Rescission of the Greenhouse Gas Endangerment Finding and Motor Vehicle Greenhouse Gas Emission Standards Under the Clean Air Act

Regulatory Impact Analysis

United States
Environmental Protection
Agency

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Office of Transportation and Air Quality
U.S. Environmental Protection Agency

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United States Environmental Protection Agency

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1 Introduction

This Regulatory Impact Analysis (RIA) contains an analysis of projected impacts for the removal of all U.S. Environmental Protection Agency (EPA) greenhouse gas (GHG) standards for light-duty (LD), medium-duty (MD) and heavy-duty vehicles (HD) and HD engines as outlined in the preamble to the *Federal Register* notice associated with this document in accordance with Executive Orders (E.O.) 12866 and 13563. As stated in the preamble for this rule, the EPA recognizes that there have been a number of significant changes since we issued the spring 2024 rulemakings for the Light- and Medium-Duty Vehicle Multipollutant final rule (LMDV)[1] and the Heavy-Duty Vehicle GHG Phase 3 final rule (HD GHG Phase 3)[2] which impact the technical assessment in those two actions, including, but not limited to, the EPA's 2024 assessment of program costs and benefits. Some of the assumptions we no longer believe are appropriate and significantly impact the costs and benefits of this rule include, but are not limited to:

- The impact and existence of electric vehicle (EV) related tax credits and other subsidies from the 2022 Inflation Reduction Act (IRA) which have been changed by the 2025 One Big Beautiful Bill (OBBB);
- The impact of the EPA's waiver rule of California's Advanced Clean Truck (ACT) regulation that has been disapproved under the Congressional Review Act (CRA) and is no longer in force;
- Changes in consumers' interest in purchasing EVs;
- Recent projections of future gasoline and diesel prices from the U.S. Energy Information Administration (EIA) as well as changes in Administration and policies; and
- Changes in the power generation sector as a result of recent projections for data center demands and changes in the OBBB, and the impacts of increased use of EVs.

This document contains discussions of some of the key assumptions that supported the technical analysis contained in the LMDV and HD GHG Phase 3 rulemakings (2024 vehicle rulemakings), and how those assumptions may be different today. Specifically:

- Chapter 2 summarizes information which has become available since the spring of 2024 regarding changes in consumers' and commercial purchasers' interest in battery EVs (BEVs), as well as recent third-party studies' assessments of how changes in policies may impact the U.S. EV market;
- Chapter 3 discusses recent projections in gasoline and diesel fuel prices;
- Chapter 4 discusses the projections the EPA made regarding the power generation sector changes needed to support the increased electrification of the vehicle fleet estimated in the 2024 vehicle rulemakings, and how those projections may change in light of more recent information; and
- Chapter 5 discusses existing literature on how LD consumers value savings due to fuel-saving technology and the EPA's treatment of fuel savings in previous rulemakings.

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[1] 89 FR 27842 (Apr. 18, 2024) "Multi-Pollutant Emissions Standards for Model Years 2027 and Later Light-Duty and Medium-Duty Vehicles."

[2] 89 FR 29440 (Apr. 22, 2024) "Greenhouse Gas Emissions Standards for Heavy-Duty Vehicles-Phase 3."

In recognition of these and other changes since the 2024 vehicle rulemakings, in Chapter 6 the EPA presents the estimated impacts of removing the GHG standards from LD, MD, and HD vehicles and HD engines. The analyses provided in the RIA have been revised since the rule was proposed to reflect a number of considerations, including elements highlighted by commenters.

These results are estimated using updated versions of the models and tools used to estimate the impacts of the 2024 vehicle rulemakings. The new modeling includes updates to the assumptions and inputs, as well as updates to the dollar year from 2022$ to 2024$. We present four scenarios using these updated models and tools: 1) scenario A1 - impacts using updated assumptions to reflect the treatment of IRA tax credits in the OBBB, the removal of the ACT rule, updated assumptions about BEV acceptance, updated fuel, electricity and hydrogen price inputs, and updated inputs regarding the cost of gasoline particulate filters; 2) scenario A2 - a sensitivity on scenario A1 reflecting reduced fuel prices; 3) scenario A3 - impacts of scenario A1 accounting only for the first two and a half years of fuel costs; and 4) scenario A4 - impacts of scenario A2 accounting only for the first two and a half years of fuel costs. More information on these scenarios is contained in Appendix A.

Chapter 7 contains our analysis of small business entities that are subject to the LD, MD, and HD GHG emission standards and related regulations subject to this action.

We note that there are benefits and costs with respect to this regulatory action that are difficult to quantify much less monetize. For example, employment impacts related to this action are too speculative to accurately determine at this time with any level of precision. While we cannot quantify the impacts on employment due to the uncertainty, removing significant costs on companies allows for increased capital that can be utilized to hire more employees and/or increase wages. Additionally, since EPA would no longer be requiring companies to build vehicles that consumers would not like to purchase, it decreases the probability of companies needing to shut down product lines and reduce the workforce.

2 Changes in assumptions related to customers' interest in purchasing electric vehicles

Regulatory, or deregulatory, policy affecting the U.S. market for light-, medium-, and heavy-duty vehicles can impact consumer surplus, producer profits, and net societal welfare. Estimating the welfare effects of such policies requires complex models that capture vehicle manufacturers' production and pricing decisions under the standards, consumer vehicle purchase and driving decisions, and the interactions between them. Ideally, such a model would describe an equilibrium between supply and demand where firms maximize profit subject to regulatory and other constraints while accounting for tradeoffs between emissions (or efficiency), performance, and other vehicle attributes valued by consumers. The model should also capture how consumers make vehicle purchase and driving decisions to maximize their welfare based on their preferences for vehicle attributes (e.g., efficiency, size, speed, reliability) and travel, new and used vehicle prices, and fuel price expectations, subject to their budget constraints and any location constraints (e.g., climate, commuting options, access to fueling infrastructure, etc). When estimating the model and calculating the welfare effects, market failures like imperfect competition, which may distort prices or availability of vehicles meeting consumer preferences, congestion and safety externalities, or consumer myopia should be considered. A model missing some of these elements may fail to capture important aspects of societal welfare — e.g., a model with incomplete representation of how consumers value tradeoffs between different vehicle attributes may potentially lead to an underestimate of the consumer surplus changes of a regulatory or deregulatory action.

As explained in Appendix A, in this analysis EPA relies on updated versions of the models and tools used in the 2024 LMDV and HDP3 rulemakings. The effects of the repeal of the light- and medium-duty standards are estimated using EPA's OMEGA compliance model, and the effects of the repeal of the heavy-duty standards were estimated using the HD TRUCS model. These models, described in detail in the 2024 rulemakings, incorporate many of the components listed above. For example, OMEGA iteratively models complex producer fleet decisions (both vehicles produced and prices) to find an equilibrium that satisfies consumer demand and any specified emission standard. However, as with all models, simplifying assumptions were made in their development that tradeoff between tractability and realism. As an example, the modeling in this rule was conducted under a constraint that manufacturers hold vehicle performance constant when adopting technologies to reduce GHG emissions, an assumption that potentially constrains the set of compliance strategies available to manufacturers. The modeling also makes simplifying assumptions that limit EPA's accounting of how the standards imposed on new vehicles could impact the used vehicle market.

As with all EPA modeling efforts, the Agency will continue to evaluate the OMEGA and HD TRUCS models and their parameters and how they relate to vehicle market dynamics and external factors and adjust assumptions as needed. For example, recent legislation, specifically the One Big Beautiful Bill Act (OBBB)[3] enacted in July 2025 and the June 2025 Congressional Review Act (CRA) resolution to disapprove the EPA waiver for California's Advanced Clean Cars II (ACC II) standards,[4] and other factors (e.g., slow expansion of EV charging infrastructure) has impacted near-term projections of LD, MD, and HD BEV market share from what the EPA considered when developing the 2024 LMDV and HDP3 rules. In light of these changes, the EPA now estimates that the share of new light-duty BEVs sold in the market will be significantly lower in the years ahead than what the Agency previously estimated in the 2024 rules. These revised estimates, described below in Appendix A of this RIA, are supported by recent announcements and developments in the industry.

There is indication that consumer/purchaser demand for LD, MD, and HD EVs has decreased below the levels projected in the 2024 vehicle rulemakings. Recent uncertainty related to the continued

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[3] *See* "An act to provide for reconciliation pursuant to title II of H. Con. Res. 14." ("One Big Beautiful Bill Act", OBBB), Pub. Law No: 119-21, July 4, 2025, 139 Stat. 72. Specifically, OBBB ends incentives such as the 30D tax credits for purchasing BEVs earlier than originally scheduled. The EPA considered these incentives in developing the LMDV Multipollutant Rule. Other incentives that would have facilitated BEV adoption were also ended early by the OBBB. These are described in more detail and modeled in the Proposed Vehicle Rule.

[4] *See* "Providing congressional disapproval under chapter 8 of title 5, United States Code, of the rule submitted by the Environmental Protection Agency relating to 'California State Motor Vehicle and Engine Pollution Control Standards; Advanced Clean Cars II; Waiver of Preemption; Notice of Decision'", Pub. 119-16, June 12, 2025, 139 Stat. 66.

existence of tax credits established by the IRA have also led to reduced projections of demand for these EVs.

For LD vehicles, a recent survey from the American Automobile Association (AAA) representing the U.S. population indicates that fewer adults in 2024 reported they were "likely" to purchase a BEV compared to the previous year.[5] The reasons cited include many of the same issues consumers have historically been concerned with: high purchase price, high battery maintenance costs, and range concerns. Other concerns cited include lower gas prices, an increasingly uncertain future of EV incentives, and politics. A survey from JD Power representing U.S. consumers planning to buy or lease a vehicle in the next year indicates that the percent of vehicle shoppers who are at least somewhat interested in buying an EV in early 2025 is the same as a year ago, and that EV sales have increased compared to last year – potentially due to concerns about the EV tax credit being eliminated.[6] The survey also indicates that there is continued concern with charging. A Gallup poll from March 2025 indicates that the percentage of Americans who either own or express interest in (seriously considering or might consider) owning an EV declined in 2024 compared to the previous year, and remains steady at the 2024 levels today, though the portion of those who say they are seriously considering purchasing an EV has declined since 2024.[7]

A study from Princeton University's Zero-carbon Energy systems Research and Optimization Laboratory (ZERO Lab) looked at the impact of removing EPA tailpipe emission regulations and the IRA's federal clean vehicle tax credits.[8] They estimate that removing the emission regulations and the tax credits together will reduce the sales of BEVs by about 30 percent in 2027 and 40 percent in 2030, compared to retaining the emission regulations and tax credits. This corresponds to a slower increase in the BEV share of new LD vehicle sales, reducing the BEV share by approximately five percentage points in 2026 (to about 13 percent), and by approximately 14 percentage points in 2030 (to about 24 percent). The study also estimates that planned construction and expansion of EV assembly and battery cell manufacturing as well as existing assembly and manufacturing could be at risk of cancellation or closure.[9]

A recent study by the Salata Institute for Climate and Sustainability at Harvard University estimated the effect of a set of EV policy change scenarios on LD vehicles, including removing the IRA tax credits, terminating the waiver that allows California to set tighter emissions standards, and withholding the remaining unspent funds in the National Electric Vehicle Infrastructure (NEVI)

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[5] Moye, B. (2025). AAA: Americans Slow to Adopt Electric Vehicles. *American Automobile Association*: https://newsroom.aaa.com/2025/06/aaa-ev-survey/.

[6] Thomhave, K. (2025). Consumers sustain interest in EVs but range anxiety still a concern. *Automotive Dive*: https://www.automotivedive.com/news/jd-power-ev-sales-consumer-interest-strong/748924/;J.D. Power. (2025). EV Purchase Consideration Holds Steady amid Market Uncertainty, J.D. Power Finds: https://www.jdpower.com/business/press-releases/2025-us-electric-vehicle-consideration-evc-study.

