803–01, that are certified and produced for U.S. sale in the specified model years and that meet the additional specifications in this section, the manufacturer may use the production multipliers in this paragraph (b) when determining additional credits for advanced technology vehicles. Full size pickup trucks eligible for and using a production multiplier are not eligible for the strong hybrid-based credits described in § 86.1870–12(a)(2) or the performance-based credits described in § 86.1870–12(b).

(1) The following production multipliers apply for model year 2017 through 2025 vehicles:

TABLE 1 TO § 86.1866–12(b)(1)

Model year	Electric vehicles and fuel cell vehicles	Plug-in hybrid electric vehicles	Dedicated and dual-fuel natural gas vehicles
2017	2.0	1.6	1.6
2018	2.0	1.6	1.6
2019	2.0	1.6	1.6
2020	1.75	1.45	1.45
2021	1.5	1.3	1.3
2022	2.0	1.6	2.0
2023–2024	2.0	1.6	1.0
2025	1.75	1.45	1.0

* (No multiplier credits)

* * * * *

(c) * * *

(3) Multiplier-based credits for model years 2022 through 2025 may not exceed credit caps, as follows:

(i) Calculate a nominal annual credit cap in Mg using the following equation, rounded to the nearest whole number:

$$CAP_{annual} = 2.5\frac{\mathrm{g}}{\mathrm{mile}}\cdot\ [195{,}264\ \mathrm{miles}\cdot P_{auto} + 225{,}865\cdot\ P_{truck}\ ]\cdot 10^{-6}\ \frac{\mathrm{tonne}}{\mathrm{g}}$$

Where:

P_{auto} = total number of certified passenger automobiles the manufacturer produced in a given model year for sale in any state or territory of the United States.

P_{truck} = total number of certified light trucks (including MDPV) the manufacturer produced in a given model year for sale in any state or territory of the United States.

(ii) Calculate an annual g/mile equivalent value for the multiplier-based credits using the following equation, rounded to the nearest 0.1 g/mile:

$$annual\ g\ per\ mile\ equivalent\ value\ =\ 2.5\ \cdot\ \frac{annual\ credits}{CAP_{annual}}$$

Where:

annual credits = a manufacturer's total multiplier-based credits in a given model year from all passenger automobiles and light trucks as calculated under this paragraph (c).

(iii) Calculate a cumulative g/mile equivalent value for the multiplier-based credits in 2022 through 2025 by adding the annual g/mile equivalent values calculated under paragraph (c)(3)(ii) of this section.

(iv) The cumulative g/mile equivalent value may not exceed 10.0 in any year.

(v) The annual credit report must include for every model year from 2022 through 2025, as applicable, the calculated values for the nominal annual credit cap in Mg and the cumulative g/mile equivalent value.

■ 7. Revise the section heading for § 86.1868–12 to read as follows:

§ 86.1868–12 CO_2 credits for improving the efficiency of air conditioning systems.

* * * * *

■ 8. Amend § 86.1869–12 by revising the section heading and paragraphs (b)(2), (4)(v), (vi), and (x), and (d)(2)(ii)(A) to read as follows:

§ 86.1869–12 CO_2 credits for off-cycle CO_2 reducing technologies.

* * * * *

(b) * * *

(2) The maximum allowable decrease in the manufacturer's combined passenger automobile and light truck fleet average CO_2 emissions attributable to use of the default credit values in paragraph (b)(1) of this section is 10 g/mi through model year 2022, and 15 g/mi for model years 2023 and later, except that manufacturers may use 15 g/mi in model years 2020 through 2022 if they meet the definitions in paragraphs (b)(4)(v)(B), (vi)(B), and (x)(B) of this section. If the total of the CO_2 g/mi credit values from paragraph (b)(1) of this section does not exceed 10 or 15 g/mi (as applicable) for any passenger automobile or light truck in a manufacturer's fleet, then the total off-cycle credits may be calculated according to paragraph (f) of this section. If the total of the CO_2 g/mi credit values from paragraph (b)(1) of this section exceeds 10 or 15 g/mi (as applicable) for any passenger automobile or light truck in a manufacturer's fleet, then the gram per mile decrease for the combined passenger automobile and light truck fleet must be determined according to paragraph (b)(2)(ii) of this section to determine whether the applicable limitation has been exceeded.

