UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

Multi-Pollutant Emissions Standards for Model Years 2027 and Later Light-Duty and Medium-Duty Vehicles **88 Fed. Reg. 29184 (May 5, 2023)**	Docket No. EPA–HQ–OAR–2022–0829; FRL 8953–03–OAR *Via regulations.gov* *July 5, 2023*

COMMENTS OF ENVIRONMENTAL AND PUBLIC HEALTH ORGANIZATIONS

Center for Biological Diversity, Conservation Law Foundation, Environmental Law & Policy Center, Natural Resources Defense Council, Public Citizen, Sierra Club, and the Union of Concerned Scientists respectfully submit these comments in response to the Environmental Protection Agency's (EPA) Proposed Rule titled Multi-Pollutant Emissions Standards for Model Years 2027 and Later Light-Duty and Medium-Duty Vehicles, 88 Fed. Reg. 29184 (May 5, 2023). Most of the materials referenced in this comment letter have already been submitted to the docket via Regulations.gov. Other key sources that contain original research conducted specifically for these comments are attached as appendices to this letter. These sources are: Benchmark Mineral Intelligence, Lithium Mining Projects - Supply Projections (June 2023); ERM, Impacts of EPA Light- & Medium-Duty Multi-Pollutant Standards: National Scenario Results (June 2023); and Roush (Himanshu Saxena, et al.), Electrification Cost Evaluation of Class 2b and Class 3 Vehicles in 2027–2030 (May 2023).

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I. Introduction

EPA has both an opportunity and an obligation to dramatically reduce emissions of greenhouse gases (GHGs) and other pollutants from light-duty vehicles (LDVs) and medium-duty vehicles (MDVs). The Agency's mandate to protect public health and welfare is made urgent by the ever more dire impacts of climate change, as well as the continuing harms to public health from vehicle criteria pollution. And the opportunity to significantly reduce these impacts is clear. Zero-emission vehicles (ZEVs) are not only feasible and cost-reasonable—they are rapidly penetrating the fleet, with more than 250,000 fully battery electric vehicles sold in the first quarter of 2023 alone, a 44.9% increase over the same period last year.[1] In addition, numerous emission control technologies for combustion vehicles are also feasible, cost-reasonable, and already extensively deployed on the fleet, yet still have potential for greater application within the fleet of new combustion vehicles that will continue to be produced.

In addition, Congress affirmed its commitment to achieving ambitious reductions in GHG and criteria pollutant emissions from motor vehicles in the Bipartisan Infrastructure Law (BIL)[2] and the Inflation Reduction Act (IRA),[3] which provide unprecedented financial support for ZEV technology and infrastructure.

The feasibility of greater pollution control, as well as growing consumer demand for ZEVs, is demonstrated by automaker commitments to increase the number of ZEV models and by their own investments and sales targets for these vehicles. Indeed, numerous projections of the light-duty fleet show high levels of ZEVs in the coming years, with several predicting more than 50% ZEVs as a portion of light-duty vehicle sales by 2030 even in the absence of new EPA regulations, which is also consistent with automaker announcements.[4]

While the market is clearly heading in the right direction, EPA's standards should facilitate even greater deployment of zero-emission and combustion vehicle technologies to help protect the public from the destructive effects of climate change and air pollution generally. To this end, we urge EPA to finalize the strongest possible emission standards. While we do not believe it is necessary for EPA to set standards beyond 2032 at this point, it is critical that the final standards are sufficiently stringent through model year 2032 to ensure that the U.S. is on track to reach 100% new ZEV sales in 2035. <u>The standards in Alternative 1, but with greater stringency after 2030, are feasible and would better serve EPA's statutory mandate to address the</u>

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[1] Cox Automotive, *Another Record Broken: Q1 Electric Vehicle Sales Surpass 250,000, as EV Market Share in the U.S. Jumps to 7.2% of Total Sales* (Apr. 12, 2023), https://www.coxautoinc.com/market-insights/q1-2023-ev-sales/.
[2] Infrastructure Investment and Jobs Act of 2021, Pub. L. No. 117–58, 135 Stat. 429 (2021), www.congress.gov/bill/117thcongress/house-bill/3684/text.
[3] Inflation Reduction Act of 2022, Pub. L. No. 117–169, 136 Stat. 1818 (2022), www.congress.gov/bill/117th-congress/house-bill/5376/text.
[4] *See, e.g.*, U.S. EPA, Multi-Pollutant Emissions Standards for Model Years 2027 and Later Light-Duty and Medium-Duty Vehicles; Proposed rule, 88 Fed. Reg. 29184, 29189, 29192-93 (May 5, 2023).

environmental and health impacts of air pollution from light- and medium-duty vehicles. Finalizing such standards will provide feasible, critical air pollution emission reductions, as directed by Congress in the Clean Air Act.