[7] Saad, L. (2025). U.S. Electric Vehicle Interest Steady at Lower 2024 Level. *Gallup*: https://news.gallup.com/poll/658964/electric-vehicle-interest-steady-lower-2024-level.aspx.

[8] Jenkins, J. (2025). Potential Impacts of Electric Vehicle Tax Credit Repeal on US Vehicle Market and Manufacturing. *Princeton University ZERO* Lab: https://doi.org/10.5281/zenodo.15001498.

[9]Domonoske, C. (2025). The fate of the EV tax credits depends on the GOP's megabill. *National Public* Radio: https://www.npr.org/2025/06/03/nx-s1-5414604/ev-tax-credits-republican-bill.

Formula Program, as well as a series of combining different policies.[10] They find that all three scenarios, as well as the combination of different scenarios, lead to a reduction in the EV share of new vehicles sold. They also find that eliminating the EV tax credits for consumers buying new and used vehicles has the biggest effect on EV sales in the single scenarios they analyzed, reducing the EV share of new vehicle sales in 2030 by 6 percentage points.

Cox Automotive's recent third quarter EV sales report shows that EV sales in the third quarter of 2025 increased compared to previous quarters, hitting a record high of 10.5 percent of sales in the quarter, up over 40 percent from the previous quarter and almost 30 percent higher than the third quarter of 2024.[11] They attribute this increase to consumers rushing to get an EV before the EV tax credits are no longer available. Though there was a recent surge, Cox Automotive is forecasting reduced sales in the fourth quarter, and through the early part of next year at least. However, they also point out that the share of BEVs, PHEVs and HEVs sold will continue to increase, though slower than previously assumed. Another EV sales forecasting group agrees, noting that they expect a sharp decline in EV demand in the near future.[12] In their reasoning, they point out that not only are the tax incentives no longer available, but that they also expect reduced growth due to impacts from tariffs, high local manufacturing costs, and reduced fuel efficiency standards likely deterring investment in domestic EV production.

BNEF 2025 Electric Vehicle Outlook states the expectation that passenger EV sales will remain relatively flat this year, and states that this is the first year they have reduced both long- and short-term passenger EV adoption outlook for the U.S.[13] They cite policy changes as the biggest factor, but also indicate rising trade tensions and increased tariffs are making it more difficult to offer affordable entry-level vehicles. BNEF also cites a "still immature supply chain" as well as uncertain policies for the low levels of MD and HD EV shares outside of current areas of expansion.

For MD and HD vehicles, California's ACT and Advanced Clean Fleet (ACF) rules were expected to provide regulatory drivers for the production of HD zero-emission vehicles (ZEVs) and the purchase of HD ZEVs. Congress' decision under the CRA to disapprove the EPA's waiver for ACT, and California's January 2025 decision to withdraw the waiver request for ACF, ended both of those programs.

In recent discussions between the EPA and HD industry stakeholders, the HD original equipment manufacturers (OEMs) indicated that, while they still believe that HD ZEVs will continue to grow and they continue to invest in HD ZEVs, they expect the pace of growth to be significantly slower than they projected just a few years ago, and OEMs continue to lower projected EV sales volumes for model years (MYs) 2025 and later. OEMs suggest there is a range of reasons for lower EV demand,

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[10] The Salata Institute for Climate and Sustainability at Harvard University. (2025). Quantifying Trump's impacts on EV adoption: https://salatainstitute.harvard.edu/quantifying-trumps-impacts-on-ev-adoption/
[11] Cox Automotive (2025). Record High: Electric Vehicle Sales Hit 438,000 in Q3 as Buyers Rushed to Beat Expiring Incentives: https://www.coxautoinc.com/insights-hub/q3-2025-ev-sales-report-commentary/
[12] Anderson, Brad (2025). Turns out EV Sales Needed the Tax Credit More than Anyone Admitted. https://www.carscoops.com/2025/10/turns-out-ev-sales-needed-the-tax-credit-more-than-anyone-admitted/
[13] McKerracher, Colin, et al., BloombergNEF, Electric Vehicle Outlooks 2025. https://assets.bbhub.io/professional/sites/24/202506-EVO2025-Executive-Summary.pdf

including higher purchase prices leading to unfavorable total cost of ownership, charging infrastructure limitations, current performance limitations of EV technology for many HD truck applications, supply chain uncertainty, potential changes in IRA incentives, and the lack of California's ACT and ACF programs.

A recent market update report from CALSTART supported the expectation of slower ZEV growth for much of the HD market.[14] CALSTART notes that zero emission truck (ZET) deployments have grown steadily since 2022, but there was a relative slowdown in the first six months of 2024. CALSTART states that the lack of growth can be attributed to many of the same reasons stated above, including high upfront costs and financing costs, underdeveloped private and public infrastructure, and policy uncertainty. They also note that though more MD and HD ZEVs were deployed in 2024 compared to 2023, these deployments were concentrated in a handful of states, and the ZEV share of new MD and HD registrations decreased from 2023. Furthermore, CALSTART showed that much of the ZEV deployments were concentrated in California or other states that adopted the ACT program. It is unclear if ZEV deployment will continue at the same level in those states without the regulatory driver of the ACT and ACF rules.

3 Estimates of future gasoline and diesel prices due to the change in Administration and related policies

Historically, the EPA has used the U.S. Energy Information Administration's (EIA) Annual Energy Outlook (AEO) to project future gasoline and diesel prices for rulemaking analyses. The 2024 vehicle rulemakings relied on AEO 2023 to project future fuel prices in those rules.[15] The AEO 2023 "Reference case" included considerations of the IRA as well as the EPA GHG and National Highway Traffic Safety Administration's (NHTSA) Corporate Average Fuel Economy (CAFE) standards that were in place at the time.

Predicting future gasoline and diesel prices, specifically 10 – 15 years or more in the future, is difficult and uncertain due to unforeseen changes, including, but not limited to: (1) changes in U. S. policies; (2) international incidents (e.g., wars); (3) changes in policies by international organizations (e.g., OPEC); and (4) changes in supply and demand of gasoline and diesel. In this final rule, we are updating our analysis to include the most recent AEO projections, including additional "side cases" that address several key uncertainties.

Our final rule analysis includes EIA's most recent release of AEO 2025, which includes significant updates to the Reference case, as well as an alternative case for the transportation sector. The AEO 2025 "Reference" case continues to include the IRA, as well as California's ACT program and the 2024 EPA vehicle rulemakings.[16] In this analysis, we are also including the AEO 2025 "Alternative

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[14] Richard, J. (2025). Zeroing in on Zero-Emission Trucks: June 2025 Market Update. *CALSTART*: https://calstart.org/wp-content/uploads/2025/05/ZIO-ZET-June.pdf.
[15] U.S. Energy Information Administration. (2023). Annual Energy Outlook 2023: https://www.eia.gov/outlooks/archive/aeo23/.
[16] U.S. Energy Information Administration. (2025). Annual Energy Outlook 2025: https://www.eia.gov/outlooks/aeo/.

Transportation" case, in which California's ACT, the EPA's 2024 vehicle rulemakings, and NHTSA's 2024 final rule for CAFE standards for MYs 2027-2032 are not in place. In addition, the AEO 2025 Alternative Transportation case also models a slower growth for IRA credit eligibility than the AEO 2025 Reference case. Finally, we are conducting analysis with the AEO 2025 "Low Oil Price" case that represents a scenario with lower crude oil prices compared to the Reference case.

In Figure 1, we compare the gasoline and diesel fuel prices for the three AEO cases:

- **Reference case**: the AEO 2025 Reference case that includes California's ACT program, the EPA's 2024 rulemakings, and the IRA tax credits.
- **Alt Transportation case**: the AEO 2025 Alternative Transportation case that removes the impacts of California's ACT program, the EPA's 2024 vehicle rulemakings, and NHTSA's 2024 CAFE rule, and lessens the growth of eligibility for IRA credits compared to the AEO 2025 Reference case.
- **Low Oil Price case:** the AEO 2025 Low Oil Price case that reflects a Brent crude oil price decrease from $91 per barrel in the Reference case to $47 per barrel.

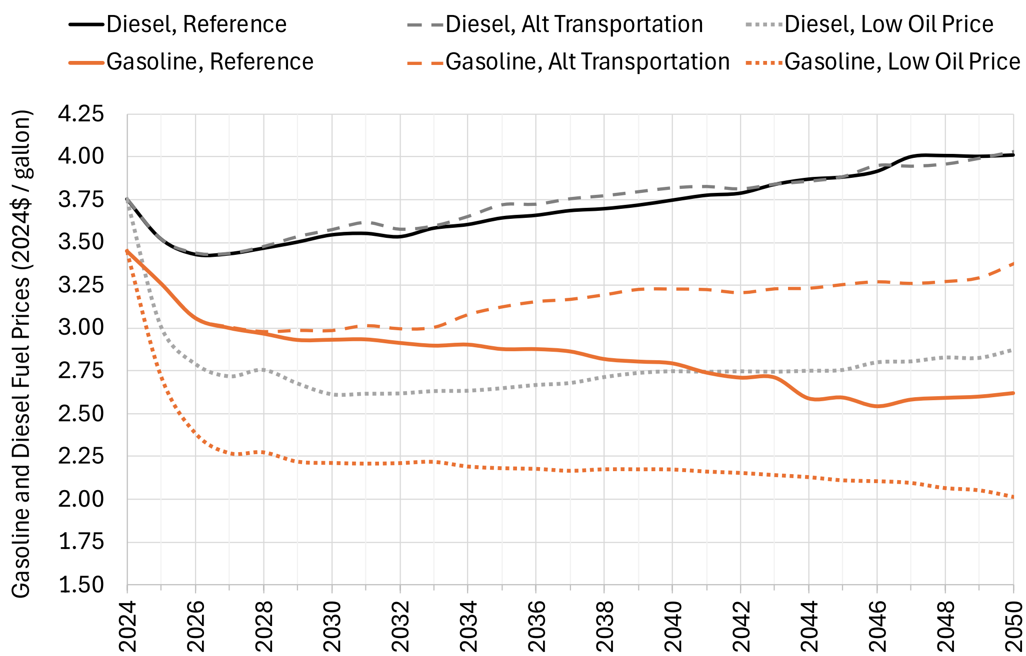

Figure 1: Comparison of AEO 2025 Fuel Price Cases (2024$).

As shown in Figure 1, the AEO 2025 Alternative Transportation case projects higher gasoline prices than the Reference case over time, with the difference growing to about $0.75 per gallon of gasoline in 2050. However, diesel fuel prices are projected to be very similar between the AEO 2025 Alternative Transportation case and the AEO 2025 Reference case, though the Alternative Transportation case is just slightly higher for most of the projected years.

Neither the Reference case nor Alternative Transportation case gasoline prices take into account the policies being implemented by President Trump that are intended to drive down the price of gasoline and diesel. For these reasons and others, we included a fuel price sensitivity assessment which examines the impact of lower fuel prices on some program costs and benefits. The AEO 2025 Low Oil Price case, which shows a decrease of up to $0.73 per gallon for gasoline and up to $1.19 for diesel fuel compared to the Reference case, was chosen to represent the low fuel price scenario in the fuel price sensitivity assessment. This assessment is summarized in Chapter 6 of this document, with more details presented in Appendix A.2 and A.3.2.

4 Impact of EVs on the power generation sector and major changes since the 2024 vehicle rulemakings

Since the EPA issued the 2024 vehicle rulemakings, there have been two significant changes as they relate to the power generation sector. There has been a significant increase in the projected growth of electricity demand for artificial intelligence (AI) data centers, and the 2022 IRA solar and wind tax incentives have been repealed in OBBB.