(i) Determine the gram per mile decrease for the combined passenger automobile and light truck fleet using the following formula:

$$\mathrm{Decrease} = \frac{Credits \times 1{,}000{,}000}{[(\mathrm{Prod}_{\mathrm{C}} \times 195{,}264) + (\mathrm{Prod}_{\mathrm{T}} \times 225{,}865)]}$$

Where:

Credits = The total of passenger automobile and light truck credits, in Megagrams, determined according to paragraph (f) of this section and limited to those credits accrued by using the default gram per mile values in paragraph (b)(1) of this section.

Prod_C = The number of passenger automobiles produced by the manufacturer and delivered for sale in the U.S.

Prod_T = The number of light trucks produced by the manufacturer and delivered for sale in the U.S.

(ii) If the value determined in paragraph (b)(2)(i) of this section is greater than 10 or 15 grams per mile (as applicable), the total credits, in Megagrams, that may be accrued by a manufacturer using the default gram per mile values in paragraph (b)(1) of this section shall be determined using the following formula:

$$\text{Credit (Megagrams)} = \frac{\left[10 \times \left((\text{Prod}_C \times 195{,}264) + (\text{Prod}_T \times 225{,}865)\right)\right]}{1{,}000{,}000}$$

Where:

Prod_C = The number of passenger automobiles produced by the manufacturer and delivered for sale in the U.S.

Prod_T = The number of light trucks produced by the manufacturer and delivered for sale in the U.S.

(iii) If the value determined in paragraph (b)(2)(i) of this section is not greater than 10 or 15 grams per mile (as applicable), then the credits that may be accrued by a manufacturer using the default gram per mile values in paragraph (b)(1) of this section do not exceed the allowable limit, and total credits may be determined for each category of vehicles according to paragraph (f) of this section.

(iv) If the value determined in paragraph (b)(2)(i) of this section is greater than 10 or 15 grams per mile (as applicable), then the combined passenger automobile and light truck credits, in Megagrams, that may be accrued using the calculations in paragraph (f) of this section must not exceed the value determined in paragraph (b)(2)(ii) of this section. This limitation should generally be done by reducing the amount of credits attributable to the vehicle category that caused the limit to be exceeded such that the total value does not exceed the value determined in paragraph (b)(2)(ii) of this section.

* * * * *

(4) * * *

(v) *Active transmission warm-up* means one of the following:

(A) Through model year 2019, and optionally for model years 2020–2022, *active transmission warm-up* means a system that uses waste heat from the vehicle to quickly warm the transmission fluid to an operating temperature range using a heat exchanger, increasing the overall transmission efficiency by reducing parasitic losses associated with the transmission fluid, such as losses related to friction and fluid viscosity.

(B) Starting in model year 2023, and optionally for model years 2020–2022, *active transmission warm-up* means a system that uses waste heat from the vehicle's exhaust to warm the transmission fluid to an operating temperature range using a dedicated heat exchanger. *Active transmission warm-up* may also include coolant systems that capture heat from a liquid-cooled exhaust manifold if the system is segregated from the coolant loop in the engine block.

(vi) *Active engine warm-up* means one of the following:

(A) Through model year 2019, and optionally for model years 2020–2022, *active engine warm-up* means a system that uses waste heat from the vehicle to warm up targeted parts of the engine so that it reduces engine friction losses and enables closed-loop fuel control more quickly.

(B) Starting in model year 2023, and optionally for model years 2020–2022, *active engine warm-up* means a system that uses waste heat from the vehicle's exhaust to warm up targeted parts of the engine so that it reduces engine friction losses and enables closed-loop fuel control more quickly. *Active engine warm-up* may also include coolant systems that capture heat from a liquid-cooled exhaust manifold if the system is segregated from the coolant loop in the engine block.