II. EPA Must Establish Strong Emission Standards to Meet Its Obligations Under the Clean Air Act.

To carry out its statutory mandate, EPA must promulgate emission standards that protect public health and welfare by minimizing harmful air pollution. In passing the Clean Air Act, Congress found that "the growth in the amount and complexity of air pollution brought about by urbanization, industrial development, and the increasing use of motor vehicles, has resulted in mounting dangers to the public health and welfare."[5] Congress thus declared that the express purpose of the Clean Air Act is to "protect and enhance the quality of the Nation's air resources so as to promote the public health and welfare."[6] As detailed throughout this comment letter, EPA must use this clear statutory authority to meet its mandate to protect public health and welfare by finalizing standards more stringent than it proposed.

A. Section 202 requires EPA to set standards that protect public health and welfare from the dangers of GHGs, criteria pollutants, and air toxics.

Section 202(a)(1)[7] of the Clean Air Act directs EPA to promulgate motor vehicle standards that "prevent or control" emissions of air pollutants that "cause, or contribute to, air pollution which may reasonably be anticipated to endanger public health or welfare."[8] The criteria and toxic pollutants at issue in this Proposal[9] have long been subject to regulation based on their harmful effects. And the Supreme Court held in *Massachusetts v. EPA* that Congress clearly provided EPA with "the statutory authority to regulate the emission of [greenhouse] gases from new motor vehicles" pursuant to Section 202(a)(1)–(2).[10] In response to this decision, in 2009 EPA found that greenhouse gas emissions from motor vehicles "contribute to the total greenhouse gas air pollution, and thus to the climate change problem, which is reasonably anticipated to endanger public health and welfare."[11]

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[5] 42 U.S.C. § 7401(a)(2).
[6] *Id.* § 7401(b)(1). Congress affirmed this goal in the 1977 amendments to the Clean Air Act, which "emphasize[d] the preventive or precautionary nature of the act, i.e., to assure that regulatory action can effectively prevent harm before it occurs; [and] emphasize[d] the predominant value of protection of public health." *Lead Industries Ass'n v. EPA*, 647 F.2d 1130, 1152 (D.C. Cir. 1980) (quoting H.R. Rep. No. 95-294, 95th Cong., 1st Sess. 49 (1977)); *see also* 74 Fed. Reg. 66496, 66507 (Dec. 15, 2009).
[7] EPA's specific statutory authority to set standards for emissions of criteria pollutants from medium-duty vehicles is addressed in Section VIII.B.
[8] 42 U.S.C. § 7521(a)(1).
[9] The terms "Proposal" and "Proposed Standards" are used interchangeably to refer to this proposed rulemaking and the standards that EPA is proposing to establish.
[10] 549 U.S. 497, 532 (2007).
[11] 74 Fed. Reg. at 66499.

Once EPA makes an endangerment finding, it must set standards that are commensurate to the magnitude of the danger to public health and welfare posed by the covered emissions.[12] The Clean Air Act defines "effects on welfare" broadly, including "effects on . . . weather . . . and climate."[13] The dangers to public health and welfare posed by GHGs that EPA originally cited in the 2009 Endangerment Finding—"risks associated with changes in air quality, increases in temperatures, changes in extreme weather events, increases in food- and water-borne pathogens, and changes in aeroallergens,"[14] to name a few—have only increased. EPA recognized that this was likely to happen in the Endangerment Finding itself, finding that these "risk[s] and the severity of adverse impacts on public welfare are expected to increase over time."[15] As for criteria pollutants and air toxics—PM, ozone, VOCs, NOx, SOx, CO, diesel exhaust, formaldehyde, acetaldehyde, acrolein, benzene, butadiene, ethylbenzene, naphthalene, and POM/PAHs—their harmful health and environmental effects have long been known, and EPA has recognized the need for continued reductions in their emissions.[16]