The analysis used for the 2024 vehicle rulemakings included projections for all necessary increases in capacity and associated costs. These costs were included in the projected retail price of electricity, which included the costs of electricity generating unit (EGU) builds, EGU retrofits, EGU retirements, increased transmission capacity, and necessary upgrades to the distribution system to accommodate direct current (DC) fast charging for LD, MD, and HD plug-in EV (PEV) applications.[17] This was modeled utilizing the "EPA's Power Sector Modeling Platform Post-IRA 2022 Reference case using the Integrated Planning Model (IPM)."[18] IPM provides projections of least-cost capacity expansion, electricity dispatch, and emission control strategies for meeting energy demand and environmental, transmission, dispatch, and reliability constraints represented within 67 regions of the 48 contiguous U.S. However, IPM does not account for difficulties in permitting for either EGUs or transmission lines. Furthermore, consideration of grid reliability is not modeled explicitly within IPM, but rather is accounted for within IPM by incorporation of NERC recommendations for reserve capacity.

The 2024 LD and MD standards were anticipated to increase electricity generation by less than one percent in 2030, and by approximately 7.6 percent by 2050. When combined with anticipated demand from HD applications, electricity generation was anticipated to increase by 11.6 percent by 2050.[19]

The IPM analysis within the RIA for 2024 vehicle rulemakings estimated that higher levels of PEV adoption would result in an incremental increase in demand for electricity, which in turn resulted in improving economics for existing thermal resources such as coal-fired EGUs. This, in turn, resulted

[17] LMDV Regulatory Impact Analysis (RIA), Chapter 5: https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P1019VPM.pdf
[18] U.S. Environmental Protection Agency. (Last updated Mar. 19, 2025). Power Sector Post-IRA 2022 Reference Case: https://www.epa.gov/power-sector-modeling/post-ira-2022-reference-case.
[19] LMDV RIA, https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P1019VPM.pdf.

in fewer projected retirements at those facilities over the analysis period.[20] This analysis was predicated on demand data from AEO 2023, which in turn was calibrated to conditions as of 2022, and included full implementation of the IRA.

Electricity rates for the 2024 vehicle rulemakings were estimated from IPM results using the Retail Price Model.[21,22] The Retail Price Model showed a trend of reduced electricity rates through 2050 despite an increase in electricity demand through 2050. Increased costs due to increased generation and transmission capacity were more than offset by a shift towards renewables and increased grid battery storage from power sector tax incentives within the RIAs. The Retail Price Model projected higher national average electricity rates in 2050 due to the 2024 vehicle rulemakings of approximately 2.5% (approximately $0.0025 per kilowatt-hour (kWh)).

Since the 2024 vehicle rulemakings were finalized in the spring of 2024, there has been a significant change in the forecasts of electricity demand. According to the 2024 North American Electric Reliability Corporation (NERC) Long Term Reliability Assessment,[23] in 2022 the projected compound annual growth rate for summer peak demand over the ten-year period 2022-2031 was estimated to be 0.65%. In the latest available assessment, the ten-year compound annual growth rate for summer peak demand over the 2025-34 period is estimated to be 1.67%. This more than 2.5-fold increase in projected growth rates is driven primarily by increasing amounts of large commercial and industrial loads, particularly those related to data center demand for AI applications. These higher levels of demand significantly improve the market fundamentals of existing firm dispatchable capacity and reduce the likelihood of thermal resource retirement. Moreover, this demand growth significantly outweighs the level of incremental electricity demand from LD, MD, and HD PEV charging projected by the adoption of LMDV and HD GHG Phase 3 standards.

Furthermore, the passage of OBBB will also have important impacts on the power sector – notably, the phase-out of tax subsidies to wind and solar resources will likely reduce incremental builds of these technologies particularly after 2028. This, in turn, will further strengthen the relative economics of existing thermal resources, resulting in fewer retirements and therefore dampening the impact of LMDV and HD GHG Phase 3 on the power sector. Finally, higher levels of demand, particularly for around-the-clock power required for data centers, will likely further improve the outlook for thermal resources and reduce incentives for retirement. Collectively, these changes – including rescinding LD, MD, and HD GHG standards – would reflect a net improvement to energy and capacity markets for thermal resources. These changes may also be anticipated to impact the year-over-year reductions in the retail price of electricity forecast within the 2024 RIAs; however, the EPA did not perform the additional analysis that would be needed to determine the impacts on the retail price of electricity for this assessment for this final rule.

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[20] LMDV RIA, Chapter 5, https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P1019VPM.pdf.
[21] ICF. 2019. "Documentation of the Retail Price Model." ICF Contract Report to the U.S. EPA.
[22] LMDV RIA, Chapter 5, https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P1019VPM.pdf.
[23] North American Electric Reliability Corporation. (2024, updated July 15, 2025). December 2024 Long-Term Reliability Assessment: https://www.nerc.com/pa/RAPA/ra/Reliability%20Assessments%20DL/NERC_Long%20Term%20Reliability%20Assessment_2024.pdf.

Considering the need to meet this higher level of demand mainly driven by data centers, managing ongoing thermal retirements, and the need for additional transmission and resource development, NERC concludes that critical reliability challenges are facing the sector. No longer requiring compliance with LD, MD, and HD GHG standards would reduce the overall demand for electricity, which in turn may incrementally improve the reliability outlook for the sector. However, the impact of reducing demand from PEV charging is likely to be small in comparison to the impact from increased data center demand, which is present in the baseline demand for electricity regardless of the policy pathway for LD, MD and HD GHG standards.[24] For example, in 2030, PEV charging demand from all vehicle categories will be reduced by approximately 64 terawatt-hour (TWh)[25] compared to new demand from data centers of approximately 600 TWh not accounted for in the 2024 LMDV Rule.[26,27]

For reasons explained above, we believe the electricity prices estimated for the 2024 rule analyses are no longer applicable and instead we use the electricity prices estimated in AEO 2025 for this final rule analysis, as explained further in RIA Chapter 6 and RIA Appendix A.[28,29]

5 How do car and light truck buyers value improved fuel economy?

Economic theory predicts that, holding all else equal, individuals will purchase more expensive fuel-efficient vehicles if they expect future savings on fuel expenditures to offset the higher upfront vehicle costs.[30] The large empirical literature (discussed below) examining this issue comes to varying conclusions about the extent that consumers value these future fuel expenditures. As noted in the Office of Management and Budget (OMB) Circular A-4 (2003),[31] "individual preferences of the affected population should be a guiding principle in the regulatory analysis." If buyers fully internalize the expected fuel savings that result from higher fuel economy in their vehicle purchase decisions, manufacturers will presumably supply any

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[24] In modeling changes to LD, MD and HD GHG standards, EPA did not attempt to model the CAFE standards.
[25] Sherwood, T. (2025). Vehicle Rule LD/MD/HD Physical Effects.
[26] U.S. Department of Energy (2025). Resource Adequacy Report Evaluating the Reliability and Security of the United States Electric Grid: https://www.energy.gov/sites/default/files/2025-07/DOE%20Final%20EO%20Report%20%28FINAL%20JULY%207%29.pdf.
[27] North American Electric Reliability Corporation. (Last updated July 2025). 2023 and 2024 NERC Electricity Supply & Demand database: https://www.nerc.com/pa/RAPA/ESD/pages/default.aspx.
[28] We note that, while AEO 2025 accounts for increased demand from data centers and vehicle charging, the increased demand is less than the NERC forecasting. AEO 2025 estimates that AI computing will consume 134 TWh in 2030, which is approximately a factor of 4.5 less than the NERC projections for 2030.
[29] EPA chose to use AEO 2025 data for this rule to acknowledge and incorporate updates to the sector that have been made since the finalization of the 2024 LMDV rule, consistent with the use of updated AEO data used for the liquid fuel inputs for this final rule.
[30] These additional up-front costs include more than just the cost of the technology necessary to improve fuel economy; because consumers have a scarcity of resources, it also includes the opportunity cost of any other desirable features that consumers give up when they choose the more fuel-efficient vehicle.
[31] Office of Management and Budget. (2003). Circular A-4: Regulatory Analysis: https://obamawhitehouse.archives.gov/omb/circulars_a004_a-4.

improvements that buyers demand, and vehicle prices will fully reflect future fuel cost savings that consumers would realize from owning – and potentially reselling – more fuel-efficient models. In this case, a regulation that induces increased fuel economy of vehicles will impose net private costs on vehicle owners and can only result in social benefits through correcting other market failures (e.g., imperfect information or internalizing health and welfare benefits from emissions reductions). If instead consumers appear to systematically "undervalue" the cost savings generated by improvements in fuel economy when choosing among competing models, then more stringent fuel economy or emissions standards may lead manufacturers to adopt improvements in fuel economy that buyers would not choose despite the cost savings they offer.

Whether the value of the resulting realized fuel savings will improve consumer welfare depends on why consumers appear to undervalue future fuel expenditures. If the apparent "undervaluation" is due to factors that are missing from the analysis – e.g., tradeoffs with vehicle attributes such as vehicle performance or driving range – these hidden or missing costs may be offsetting some or all of the value of fuel savings and not result in additional social benefits. If instead undervaluation is due to consumer or manufacturer inattention to future fuel costs resulting from a market failure such as an information asymmetry, then the value of fuel savings is a social benefit of the regulation. How potential buyers value improvements in the fuel economy of new cars and light trucks is therefore an important issue when assessing the benefits and costs of government regulation.

The potential for car buyers to voluntarily forego improvements in fuel economy that seemingly offer savings exceeding their initial costs is one example of what is often termed the "energy efficiency gap." The topic of the "energy efficiency gap" or "energy efficiency paradox" has been extensively discussed in previous analyses of EPA regulations, including the 2024 LMDV final rule RIA. The appearance of such a gap, between the level of energy efficiency that would minimize consumers' overall expenses and what they actually purchase, is typically based on engineering calculations that compare the initial cost of providing higher energy efficiency to the discounted present value of the resulting savings in future energy costs.

There has long been an active debate about why such a gap might arise and whether it actually exists (Klemick and Wolverton, 2025).[32] Such a gap may be due to failure to account for the opportunity cost of any other desirable features that consumers give up when they choose the more energy-efficient alternative. In the context of vehicles, whether the expected fuel savings outweigh the opportunity cost of purchasing a vehicle offering higher fuel economy will depend, among other things, on how much its buyer expects to drive, their expectations about future fuel prices, the discount rate they use to value future expenses, the expected effect on resale value, and whether more efficient models offer equivalent attributes such as performance, carrying capacity, reliability, quality, or other characteristics.

As is the case for this analysis, present-value calculations of potential returns from energy-efficiency investments are often calculated for the typical or average consumer,

[32] Klemick, H., and Wolverton, A. (2025). The Energy-Efficiency Gap in Encyclopedia of Energy, Natural Resource, and Environmental Economics. 2nd Edition. Elsevier Academic Press: https://doi.org/10.1016/B978-0-323-91013-2.00033-2

but varying preferences and behavior can also affect individual trade-offs between upfront costs and future energy savings across vehicle types (Forsythe, et al., Levinson and Sager, 2023 2023; Jacobsen, 2013).[33,34,35] Not accounting for heterogeneity across consumers has been found to bias willingness-to-pay estimates for fuel economy toward zero, consistent with the appearance of an energy-efficiency gap (e.g., Helfand and Wolverton, 2011; Bento et al., 2012).[36,37]

Several explanations for the energy-efficiency gap also point to the potential for market or behavioral failures. Evidence suggests that consumers may not be well informed about how a vehicle purchase will affect future fuel expenditures or make mistakes when calculating those future expenditures (Larrick and Soll 2008; Allcott 2013).[38,39] Consumers may also be observed to undervalue future fuel savings due to rational inattention (Sallee 2014).[40,41] It can be costly for an individual to research multiple models and compare the savings expected under his or her specific usage patterns. It also may be more natural for consumers to evaluate bundles of vehicle attributes they care about rather than varying a single attribute in isolation when evaluating vehicles for purchase (Helfand and Wolverton 2011). In these instances, consumers may instead rely on rules of thumb, particularly when differences in expected fuel savings across their choice set are relatively small.