* * * * *

(x) Passive *cabin ventilation* means one of the following:

(A) Through model year 2019, and optionally for model years 2020–2022, *passive cabin ventilation* means ducts, devices, or methods that utilize convective airflow to move heated air from the cabin interior to the exterior of the vehicle.

(B) Starting in model year 2023, and optionally for model years 2020–2022, *passive cabin ventilation* means methods that create and maintain convective airflow through the body's cabin by opening windows or sunroof when the vehicle is parked outside in direct sunlight.

* * * * *

(d) * * *

(2) * * *

(ii) * * *

(A) A citation to the appropriate previously approved methodology, including the appropriate **Federal Register** Notice and any subsequent EPA documentation of the Administrator's decision;

* * * * *

■ 9. Amend § 86.1870–12 by revising the section heading and paragraphs (a)(2) and (b)(2) to read as follows:

§ 86.1870–12 CO_2 credits for qualifying full-size light pickup trucks.

* * * * *

(a) * * *

(2) Full size pickup trucks that are strong hybrid electric vehicles and that are produced in the 2017 through 2025 model years are eligible for a credit of 20 grams/mile. To receive this credit in a model year, the manufacturer must produce a quantity of strong hybrid electric full size pickup trucks such that the proportion of production of such vehicles, when compared to the manufacturer's total production of full size pickup trucks, is not less than 10 percent in that model year. Full size pickup trucks earning credits under this paragraph (a)(2) may not earn credits based on the production multipliers described in § 86.1866–12(b).

* * * * *

(b) * * *

(2) Full size pickup trucks that are produced in the 2017 through 2025 model years and that achieve carbon-related exhaust emissions less than or equal to the applicable target value determined in § 86.1818–12(c)(3) multiplied by 0.80 (rounded to the nearest gram/mile) in a model year are eligible for a credit of 20 grams/mile. A pickup truck that qualifies for this credit in a model year may claim this credit for a maximum of four subsequent model years (a total of five consecutive model years) if the carbon-related exhaust emissions of that pickup truck do not increase relative to the emissions in the model year in which the pickup truck

first qualified for the credit. This credit may not be claimed in any model year after 2025. To qualify for this credit in a model year, the manufacturer must produce a quantity of full size pickup trucks that meet the emission requirements of this paragraph (b)(2) such that the proportion of production of such vehicles, when compared to the manufacturer's total production of full size pickup trucks, is not less than 10 percent in that model year. A pickup truck that qualifies for this credit in a model year and is subject to a major redesign in a subsequent model year such that it qualifies for the credit in the model year of the redesign may be allowed to qualify for an additional five years (not to go beyond the 2025 model year) with EPA approval. Use good engineering judgment to determine whether a pickup truck has been subject to a major redesign.

* * * * *

■ 10. Revise the section heading of § 86.1871–12 to read as follows:

§ 86.1871–12 Optional early CO_2 credit programs.

* * * * *

PART 600—FUEL ECONOMY AND GREENHOUSE GAS EXHAUST EMISSIONS OF MOTOR VEHICLES

■ 11. The authority citation for part 600 continues to read as follows:

Authority: 49 U.S.C. 32901–23919q, Pub. L. 109–58.

■ 12. Amend § 600.510–12 by revising paragraphs (j)(2)(v) introductory text and (vii)(A) introductory text to read as follows:

§ 600.510–12 Calculation of average fuel economy and average carbon-related exhaust emissions.

* * * * *

(j) * * *

(2) * * *

(v) For natural gas dual fuel model types, for model years 2012 through 2015, the arithmetic average of the following two terms; the result rounded to the nearest gram per mile:

* * * * *

(vii)(A) This paragraph (j)(2)(vii) applies to model year 2016 and later natural gas dual fuel model types. Model year 2021 and later natural gas dual fuel model types may use a utility factor of 0.5 or the utility factor prescribed in this paragraph (j)(2)(vii).

* * * * *

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