Given that the danger to public health and welfare from GHG emissions continues to intensify, and in light of the ongoing harm from criteria pollutant and air toxics emissions, EPA must use its authority under Section 202(a) to set strong emission standards. Section 202(a)(2) provides that standards promulgated pursuant to Section 202(a)(1) "shall take effect after such period as the Administrator finds necessary to permit the development and application of the requisite technology."[17] As the D.C. Circuit has recognized, this language embodies Congress's intent that EPA "press for the development and application of improved technology rather than be limited by that which exists today."[18] Here, adopting more stringent standards would not require EPA to press for the development of new technologies; zero-emission and combustion vehicle technologies have reached technological maturation and are on the market for light- and medium-duty vehicles. Because greater deployment of those technologies within the fleet is feasible and readily achievable, EPA must go further to address the dangers to public health and welfare wrought by GHG, criteria pollutant, and air toxics emissions from these vehicles—specifically, by finalizing Alternative 1 with a steeper increase in stringency after

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[12] *See Massachusetts*, 549 U.S. at 532 (noting that Section 202(a) "charge[s] [EPA] with protecting the public's 'health' and 'welfare'"); *Coal. for Responsible Regulation v. EPA*, 684 F.3d 102, 117, 122 (D.C. Cir. 2012) (stating that EPA must carry out "the job Congress gave it in § 202(a)—utilizing emission standards to prevent reasonably anticipated endangerment from maturing into concrete harm"). *See also* S. Rep. No. 91-1196, at 24 (1970), reprinted in A Legislative History of the Clean Air Amendments of 1970, at 424 (1974) (Section 202(a) requires EPA to "make a judgment on the contribution of moving sources to deterioration of air quality and establish emission standards which would provide the required degree of control."). *Cf.* 74 Fed. Reg. at 66505 ("the Administrator is required to protect public health and welfare, but she is not asked to wait until harm has occurred. EPA must be ready to take regulatory action to prevent harm before it occurs.").
[13] 42 U.S.C. § 7602(h).
[14] 74 Fed. Reg. at 66497.
[15] 74 Fed. Reg. at 66498–66499.
[16] 88 Fed. Reg. at 29186, 29208-24.
[17] *Id.* § 7521(a)(2).
[18] *NRDC v. EPA*, 655 F.2d 318, 328 (D.C. Cir. 1981) (quoting S. Rep. No. 91-1196 (1970)).

2030.[19] As detailed in Section III below, greenhouse gas emissions from light- and medium-duty vehicles contribute massively to the worsening climate crisis, while criteria pollutant and air toxics emissions from those vehicles continue to threaten public health. EPA should therefore choose a regulatory response that will better address the pollution responsible for the "endanger[ment]" that these vehicles pose to public health and welfare.[20]

Congress directed EPA, the expert agency with authority over air pollution from vehicles and engines, to develop a record and apply the Section 202(a) criteria to the facts to develop standards.[21] In doing so, the Agency is "not obliged to provide detailed solutions to every engineering problem, but ha[s] only to identify the major steps for improvement and give plausible reasons for its belief that the industry will be able to solve those problems in the time remaining."[22] Indeed, courts have consistently upheld EPA's vehicle and engine regulations over manufacturers' objections about technological readiness.[23] And manufacturers have consistently risen to the challenge, complying with the very standards they previously claimed were impossible to meet.[24]

B. The Clean Air Act authorizes EPA to rely on zero-emission technologies in standard-setting.

We agree with EPA's assessment of its statutory authority to set vehicle emission standards that rely on the full spectrum of technologies to prevent and control tailpipe pollution, including both zero-emission and combustion vehicle technologies.[25] As set forth in detail in the Proposal, the Clean Air Act authorizes EPA to consider zero-emission technologies when setting emission standards and to finalize standards at levels that will lead to greater deployment of ZEVs.[26] Section 202(a) does not give preference to any particular emission control technology, propulsion system, or powertrain type.[27] And far from enshrining the status quo or protecting the