Historically, the published literature has offered little consensus about consumers' willingness to pay for greater fuel economy, and whether it implies over-, under- or full-valuation of the expected discounted fuel savings from purchasing a model with higher fuel economy. Most of these studies have relied on car buyers' purchasing behavior to estimate their willingness to pay for future fuel savings. Traditionally the approach was to use "discrete choice" models that relate cross-sectional data on individual buyers' choices among competing vehicles to their

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[33] Forsythe, C., K. Gillingham, J. Michalek, and K. Whitefoot (2023). Technology advancement is driving electric vehicle adoption. PNAS 120(23): e2219396120.

[34] Levinson, A. and L. Sager (2023). Who values future energy savings? Evidence from American drivers. Journal of the Association of Environmental and Resource Economists 10(3): 717-750.

[35] Jacobsen, M. (2013). Evaluating US Fuel Economy Standards in a Model with Producer and Household Heterogeneity. *American Economic Journal: Economic Policy*, 5 (2): 148–87.

[36] Helfand, G., and Wolverton, A. (2011). Evaluating the Consumer Response to Fuel Economy: A Review of the Literature. *International Review of Environmental and Resource Economics,* 5: 103-146.

[37] Bento, A. et al. (2012). Is There an Energy Paradox in Fuel Economy? A Note on the Role of Consumer Heterogeneity and Sorting Bias. *Economics Letters* 115(1): 44–48.

[38] Larrick, R. P., and Soll, J. B. (2008). The MPG Illusion. Science 320: 1593-1594.

[39] Allcott, H. (2013). The Welfare Effects of Misperceived Production Costs: Data and Calibrations from the Automobile Market. *American Economic Journal: Economic Policy* 5(3): 30-66.

[40] Sallee, J. 2014. Rational Inattention and Energy Efficiency. *The Journal of Law and Economics* 57(3): 781-820.

[41] Several recent studies rely on interview-based or stated preference approaches to ask consumers directly about the importance of fuel economy in recent vehicle purchase decisions (Leard 2018; Allcott and Knittel 2019). They often find far lower valuation of fuel economy than recent revealed preference approaches that rely on panel microdata and variation in fuel prices to identify willingness to pay for fuel economy. The extent to which these lower values are due to information or behavioral failures remains unexplored in the literature. Allcott, H., and Knittel, C. (2019). Are Consumers Poorly Informed about Fuel Economy? Evidence from Two Experiments. *American Economic Journal: Economic Policy* 11 (1): 1–37. Leard, B. (2018). Consumer inattention and the demand for vehicle fuel cost savings. *Journal of Choice Modelling*. 29: 1-16.

purchase prices, fuel economy, and other attributes (such as performance, carrying capacity, and reliability), and to infer buyers' valuation of higher fuel economy from the relative importance of purchase prices and fuel economy.[42] Empirical estimates using this approach span a wide range, thus making it difficult to draw solid conclusions about the influence of fuel economy on vehicle buyers' choices (e.g., Helfand and Wolverton, 2011 and Greene, 2010).[43] Because a vehicle's price is correlated with its other attributes (both measured and unobserved), analysts have often used instrumental variables or other approaches to address endogeneity and other resulting concerns (e.g., Berry et al., 1995).[44]

More recent research has criticized these cross-sectional studies. Some studies have questioned the effectiveness of the instruments they use (Allcott and Greenstone, 2012).[45] Others have observed that coefficients estimated using non-linear statistical methods can be sensitive to the optimization algorithm and starting values (Knittel and Metaxoglou, 2014).[46] Collinearity (i.e., high correlations) among vehicle attributes – most notably among fuel economy, performance or power, and vehicle size – and between vehicles' measured and unobserved features also raises questions about the reliability and interpretation of coefficients that may conflate the value of fuel economy with other attributes (Leard et al., 2023;[47] Sallee et al.,2016;[48] Busse et al., 2013;[49] Allcott and Wozny, 2014;[50] Allcott and Greenstone, 2012; Helfand and Wolverton, 2011).

In an effort to overcome shortcomings of past analyses, recent studies have relied on panel data from sales of individual vehicle models to improve their reliability in identifying the association between vehicles' prices and their fuel economy (Leard et al. 2025; Gillingham et al. 2021; Leard et al. 2023; Sallee et al. 2016; Allcott and Wozny 2014; Busse et al. 2013). Table 1 summarizes the findings of six recent studies that rely on panel data. Although they differ in certain details, most of these analyses relate changes over time in individual models' selling prices to fluctuations in fuel prices, differences in their fuel economy, and increases in their age and accumulated use, which affects their expected remaining life and thus their market value. Because a vehicle's future fuel costs are a function of both its fuel economy and expected gasoline prices, changes in fuel prices have different effects on the market values of

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[42] In a typical vehicle choice model, the ratio of estimated coefficients on fuel economy – or more commonly, fuel cost per mile driven – and purchase price is used to infer the dollar value buyers attach to slightly higher fuel economy.
[43] Greene, D. (2010). How Consumers Value Fuel Economy: A Literature Review. EPA-420-R-10-008.
[44] Berry, S. et al. (1995). Automobile Prices in Market Equilibrium. *Econometrica,* 63(4): 841-890.
[45] Allcott, H., and Greenstone, M. (2012). Is There an Energy Efficiency Gap*? Journal of Economic Perspectives,* 26(1): 3-28.
[46] Knittel, C., and Metaxoglou, K. (2014). Estimation of Random-Coefficient Demand Models: two Empiricists' Perspectives. *Review of Economics and Statistics,* 96(1): 34-59.
[47] Leard, B. et al. (2023). How Much Do Consumers Value Fuel Economy and Performance? Evidence from Technology Adoption. *Review of Economics and Statistics,* 105(1): 158–174.
[48] Sallee, J. et al. (2016). Do Consumers Recognize the Value of Fuel Economy? Evidence from Used Car Prices and Gasoline Price Fluctuations. *Journal of Public Economics,* 135: 61-73.
[49] Busse, M. R. et al. (2013). Are Consumers Myopic? Evidence from New and Used Car Purchases. *American Economic Review*, 103(1): 220–256.
[50] Allcott, H., and Wozny, N. (2014). Gasoline Prices, Fuel Economy, and the Energy Paradox. *Review of Economics and Statistics,* 96(5): 779–795.

vehicles with different fuel economy; comparing these effects over time and among vehicle models reveals the fraction of changes in fuel costs that is reflected in changes in their selling prices (Allcott and Wozny, 2014). Using very large samples of sales enables these studies to define vehicle models at an extremely disaggregated level, which enables their authors to isolate differences in their fuel economy from the many other attributes, including those that are difficult to observe or measure, that affect their sale prices.[51,52]

Table 1 indicates there continues to be a wide range of estimates from these panel studies of the degree to which consumers incorporate fuel costs into their vehicle purchase decisions. At discount rates of four to seven percent, for example, four of the studies find consumers incorporate the majority of future fuel costs into their purchase decisions (Busse et al 2013; Allcott and Wozny 2014; Sallee et al 2016; Leard et al 2023), while two studies find evidence of substantial undervaluation (Gillingham, et al. 2021; Leard, et al 2025). Estimates based on the authors' preferred specification (bolded in Table 1) do not narrow this range, which varies from 16% to 101%.[53] As Table 1 suggests, higher private discount rates move estimates closer to full

[51] These studies rely on individual vehicle transaction data from dealer sales and wholesale auctions, which include actual sale prices and allow their authors to define vehicle models at a highly disaggregated level. For instance, Allcott and Wozny (2014) differentiate vehicles by manufacturer, model or nameplate, trim level, body type, fuel economy, engine displacement, number of cylinders, and "generation" (a group of successive model years during which a model's design remains largely unchanged). The three studies with datasets including 2008 sales include transactions only through mid-2008 to limit the effect of the recession on vehicle prices. To ensure that the vehicle choice set consists of true substitutes, Allcott and Wozny (2014) define the choice set as all gasoline- fueled light-duty cars, trucks, SUVs, and minivans that are less than 25 years old (i.e., they exclude vehicles where the substitution elasticity is expected to be small). Sallee et al. (2016) exclude diesels, hybrids, and used vehicles with less than 10,000 or more than 100,000 miles.

[52] Killian and Sims (2006) and Sawhill (2008) rely on similar longitudinal approaches to examine consumer valuation of fuel economy except that they use average values or list prices instead of actual transaction prices. Since these studies remain unpublished, their empirical results are subject to change, and they are excluded from this discussion. In the European context, Grigolon, Reynaert and Verboven (2018) find that consumers value 91% of future fuel expenditures in vehicle purchase decisions at a 6% discount rate. Grigolon, L., M. Reynaert, and F. Verboven (2018). Consumer Valuation of Fuel Costs and Tax Policy: Evidence from the European Car Market. American Economic Journal: Economic Policy 10(3): 193-225.

[53] Each study makes slightly different assumptions about discount rates. Sallee et al. (2016) use five percent in their base specification, while Allcott and Wozny (2014) rely on six percent. As some authors note, a five to six percent discount rate is generally consistent with observed interest rates on car loans, but they acknowledge that borrowing rates could be higher in some cases, which could justify higher discount rates. Rather than assuming a specific discount rate, Busse et al. (2013) and Leard et al. (2023) directly estimate implicit discount rates at which future fuel costs would be fully internalized; Busse et al. (2013) find discount rates of six to 21 percent for used cars and one to 13 percent for new cars at assumed demand elasticities ranging from -2 to -3. Leard et al. (2023) finds implied discount rates of 10 and 12 percent using an assumed demand elasticity of -2 and -3, respectively. Their estimates can be translated into the percent of fuel costs internalized by consumers, assuming a particular discount rate. To make the Busse et al. (2013) results more directly comparable to the other studies, we assume a range of discount rates and uses the authors' spreadsheet tool to translate their results into the percent of fuel costs internalized into the purchase price at each rate. Because Busse et al. (2013) estimate the effects of future fuel costs on vehicle prices separately by fuel economy quartile, these results depend

valuation or to over-valuation, while lower discount rates imply less complete valuation across the studies.

Most of the studies rely on variation in gasoline prices to identify and estimate willingness to pay for future fuel expenditures when purchasing a vehicle. A distinguishing feature of Leard et al. (2023) is their use of variation in engine technology adoption, rather than gasoline price changes, to predict within-vehicle variation in fuel economy and performance over time. Gillingham et al. (2021) rely on a revision in fuel economy ratings that applied to certain Kia and Hyundai models as their identifying variation. As they note, this select sample may bias their estimates – purchasers of Kias and Hyundais may value fuel economy more highly than other consumers since they opted to purchase smaller, more fuel-efficient cars. On the other hand, these vehicles had lower upfront costs, which may be more appealing to lower income households. Recent research has found that lower income households, on average, undervalue future fuel costs to a greater extent than higher income households compared to the average consumer (Leard et al. 2025).[54]

Estimates of buyer valuation of fuel economy from these studies are sensitive to the strategies used to isolate differences in individual models' fuel economy. Because the studies rely on estimates of fuel costs over expected vehicle lifetimes, their estimates are also sensitive to assumptions about buyers' discount rates, gasoline price expectations, and annual vehicle miles traveled, among others. All the studies included in Table 1 follow Anderson et al. (2013)[55] and assume that consumers expect future gasoline prices to resemble current prices, though several of them also explore the sensitivity of their estimates to alternate assumptions. It is also possible to map the consumer valuations presented in Table 1 to payback periods – the number of years of fuel costs consumers consider when purchasing a vehicle – given a consistent set of assumptions on discount rates, fuel prices, and mileage.[56]

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on which quartiles of the fuel economy distribution are compared; our summary shows results using the full range of quartile comparisons.

[54] Leard, B., J. Linn, and K. Springel (2025). Vehicle Attribute Tradeoffs and the Distributional Effects of US Fuel Economy and Greenhouse Gas Emissions Standards. *Journal of Political Economy Microeconomics*, ahead of print, September 29. https://doi.org/10.1086/738879.

[55] Anderson, S.T. et al. (2013). What do consumers believe about future gasoline prices? *Journal of Environmental Economics and Management,* 66(3): 383-403.

[56] Ankney et al. (2021) provide such a calculation in their review of the fuel economy valuation literature. The authors calculate the implied payback using a consistent set of assumptions across the studies. See Ankney et al. (2021). What Should Federal Agencies Assume for How Much Consumers Are Willing to Pay for Fuel Cost Savings: https://www.resources.org/common-resources/what-should-federal-agencies-assume-for-how-much-consumers-are-willing-to-pay-for-fuel-cost-savings/.

Table 1: Percent of Future Fuels Costs Internalized in Car and Light-Truck Purchase Prices

Authors (Pub. Date)	Sample period	Vehicle Type	Variation used to identify WTP	Future fuel price assumption	Discount rate assumption			
					1 - 3%	**4 - 5%**	**6% - 7%**	**10 - 12%**
Busse et al. (2013)*	1999-2008	New and used cars & light trucks	Gasoline price changes	Gasoline price at time of sale	54-87%	60-96%	62-100%	73-117%
				24-month gasoline price futures	71-103%	78-114%	81-119%	96-139%
Allcott & Wozny (2014)	1999-2008	Used cars & light trucks	Gasoline price changes	Gasoline price at time of sale	48%		55%	65%
				Oil futures-based forecast	67%		**76%**	87%
Sallee et al. (2016)	1999-2008	Used cars & light trucks	Gasoline price changes	Gasoline price at time of sale		**101%**		142%
Leard et al. (2023)	2009-2014	New cars & light trucks	Engine technology adoption	Gasoline price at time of sale	**54%**	69%	77%	
				AEO projected gasoline price	57%			
Gillingham et al. (2021)	2011-2014	New cars (two automakers)	Fuel economy label restatement	Gasoline prices at the time of sale	13–33%	**16–39%**	18–46%	23–58%
Leard et al. (2025)	2010-2018	New cars & light trucks	Gasoline price changes	Gasoline price at time of sale		**22%**		

*Note: For each paper, estimates based on the authors' preferred specification are bolded in this table when applicable. Papers without a bold estimate indicate that the authors did not highlight a preferred specification. The ranges in the Busse et al. (2013) estimates depend on which quartiles of the fuel economy distribution are compared. With no prior on which quartile comparison to use, this analysis presents the full quartile comparison range.

Several of the studies also explore the sensitivity of the results to other parameters that could influence their results. Busse et al. (2013) and Allcott and Wozny (2014) find that relying on data that suggest lower annual vehicle use or survival probabilities, which imply that vehicles will not last as long, moves their estimates closer to full valuation. This result is not surprising because both reduce the changes in expected future fuel costs caused by fuel price fluctuations. Allcott and Wozny's (2014) main results rely on an instrumental variables estimator that groups miles per gallon (MPG) into two quantiles to mitigate potential attenuation bias due to measurement error in fuel economy, but they find that greater disaggregation of the MPG groups implies greater undervaluation (for example, it reduces the 55 percent estimated reported in Table 1 to 49 percent). Busse et al. (2013) allow gasoline prices to vary across local markets in their main specification; using national average gasoline prices, an approach more directly comparable to the other studies, results in estimates that are closer to or above full valuation. Sallee et al. (2016) find modest undervaluation by vehicle fleet operators or manufacturers making large-scale purchases, compared to retail dealer sales (i.e., 70 to 86 percent). When Leard et al (2023) adopt similar assumptions to Busse et al. (2013) for vehicle miles traveled (VMT) and scrappage rates, they find that consumers valued 73 percent of future fuel costs at their preferred discount rate (1.3 percent) instead of the authors' preferred estimate of 54 percent. The authors also report the results of a range of robustness checks under different input assumptions, including for example, a 77 percent valuation estimate at a 7 percent discount rate.

Most of the studies in Table 1 examine new vehicle sales. Busse et al (2013) examine both new and used vehicles. For new vehicles, they find that consumers value between 75 to 129 percent of future fuel costs. It is also possible to infer values from Allcott and Wozny (2014) that are potentially comparable to new vehicles: they find that buyers of younger vehicles whose fuel price expectations mirror the petroleum futures market value a higher fraction of future fuel costs, 93 percent for one- to three- year-old vehicles, compared to all used vehicles.[57] Allcott and Wozny (2014) and Sallee et al. (2016) also find that purchasers of older vehicles substantially undervalue future fuel costs (26-30 percent).

The empirical literature also finds evidence that manufacturers invest in performance instead of improved fuel economy when standards remain unchanged (Leard, et al, 2025; Leard et al., 2023; Klier and Linn, 2016;[58] Knittel, 2011[59]). Thus, in addition to understanding how consumers value changes in fuel economy, it is important to account for the value they place on changes in performance at the margin. Explicitly accounting for the tradeoff between fuel economy and performance, Leard et al. (2023) find that consumers are willing to pay about three times as much for improved performance than a comparable fuel economy increase. Taken together, they calculate that a one percent improvement in fuel economy slightly reduces consumer welfare, holding all other vehicle attributes constant, despite undervaluation of fuel economy.[60,61,62,63] Leard et al. (2025), on the other hand, find the opposite result in their modeling of the fuel economy-performance tradeoff compliance behavior over 2012-

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[57] The pattern of results in Allcott and Wozny (2014) for different vehicle ages is similar when they use retail transaction prices (adjusted for customer cash rebates and trade-in values) instead of wholesale auction prices, although the degree of valuation falls substantially in all age cohorts with the smaller, retail price-based sample.

[58] Klier, T., and Linn, J. (2016). Technological Change, Vehicle Characteristics and the Opportunity Costs of Fuel Economy Standards. *Journal of Public Economics,* 133: 41–63.

[59] Knittel, C. (2011). Automobiles on Steroids: Product Attribute Tradeoffs and Technological Progress in the Automobile Sector. *American Economic Review*, 101: 368–3399.

[60] Allcott, H. and Knittel, C. (2019). Are Consumers Poorly Informed about Fuel Economy? Evidence from Two Experiments. *American Economic Journal: Economic Policy,* 11(1): 1–37.

[61] This finding is consistent with other recent work by Allcott and Knittel (2019). They find that experiments designed to overcome possible consumer inattention and imperfect information in new car buyers result in little additional uptake of fuel economy. They conclude that one must either point to some other market or behavioral failure to justify increasingly stringent fuel economy standards or that the large net private benefits projected by recent regulatory analyses do not exist. "The latter possibility would arise if the [regulatory analyses] engineering models did not account for the full fixed costs, production costs, or performance reductions from fuel economy-improving technologies."

[62] Watten, A., and Anderson, S. (2025). Attribute Production and Biased Technical Change in Automobiles. *National Bureau of Economic Research* Working Paper, #33979: https://www.nber.org/system/files/working_papers/w33979/w33979.pdf .

[63] Recent, still unpublished work by Watten and Anderson (2025) finds that the tradeoff between fuel economy and performance may have fallen over time.

2022. They find that more stringent standards over this time period increased consumer welfare because the estimated fuel economy undervaluation was sufficiently large that the value of fuel savings outweighed changes in vehicle price and tradeoffs with horsepower.

5.1 How the EPA Models Valuation of Fuel Cost Savings

The empirical literature reviewed in the previous section suggests that consumers may undervalue future fuel cost savings from more stringent standards, though there is not a consensus on the magnitude of this effect. Empirical results that find buyers internalize a large proportion – and perhaps even all – of the future savings that vehicles with higher fuel economy offer implies that consumers are already fully incorporating private fuel expenditures into their upfront purchase decisions. Under this case, there should be few if any private benefits from additional fuel savings attributable to a tightening of fuel economy or vehicle emissions standards. Empirical results that find buyers internalize a smaller share of expected fuel savings from higher fuel economy vehicles in their decisions are more difficult to interpret. One reason for undervaluation could be the presence of opportunity costs associated with tradeoffs with other vehicle attributes that may be missing from the analysis. The second reason for undervaluation could be a market or behavioral failure such as imperfect information or consumer or manufacturer inattention to future fuel costs in their decision-making. In these cases, some of the value of private future fuel savings could be attributable to the rule.

It is also worth noting that how consumers value fuel savings relative to other vehicle attributes could be affected by what bundles of vehicle attributes manufacturers supply. Manufacturers may design vehicles with a focus on characteristics that consumers have signaled a consistent desire for (e.g., performance) and be less responsive to changes in consumer preferences for fuel economy (Helfand and Wolverton 2011). While theory predicts that profit-maximizing manufacturers will invest in the vehicle attributes that consumers demand, there is little empirical investigation of the role producers play in the appearance of an energy efficiency gap for fuel economy. An ideal analysis would model both how producers design vehicles to comply with more stringent standards, for example how they might trade off fuel efficiency with other vehicle attributes (including forgoing future improvements) and how consumers differentially value those attributes. However, many of these attributes are challenging to measure or are collinear with other observed attributes, and it is therefore difficult to derive empirical willingness to pay estimates for them. This then makes it challenging to robustly represent and parameterize firm and consumer behavior in a model of vehicle production and purchase decisions.

Due to the inherent complexity of modeling the automobile market and flexible standards that allow for numerous compliance options, the EPA has instead historically imposed assumptions in its modeling of consumer and manufacturer decisions and regarding valuation of the estimated changes in future fuel expenditures when analyzing the effects of its vehicle standards. Given the wide range of estimates in the fuel economy valuation literature and the magnitude of estimated private fuels savings, the EPA's assumptions clearly matter for the results of the benefit-cost analysis.

In the light-duty vehicle analysis conducted for the scenarios in Appendix A, as in the Draft RIA and the 2024 LMDV RIA, producer decisions are modeled as assuming that the value consumers are willing to pay for fuel economy improvements is equal to the savings from the first 2.5 years of reduced fuel costs. Similarly, the modeling assumes consumers only consider the first 2.5 years of reduced fuel costs in the purchase decision. As noted in the Draft RIA, this assumption is consistent with input the Agency has received in public comments on previous rules and other sources. Manufacturers have consistently told the Agency that new vehicle buyers will pay for about two- or three-years' worth of fuel savings before the price increase associated with providing those improvements begins to affect sales. Surveys that ask consumers directly how many years of fuel expenditures they account for in vehicle purchase decisions yield similar findings (Kubik 2006).[64] More specifically, the EPA's modeling of consumer and producer decisions explicitly assumes that: 1) consumers are willing to pay for fuel-saving technology that pays back within the first 2.5 years of vehicle ownership (at average usage rates); 2) manufacturers know this and will provide these improvements even in the absence of regulatory pressure; 3) consumers weigh these savings against increases in new vehicle prices when deciding whether to purchase a vehicle; 4) vehicle performance is held constant (i.e., the potential to enhance performance even further in lieu of investing in fuel economy is not accounted for);[65] and 5) the amount of technology for which buyers will pay fluctuates with fuel prices. The 2.5-year payback assumption aligns with some of the lower estimates presented in Table 1. For example, Gillingham et al. (2021) note that their central estimates translate to a payback period of a little less than 3 years. We also note that, while some manufacturers state that 2.5-3 years is appropriate, Tesla uses an estimate of 1 – 10 years in their estimates of fuel costs for financed vehicles.[66,67]

The modeling of consumer and manufacturer decisions for the medium- and heavy-duty vehicle analysis in Appendix A is also consistent with the Draft RIA and 2024 LMDV and HD GHG Phase 3 RIAs. Like light-duty vehicles, medium-duty vehicle producers assume that consumer willingness to pay for fuel economy improvements is equal to the savings from the first 2.5 years of reduced fuel costs. However, there is no corresponding consumer modeling for medium-duty vehicles as there is for light-duty vehicles. The heavy-duty vehicle modeling only includes technologies with payback periods less than 10 years.[68] The longer payback

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[64] Kubik, M. (2006). Consumer Views on Transportation and Energy. Third edition. Technical Report: National Renewable Energy Laboratory.

[65] Recent, still unpublished work by Watten and Anderson (2025) notes that holding vehicle attributes fixed may overstate technology costs since they find evidence that downsizing is a much cheaper alternative to a technology-only response to meeting abatement requirements. "

[66] See https://www.tesla.com/model3/design#overview.

[67] See https://www.tesla.com/cybertruck/design?financeModalTab=finance_options&financeProduct=finplat.AUTO_LOAN%3ALOAN%3ACT_PRIVATE#overview

[68] The payback period was chosen to align with the HDP3 rulemaking. During that rulemaking, EPA evaluated comments on the payback period and moved forward with a 10-year value. More details on these considerations can be found in EPA's response to comment document produced as a part of the HDP3 rulemaking. "Response to Comments (RTC) document accompanying the Greenhouse Gas Emissions Standards for Heavy-Duty Vehicles: Phase 3 Final Rule." EPA-420-R-24-007, March 2024. In addition, EPA did

period for heavy-duty vehicles reflects that these vehicles are part of commercial fleets in competitive markets where operators likely better account for these fuel costs as they are often a major operating expense. While many medium-duty vehicles also operate in commercial fleets, there has been little literature examining how purchasers value fuel cost savings in this segment. We acknowledge that the 2.5-year assumption applied in the medium-duty manufacturer decisions likely represents a lower bound on purchasers' true valuation in this segment of the vehicle market due to the high share of commercial buyers.

One notable difference between the analysis for this rule and the 2024 LMDV RIA is how the value of realized fuel cost savings is accounted for in the benefit-cost analysis. The 2024 LMDV RIA valued the full stream of future fuel cost savings in estimating the net monetized benefits of the rule. This assumption is consistent with the view that consumers drastically undervalue fuel economy strictly due to market failures (and that, as a consequence, these benefits are unlikely to be realized without stringent fuel economy standards). The findings of recent empirical studies reviewed above suggests that consumers may undervalue future fuel cost savings. There is not a consensus on the magnitude of this effect – with overvaluation also estimated (particularly when higher discount rates are used) – and it remains challenging to parse the multiple explanations for undervaluation of fuel economy that are rarely evaluated in tandem.

In this RIA, as in the Draft RIA, we employ two separate assumptions to better reflect the range of potential outcomes reflecting uncertainty in the empirical literature. First, we present results following the 2024 LMDV RIA methodology, valuing the full stream of future fuel cost savings in estimating the net monetized impact of the rule. As in the 2024 RIA, this case represents the view that undervaluation of fuel savings in the consumer purchase decisions can be attributed to behavioral or market failures. Second, we present results in which the share of fuel savings counted in the benefit-cost analysis align with the modeling assumptions underlying the consumer and producer decisions outlined above. The first 2.5 years of the change in future fuel expenditures resulting from the rule are incorporated in the net monetized impact of the rule.[69] This second case represents the view that consumers fully internalize changes in future fuel costs and hence any savings realized from fuel efficiency improving features would be offset by the opportunity cost of the improvements in a vehicle's other features (that manufacturers would defer or forgo). The 2.5-year payback assumption embedded in the OMEGA analysis then approximates consumers' willingness to pay for the increase in fuel economy adjusted for such opportunity costs, as discussed in the previous section.

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not receive public comment on the use of the 10 year payback period in the analysis for this rulemaking. For more information, see the Response to Comments document.

[69] This assumption is applied to light-duty, medium-duty, and heavy-duty vehicles despite different assumptions in modeling across the vehicle classes. Alternatively, different periods could be applied across classes (e.g., a 10-year period to align with heavy-duty vehicle manufacturer technology adoption assumptions). For heavy-duty vehicles, increasing the number of years of fuel savings counted in the benefit-cost analysis would increase the monetized fuel savings impact of the rule. For medium-duty vehicles, however, changing the payback period assumption from 2.5 to 10 years would also change the degree to which certain fuel-saving technologies are adopted in the baseline, making it directionally unclear how this change would affect the estimated fuel cost savings attributable to the rule.

These scenarios represent a wide range of plausible interpretations of consumer undervaluation of fuel cost savings – attributing all the undervaluation in private fuel savings to either rational inattention or unquantified opportunity costs due to tradeoffs with other vehicle attributes. Based on recent literature, both elements are likely present in the vehicle market. The EPA therefore views the results presented here as a form of a bounding exercise on this dimension of uncertainty in the analysis. On the one hand, attributing all undervaluation to rational inattention likely overestimates the costs of this rule while attribution to unquantified opportunity costs likely underestimates the costs of the rule.

In light of the range of estimates in Table 1, several public commenters recommend that the EPA adopt different assumptions related to consumer payback period and fuel savings valuation consistently in both the modeling of producer and consumer behavior and the valuation of realized fuel savings. For example, some commenters suggested we use a longer payback period in the modeling of consumer and producer decisions. One commenter points out that the preferred results in Leard et al. (2023) are consistent with a 7-year payback, instead of the EPA's 2.5-year assumption. The EPA recognizes that the 2.5-year assumption is on the lower end of the estimates in Table 1.[70] However, given the wide range of estimates in the literature it is not clear why any one study should be given prominence over other studies. Considering how the results vary under different assumptions on consumer payback period and fuel savings valuation can be helpful though.

Extending the payback period beyond 2.5 years in the modeling of producer and consumer decision making, as suggested by some commenters, would significantly affect numerous elements of the OMEGA model and its outputs. Functionally, assuming a longer payback period in consumer modeling decisions means consumers consider additional fuel savings when making their purchase decisions. On the producer side, extending the payback period makes more fuel-efficient technologies more attractive and therefore increases adoption even in the baseline. In other words, extending the payback period in the decision modeling increases baseline fuel efficiency. When analyzing the effects of the standard, all else equal, the difference between baseline outcomes and policy outcomes would be smaller in the case of assuming longer payback period in the decision modeling. The cumulative effect of such a change would likely be to shrink both the cost savings and reduce benefits from repealing the standard. Using a longer payback period could also cause manufacturers to opt for different technologies to comply. The net effect of these changes on the monetized benefits and costs of the rule is ambiguous.

Adjusting the payback period assumption in the estimates of the valuation of fuel savings as a societal benefit, without changing any assumptions underlying the producer and consumer decision making, has a more mechanical effect. Longer payback periods increase the magnitude of the additional fuel costs of this rule while shorter payback periods suggest that the additional fuel costs are smaller.

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[70] Particularly, Gillingham et al. (2021) note that their preferred valuation estimate of 39 percent corresponds to a payback time of a little less than three years with a four percent discount rate assumption. The implied payback period would decrease with a lower discount rate assumption and conversely grow with a higher discount rate assumption.

Some commenters also noted that the literature discussed above predominantly focuses on consumers deciding between ICEVs with different levels of efficiency. However, the proliferation of PEVs, and in particular BEVs, is one of the primary compliance pathways that OMEGA predicted would be used to meet the 2024 standards. The EPA acknowledges that consumers may value fuel savings differently when comparing only within ICEVs versus when they switch between ICEV and PEV technologies. When switching between technologies, there may be greater differences in hidden costs that the current modeling does not capture, such as switching between battery electric vehicles (BEVs) and conventionally-fueled vehicles (Forsythe, et al., 2023).[71] As noted in the previous section, there may also be substantial consumer heterogeneity in the valuation of fuel expenditures or particular vehicle attributes and technologies; this analysis takes the perspective of the average consumer.

6 Summary of results

As discussed in the introduction, this analysis of the final rule includes many changes to the underlying projections used for the 2024 rulemakings and in the DRIA for this action. The details for this analysis are presented in Appendix A.

The analyses provided in this RIA has been revised since the rule was proposed to reflect a number of considerations. The analyses rely on updated versions of the models used to analyze the impacts of the proposal, which were based on the models and tools used to estimate impacts of the 2024 rules. For this final rule analysis, we estimate impacts under four different scenarios using these tools. The results from all scenarios are presented in 2024 dollars. The first four scenarios include updates to the models and tools from the proposed rule related to aligning the IRA tax credits in the analysis with the OBBB, removing the California ACT rule, reducing LD BEV acceptance levels, and updating assumptions about the costs of gasoline particulate filters in LD vehicles to better account for remaining LD criteria pollutant standards. For the action case, we have updated the analysis to model the complete revocation of LD and MD GHG standards, which is more accurate than the proposal's analysis, where stringency was relaxed to the level of GHG standards in place prior to the finalization of the 2024 LMDV rule.[72] Recognizing the significant uncertainties related to future gasoline and diesel prices, the first two scenarios include different fuel prices. The first scenario considers the AEO 2025 Reference case and Alternative Transportation case for gasoline, diesel, electricity, and hydrogen prices. The second scenario considers lower fuel prices, reflecting the gasoline, diesel, electricity, and hydrogen prices from AEO 2025's Low Oil Price case. The third and fourth scenarios build on the first and second scenarios, respectively, accounting for only the first 2.5 years of fuel savings in estimating the net monetized impact of this rule.

The first scenario (A1) , discussed further in Appendix A.1, shows the impacts of rescinding the GHG standards for LD, MD, and HD vehicles result in an estimated net cost of about $180 billion over 2027 through 2055 discounted at a 3 percent discount rate (a $9.1 billion per year annualized

[71] Forsythe, C., K. Gillingham, J. Michalek, and K. Whitefoot (2023). Technology advancement is driving electric vehicle adoption. PNAS 120(23): e2219396120.

[72] For more information on how this update is implemented, see Memorandum to Docket EPA-HQ-OAR-2025-0194. "Updated modeling assumptions and tools for 'Rescission of the Greenhouse Gas Endangerment Finding and Motor Vehicle Greenhouse Gas Emission Standards Under the Clean Air Act' Final Rule."

cost), or a net savings of $89 billion discounted at a 7 percent discount rate (a $7.3 billion per year annualized savings).

As discussed in Chapter 3, it is likely that diesel and gasoline prices could be lower throughout the analysis period compared to the fuel prices in AEO 2025. To reflect this, the second scenario, discussed further in Appendix A.2, is a sensitivity analysis on lower fuel prices. The estimated net savings under scenario A2 are about $250 billion over 2027 through 2055 at a three percent discount rate ($13 billion annualized per year), or $320 billion discounted at a 7 percent rate ($27 billion annualized per year).

As discussed in Chapter 5, there is uncertainty regarding how vehicle purchasers value the fuel savings that result from increased fuel efficiency. To reflect some of this uncertainty, the third (A3) and fourth (A4) scenarios discussed in Appendix A.3 assume consumers' willingness to pay for the changes in fuel economy are consistent with the value of the first 2.5 years of fuel savings in estimating the net monetized impacts of this rule. Scenario A3 is based on the same assumptions as scenario A1 and scenario A4 is based on the same assumptions as scenario A2. The estimates for scenario A3 result in a reduction in the net societal costs (i.e., a net benefit) associated with rescinding GHG standards of about $790 billion over 2027 through 2055 at a three percent discount rate ($41 billion annualized per year), or $600 billion at a seven percent discount rate ($49 billion annualized per year). The estimates for scenario A4 result in a reduction in net societal costs of about $920 billion over 2027 through 2055 at a 3 percent discount rate ($48 billion annualized per year), or $680 billion at a 7 percent discount rate ($55 billion annualized per year).

Table 2 and Table 3 show the net present value of the monetized savings, costs, and net savings of the four scenarios discussed above presented at three and seven percent discount rates, respectively.

*Table 2: Monetized Savings, Costs, and Net Savings at 3 Percent Net Present Value (billions of 2024 dollars)**

	Scenario A1 AEO 2025 Reference & Alternative Transportation case energy prices	**Scenario A2** AEO 2025 Low Oil Price case energy prices	**Scenario A3** AEO 2025 Reference & Alternative Transportation case energy prices, 2.5 year fuel cost valuation	**Scenario A4** AEO 2025 Low Oil Price case energy prices, 2.5 year fuel cost valuation
Savings	$1,290	$1,340	$1,290	$1,340
Costs	$1,470	$1,090	$500	$420
Net Savings	($180)	$250	$790	$920

*Results may not sum due to rounding. For detailed cost and savings subcategories, see Appendix A.

*Table 3: Monetized Savings, Costs, and Net Savings at 7 Percent Net Present Value (billions of 2024 dollars)**

	Scenario A1 AEO 2025 Reference & Alternative Transportation case energy prices	**Scenario A2** AEO 2025 Low Oil Price case energy prices	**Scenario A3** AEO 2025 Reference & Alternative Transportation case energy prices, 2.5 year fuel cost valuation	**Scenario A4** AEO 2025 Low Oil Price case energy prices, 2.5 year fuel cost valuation
Savings	$850	$870	$850	$870
Costs	$760	$550	$240	$200
Net Savings	$89	$320	$600	$680

*Results may not sum due to rounding. For detailed cost and savings subcategories, see Appendix A.

7 Small Business Analysis

The Regulatory Flexibility Act (RFA), as amended by the Small Business Regulatory Enforcement Fairness Act of 1996 (SBREFA), generally requires an agency to prepare a regulatory flexibility analysis for any rule subject to notice-and-comment rulemaking requirements under the Administrative Procedure Act or any other statute. This requirement does not apply if the agency certifies that the rule will not have a significant economic impact on a substantial number of small entities. This chapter contains an overview of small entities in the LD, MD, and HD vehicle and HD engine markets, and our assessment that the rule will not have a significant impact on a substantial number of small entities.

Under the Regulatory Flexibility Act (5 USC 601 et seq.), a small entity is defined as: (1) a business that meets the definition for small business based on the Small Business Administration's (SBA) size standards; (2) a small governmental jurisdiction that is a government of a city, county, town, school district, or special district with a population of less than 50,000; or (3) a small organization that is any not-for-profit enterprise which is independently owned and operated and is not dominant in its field.

This analysis considers small business entities that were subject to the LD, MD, and HD GHG emission standards and related regulations we are removing. Small governmental jurisdictions and small not-for-profit organizations are not subject to the rule as they have no certification or compliance requirements.

The regulated entities that are subject to the regulations we are removing in this rule are engine and vehicle manufacturers, alternative fuel converters, and independent commercial importers subject to GHG emissions standards for vehicles. These entities are expected to have registered under NAICS codes shown in Table 4. The small business size standards that qualify the regulated entities as "small entities" are also outlined in Table 4.

Table 4: Primary small business NAICS categories affected by this rule[a]

NAICS Code[b]	NAICS Title	Defined by SBA (3/17/2023) as a small business if less than or equal to:[c]
336110	Automobile and Light-duty Motor Vehicle Manufacturing	1,500 employees
336120	Heavy Duty Truck Manufacturing	1,500 employees
336211	Motor Vehicle Body Manufacturing	1,000 employees
336213	Motor Home Manufacturing	1,250 employees
336310	Motor Vehicle Gasoline Engine and Engine Parts Manufacturing	1,050 employees
336390	Other Motor Vehicle Parts Manufacturing	1,000 employees
333618	Other Engine Equipment Manufacturing	1,500 employees
423110	Automobile and Other Motor Vehicle Merchant Wholesalers	250 employees
811198	All Other Automotive Repair and Maintenance	$10.0 million annual receipts

[a] According to SBA's regulations (13 CFR Part 121), businesses with no more than the listed number of employees or dollars in annual receipts are considered "small entities" for RFA purposes.
[b] NAICS Association. NAICS & SIC Identification Tools: https://www.naics.com/search.
[c] U.S. Small Business Administration. (2023). Table of Small Business Size Standards Matched to North American Industry Classification System Codes: https://www.sba.gov/document/support-table-size-standards; pdf version at https://www.sba.gov/sites/default/files/2023-06/Table%20of%20Size%20Standards_Effective%20March%2017%2C%202023%20%282%29.pdf.

All entities, including all small entities, in the three industries (engine and vehicle manufacturers, alternative fuel converters, and commercial importers) are expected to see a decrease in regulatory burden as a result of the action. This action removes portions of the regulations of the standard-setting parts directly related to GHG emission standards and compliance provisions for implementing the EPA's GHG engine and vehicle programs. We do not anticipate that there will be any significant adverse economic impact on directly regulated small entities as a result of these revisions. Because the action will relieve regulatory burden, creating a benefit for the small entities subject to the current rules, an initial regulatory flexibility analysis of this rule is not required.

An additional benefit of the rule is to give vehicle buyers, including vehicle buyers that are small entities, more choices and relieve them from unnecessary and sometimes prohibitive regulatory costs that would be built into vehicle prices without this action. This action achieves this end by removing portions of the regulations of the standard-setting parts directly related to GHG emission standards and compliance provisions that apply to engine and vehicle manufacturers, alternative fuel converters, and independent commercial importers implementing the EPA's GHG engine and vehicle programs. The EPA notes that about 14 million Schedule C businesses own at least one vehicle, with most of those owning two or more. With 285 million vehicles registered nationwide, about 10 percent of those vehicles, if not more, are owned by small businesses. Additional vehicles are owned by non-profits and small for-profit businesses that do not file Schedule C. The savings to these businesses will be substantial, as discussed in Chapter 6 of this RIA.

Appendix A: Results using LMDV and HDP3 methodologies

The analyses in this Appendix rely on updated versions of the same models and tools used to analyze the impacts of the NPRM, which were based on the 2024 rules.[73] Below we discuss the major updates to the analysis that were completed for this final rule compared to the proposal. We discuss more details of the updated models, tools, assumption, and methodologies we used to estimate the impacts of this action in a separate memorandum to the docket.[74] The models and tools themselves are also available in the docket. The updates discussed below apply to all four scenarios discussed in this Appendix.

In the proposal, we removed all IRA tax credits. For the analyses presented here, we reflect the actions signed into law in the OBBB.[75] Specifically, we removed the following IRA tax credits after 2025: the credits for purchasing (30D) and leasing (45W) LD and MD BEVs, vehicle purchase tax credits (45W) for HD BEVs and HD FCEVs, and the tax credit for EV supply equipment (EVSE) installation (30C) for HD BEVs. We also revised the phase-out of the advanced manufacturing production credit (45X) to reflect 75% in 2031, 50% in 2032, 25% in 2033, 0% in 2034 and later.

For purchasers of LD, MD, and HD ZEVs,[76] the removal of the purchasing and leasing credits would lead to higher purchasing costs, decreasing the demand for ZEVs compared to a scenario in which the tax credits are in place. HD purchasers also face further increased costs resulting from the removal of the Electric Vehicle Supply Equipment (EVSE) tax credits. Consequently, with the reduced IRA tax credits, LD, MD, and HD purchasers would be less likely to purchase a ZEV due to the higher price.

In this updated analysis, we also removed the impacts of the California ACT rule. We modeled reduced adoption of HD BEVs and FCEVs in California and other states that had adopted ACT, consistent with how we modeled ZEV adoption in non-ACT states in the final HD GHG Phase 3 analysis. In addition, we reduced the long-term adoption of HD BEVs and FCEVs across all states to account for the repeal of IRA incentives for ZEVs and lower investment in supporting infrastructure. Altogether, removing the ACT rule, removing all but the 45X IRA tax credits, and updates to MOVES5 (EPA's latest emissions inventory modeling platform), leads to reduced estimates of HD ZEV populations for this analysis.

In RIA Chapter 2, we discuss recent changes in assumptions related to customers' interest in purchasing EVs. Due to lower projections of consumer interest compared to what was assumed in the 2024 LMDV rule, we have updated the BEV acceptance parameter values in our modeling for

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[73] See "Multi-Pollutant Emissions Standards for Model Years 2027 and Later Light-Duty and Medium-Duty Vehicles: Regulatory Impact Analysis", EPA-420-R-24-004, March 2024; and "Greenhouse Gas Emissions Standards for Heavy-Duty Vehicles: Phase 3: Regulatory Impact Analysis, EPA-420-R-24-06, March 2024.
[74] See Memorandum to Docket EPA-HQ-OAR-2025-0194. "Updated modeling assumptions and tools for 'Rescission of the Greenhouse Gas Endangerment Finding and Motor Vehicle Greenhouse Gas Emission Standards Under the Clean Air Act."
[75] One Big Beautiful Bill. July 4, 2025. See Sections 70502, 70503, 70504, 70514. https://www.congress.gov/bill/119th-congress/house-bill/1/text
[76] For the purposes of this discussion, ZEVs refer to LD, MD, and HD BEVs and HD FCEVs.

this final rule. In the proposal, we used the central BEV acceptance scenario as presented in the 2024 LMDV rule. For this final rule analysis, to reflect the lower level of BEV shares expected in the future as discussed in RIA Chapter 2, we are using the “Slower BEV Acceptance” sensitivity scenario as presented in the 2024 LMDV rule.

In the proposal, our analysis assumed the complete revocation of the 2024 LMDV and HD Phase 3 rules. For the 2024 LMDV rule, this included both GHG standards and criteria pollutant standards. This meant that we were unable to account for the continuation of the non-GHG standards that were finalized in the 2024 LMDV rule. The analysis for this final rule has been updated to partially account for the continuation of those non-GHG standards. Specifically, we have added the cost of gasoline particulate filters back into the case without the GHG standards. This reduces the cost savings of the rule compared to the proposal. We have also updated the analysis for this final rule to model the complete revocation of all LD and MD GHG standards, not just the standards finalized in the 2024 LMDV rule. This update also allows for backsliding, which is modeled as the removal of technology that does not pay for itself in fuel savings over the first 2.5 years of vehicle.

In the proposal, we presented impacts in 2022 dollars. For this final analysis, all monetary impacts have been updated to 2024 dollars.

The net results presented for each of the four scenarios in this Appendix represent the difference between a “no action” case where the EPA’s GHG emission standards remain in place and an “action” case where the EPA’s GHG emission standards are removed.

Appendix A.1: Scenario A1

The results in Table A-1 illustrate the estimated impact of rescinding GHG standards under the updated assumptions, described above, and using the updated tools and models as described in a memo to the docket.[74] In addition to the changes described above, we have also updated the gasoline, diesel, electricity and hydrogen prices that we used for the analysis.[77]

In RIA Chapter 3, we present a range of projected future gasoline and diesel fuel prices comparing three cases in AEO 2025. For this final rule analysis, we have updated our fuel prices to reflect the AEO 2025 fuel prices. As discussed in Chapter 3 of the RIA, AEO 2025 contains a reference case, as well as an “Alternative Transportation” case, in which California’s ACT, the EPA’s 2024 vehicle rulemakings, and NHTSA’s 2024 final rule for CAFE standards for MYs 2027-2032 are not in place. Therefore, we use the AEO 2025 Reference case fuel prices in our no action case where the GHG standards are still in place, and the AEO 2025 Alternative Transportation case prices in our action case where the GHG standards are removed.

Similarly, we updated the electricity prices used in the analysis for scenario A1. The electricity prices used in the analyses for the 2024 rules were projected based on IPM modeling. For this action, we are revising the LD electricity prices to reflect the AEO 2025 prices. For HD charging prices, we are using AEO 2025 for the base electricity rates and applying an additional EVSE maintenance cost for depot charging. Similarly, for when HD vehicles charge at public chargers, we are using the AEO 2025 electricity prices for the base rates and applying the additional costs that

[77] To note, we do not fully account for the lack of infrastructure related to hydrogen but note that that could make costs significantly higher and/or change compliance strategies significantly.

apply to public charging we used in the HDP3 analysis.[78] For both LD and HD electricity rates, we used AEO 2025 reference case for the no action case and the alternative transportation case for the action case.

We also updated the hydrogen prices used in scenario A1 to reflect AEO 2025 reference case for the no action case and the alternative transportation case for the action case.[79]

All other assumptions and inputs remain the same as those used in the final LMDV and HD GHG Phase 3 rules.

*Table A-1: Scenario A1 net monetized costs of the rule from 2027 through 2055 using the AEO 2025 Reference case and Alternative Transportation case energy prices (billions of 2024 dollars)**

	2055	Present Value at 3%	Present Value at 7%	Annualized Value at 3%	Annualized Value at 7%
Vehicle Technology	$35	$1,090	$730	$57	$59
Electric Vehicle Supply Equipment & Replacements	$12	$200	$120	$11	$9.6
Fuel, Repair, Maintenance, Insurance, Congestion & Noise	($170)	($1,430)	($730)	($75)	($60)
Energy Security, Refueling Time, Drive Value	($2.0)	($40)	($23)	($2.1)	($1.9)
Net Monetized Impacts	($120)	($180)	$89	($9.1)	$7.3

* Positive values reflect savings due to the rule (i.e., decreases in social costs) while negative values reflect increases in social costs.

As shown in Table A-1, the scenario A1 analysis shows an estimated net societal cost associated with rescinding GHG standards for LD, MD, and HD vehicles of about $180 billion over calendar years 2027 through 2055 at a three percent discount rate. This scenario also shows that removing the GHG standards would lead to a reduction in vehicle technology and EVSE costs of approximately $1.3 trillion over calendar years 2027 through 2055 at a three percent discount rate. Under scenario A1, our modeling projects this rule to result in about 469 million new combined LD, MD, and HD vehicle sales over the 2027 to 2055 time period. Combining that with the estimated $1.09 trillion reduction in vehicle technology cost at a three percent discount rate as shown in the Table A-1, we estimate this action will result in an average cost reduction of $2,330 per vehicle.

In this updated analysis, our modeling of the No Action case projects that both light- and medium-duty vehicles would be compliant with the GHG standards that were established in the 2024 LMDV rule. The issue of non-compliance for MY 2032 that was identified in the DRIA for the proposed rule has been corrected in these updated results by the removal of modeled constraints on the use of carry-forward and carry-back credits. These artificial constraints prevented manufacturers from building a bank of additional credits that could be used in years where a credit deficit occurred.

[78]These additional costs include the amortized cost of public charging equipment, land costs, both electricity prices and demand charges associated with high peak power, distribution upgrade costs for substations, feeders, and transformers, and EVSE maintenance costs.
[79] AEO 2025 Table 19, Hydrogen Market Projections: Delivered End-Use prices: Transportation

Similar to the LD and MD modeling, the HD truck model evaluates a single compliance strategy. The HD model uses a technology acceptance model based on payback periods of ZEV technologies.[80] With reduced IRA tax credits due to the OBBB and without the California ACT Rule, HD ZEV purchasers would experience longer payback periods for adopting ZEV technologies than modeled in the HD GHG Phase 3 analysis, impacting the acceptance of the technologies in the market. The estimates of average payback period as projected in the HD GHG Phase 3 final rule, which includes IRA tax credits, and scenario A1 with reduced IRA tax credits and updated diesel, electricity, and hydrogen prices are shown in Table A-2.

Table A-2: Average payback period (years) of MY 2032 HD ZEVs in 2024 rule analysis and Scenario A1

	2024 Analysis with IRA Tax Credits	**Scenario A1**
Light Heavy-Duty Vocational Vehicles	2	2
Medium Heavy-Duty Vocational Vehicles	3	4
Heavy Heavy-Duty Vocational Vehicles	4	5
Day Cab Tractors	2	6
Sleeper Cab Tractors[a]	5	>15

[a] The increase in payback period is due to a combination of increases in modeled operating expenses (charging and hydrogen prices), along with the removal of the $40,000 IRA purchasing tax credit for zero emission sleeper cab tractors.

In this scenario A1 that includes reduced IRA tax credits with only the 45X battery manufacturing tax credit, the longer payback periods of ZEV technologies *lead the model to project that the HD industry would not be in compliance with the existing MY 2027 through MY 2032 and later standards*. For this scenario, we did not revise the technology assessment for the no-action case (with standards) and instead assume that HD vehicle purchasers would continue to purchase HD ZEVs under much longer payback periods. It is plausible that what would more likely happen under these circumstances is that manufacturers may restrict sales of higher emitting vehicles or substitute other technologies, such as hybrid vehicles, to comply with the standards. We have not modeled the impacts of how limiting or eliminating the sales of the highest emitting vehicles (in general, gasoline and diesel-fueled vehicles) in order to ensure compliance would impact the HD vehicle manufacturers, HD vehicle workers, dealerships, fleets, and other purchasers; nor have we assessed the impacts on the program's costs, benefits, and other impacts.

Appendix A.2: Scenario A2

In RIA Chapter 3, we present a range of projected future gasoline and diesel fuel prices comparing several AEO 2025 cases. As noted there, neither the AEO 2025 Reference case nor Alternative Transportation case gasoline prices take into account the policies being implemented by President Trump that are intended to reduce the price of gasoline and diesel. For these reasons and others, we included a fuel price sensitivity assessment which examines the impact of lower fuel prices on some program costs and benefits. The results presented in Table A-3 contain the same

[80] Payback period is the amount of time it takes for the lower annual operational costs of a ZEV to offset the higher upfront cost of the ZEV technologies.

assumptions as those in Table A-1 (reduced IRA tax credits, no ACT rule, lower BEV acceptance, included GPF costs), with the exception of fuel, electricity and hydrogen prices. For this scenario, we use the fuel, electricity and hydrogen prices from the Low Oil Price case from AEO 2025 for the no action case. For the fuel prices for the action case, we estimated the difference between the Reference case and the Low Oil Price case and applied that difference to the Alternative Transportation case prices. For the electricity and hydrogen prices, we use the Alternative Transportation case prices without any adjustments. With these lower fuel costs, we estimate a net societal savings associated with rescinding GHG standards for LD, MD, and HD vehicles of about $250 billion over calendar years 2027 through 2055 at a three percent discount rate and a net savings of approximately $320 billion over calendar years 2027 through 2055 at a seven percent discount rate. Under scenario A2, our modeling projects this rule to result in about 472 million new combined LD, MD, and HD vehicle sales over the 2027 to 2055 time period. Combining that with the estimated $1.14 trillion reduction in vehicle technology cost at a three percent discount rate as shown in Table A-3, we estimate this action will result in an average cost reduction of $2,420 per vehicle.

*Table A-3: Scenario A2 net monetized costs of the rule from 2027 through 2055 using lower projected fuel prices (billions of 2024 dollars)**

	2055	**Present Value at 3%**	**Present Value at 7%**	**Annualized Value at 3%**	**Annualized Value at 7%**
Vehicle Technology	$41	$1,140	$750	$59	$61
Electric Vehicle Supply Equipment & Replacements	$12	$200	$120	$11	$9.6
Fuel, Repair, Maintenance, Insurance, Congestion & Noise	($130)	($1,040)	($520)	($54)	($42)
Energy Security, Refueling Time, Drive Value	($2.7)	($46)	($26)	($2.4)	($2.1)
Net Monetized Impacts	($83)	$250	$320	$13	$27

* Positive values reflect savings due to the rule (i.e., decreases in social costs) while negative values reflect increases in social costs.

Appendix A.3: Impact of accounting for 2.5 years of fuel costs

RIA Chapter 5 presents a summary of literature on how consumers value future fuel costs at the time of vehicle purchase. As discussed, some of these studies suggest that buyers may fully value the future fuel cost savings from a vehicle with improved fuel economy, in which case the entire benefit from private fuel savings is incorporated in the buyers' purchase decisions. Other studies suggested buyers do not fully value the future fuel cost savings from improved fuel economy, and only part of the private future fuel savings would be incorporated into the purchase decision. In this section, we present the monetized net impacts of this action under the assumption that consumers' willingness to pay for the change in fuel economy is consistent with the fuel cost impacts during the first 2.5 years of use after new vehicle purchase.

Appendix A.3.1: Scenario A3

The results for scenario A3 are presented in Table A-4 and are based on the same modeling as scenario A1 (Table A-1), with the exception that for this estimate, fuel cost impacts are scaled to account for only the first 2.5 years of vehicle ownership. We estimate about $790 billion in net societal savings over calendar years 2027 through 2055 at a three percent discount rate. Compared to the results for scenario A1, the combined reduction in vehicle technology costs ($1,090 billion) and EVSE costs ($200 billion) is the same as shown in Table A-1, while the lower valuation of fuel cost reduces the Fuel, Repair, Maintenance, Insurance, Congestion & Noise value ($460 billion versus $1,430 billion).

*Table A-4: Scenario A3 net monetized costs of the rule from 2027 through 2055 with 2.5 years of lifetime fuel costs (billions of 2024 dollars)**

	2055	**Present Value at 3%**	**Present Value at 7%**	**Annualized Value at 3%**	**Annualized Value at 7%**
Vehicle Technology	$35	$1,090	$730	$57	$59
Electric Vehicle Supply Equipment & Replacements	$12	$200	$120	$11	$9.6
Fuel, Repair, Maintenance, Insurance, Congestion & Noise	($63)	($460)	($220)	($24)	($18)
Energy Security, Refueling Time, Drive Value	($2.0)	($40)	($23)	($2.1)	($1.9)
Net Monetized Impacts	($18)	$790	$600	$41	$49

* Positive values reflect savings due to the rule (i.e., decreases in social costs) while negative values reflect increases in social costs.

Appendix A.3.2: Scenario A4

Scenario A4 is based on the same modeling as scenario A2 (Table A-3), except the fuel cost impacts are scaled to account for only the first 2.5 years of vehicle ownership. The results of this scenario are shown in Table A-5. We estimate about $920 billion in net societal savings over calendar years 2027 through 2055 at a three percent discount rate. Compared to the results for scenario A2, the combined reduction in vehicle technology costs ($1,140 billion) and EVSE costs ($200 billion) is the same as shown in Table A-3, while the lower valuation of fuel cost reduces the Fuel, Repair, Maintenance, Insurance, Congestion & Noise value ($380 billion versus $1,040 billion).

*Table A-5: Scenario A4 net monetized costs of the rule from 2027 through 2055 with 2.5 years of lifetime fuel costs (billions of 2024 dollars)**

	2055	**Present Value at 3%**	**Present Value at 7%**	**Annualized Value at 3%**	**Annualized Value at 7%**
Vehicle Technology	$41	$1,140	$750	$59	$61
Electric Vehicle Supply Equipment & Replacements	$12	$200	$120	$11	$9.6
Fuel, Repair, Maintenance, Insurance, Congestion & Noise	($55)	($380)	($170)	($20)	($14)
Energy Security, Refueling Time, Drive Value	($2.7)	($46)	($26)	($2.4)	($2.1)
Net Monetized Impacts	($4.3)	$920	$680	$48	$55

* Positive values reflect savings due to the rule (i.e., decreases in social costs) while negative values reflect increases in social costs.