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[19] Granted, Section 202(a) provides discretion to EPA as to the exact *manner* of "prevent[ing] or control[ing]" emissions of dangerous air pollutants. And Section 202 places certain limitations on EPA in setting standards. EPA's standards pursuant to Section 202(a) must allow lead time for technical feasibility and must give "appropriate consideration to the cost of compliance." 42 U.S.C. § 7521(a)(2). Accounting for these requirements, EPA must promulgate standards that adequately address the danger to public health and welfare caused by the pollutant at issue.
[20] *See Massachusetts*, 549 U.S. at 532; 74 Fed. Reg. at 66525–26.
[21] *See Coal. for Responsible Regulation*, 684 F.3d at 126.
[22] *Nat'l Petrochemical & Refiners Ass'n v. EPA*, 287 F.3d 1130, 1136 (D.C. Cir. 2002) (cleaned up).
[23] *Id*. at 1136–41 (upholding NOx and PM regulations predicated on future developments in pollution control technology); *NRDC v. Thomas*, 805 F.2d at 428–34 (upholding PM regulation over manufacturers' concerns about the feasibility of trap-oxidizer technology); *NRDC v. EPA*, 655 F.2d at 331–36 (same).
[24] *See, e.g.*, 87 Fed. Reg. 17414, 17536 (explaining that manufacturers deployed technologies that EPA had not predicted to meet the 2001 heavy-duty criteria pollutant standards, which they had unsuccessfully challenged in *National Petrochemical & Refiners Association*).
[25] *See* 88 Fed. Reg. at 29232-33.
[26] *See id.* at 29231–33 (relying on statutory language, legislative materials, case law, and regulatory history).
[27] *See* EPA Br. 7-10; Oge & Hannon Amicus Br. 17-18; Final Br. of State & Pub. Int. Respondent-Intervenors, *Texas v. EPA*, Case No. 22-1031 (D.C. Cir. Apr. 27, 2023), ECF No. 1996908, 6-8, 28-29 [hereinafter "State & Pub. Int.

market share of polluting vehicles, Congress intended that EPA set standards that drive improvements in emission control technologies.[28] Indeed, Congress was intensely interested in electrification and other emerging vehicle technologies as far back as the 1960s and 1970s, and it expected EPA to consider emission reductions that could be achieved through the use of alternative fuels and propulsion systems (including electrification) that control air pollution more effectively than combustion vehicle technologies.[29] As "complete systems…to prevent" air pollution,[30] ZEVs fall well within the scope of Section 202(a)(1).[31]

Accelerating the deployment of zero-emission technologies through this rulemaking would also build on EPA's long and consistent practice of both considering and incentivizing these technologies in its Section 202(a) rulemakings.[32] EPA began doing so more than two decades ago when it finalized the "Tier 2" criteria pollutant standards.[33] That rule required manufacturers to certify all new light-duty vehicles into one of eight emissions profiles, or "bins."[34] A sales-weighted average of those bins determined the manufacturer's compliance with the fleet-average NOx standard.[35] Bin 1 was designated for ZEVs.[36] EPA recognized that including ZEVs in the fleet average would "provide a strong incentive" for manufacturers to develop and introduce ultra-clean vehicle technologies, serving as "a stepping stone to the[ir] broader introduction."[37] (EPA's prediction has proven correct, as ZEVs have grown to comprise

Br."]; Br. of Sen. Thomas R. Carper & Rep. Frank Pallone, Jr. as Amici Curiae in Support of Respondents, *Texas v. EPA*, Case No. 22-1031 (D.C. Cir. Mar. 2, 2023), ECF No. 1988363, 12-16, 19-22 [hereinafter "Carper & Pallone Amicus Br."].

[28] *See Int'l Harvester Co. v. Ruckelshaus*, 478 F.2d 615, 640 (D.C. Cir. 1973) (recognizing that Congress's choices in the 1970 Clean Air Act Amendments may lead to "fewer models and a more limited choice of engine types"). As EPA explained in its brief in *Texas v. EPA*, Section 202(a), "by design, seeks innovation and change." EPA's Final Answering Br., *Texas v. EPA*, Case No. 22-1031 (D.C. Cir. Apr. 27, 2023), ECF No. 1996730, at 43-44 [hereinafter "EPA Br."]. Indeed, over the decades, EPA's emission standards have led to significant technological innovation and advancements in the auto industry. *See id.* at 7; Br. of Amici Curiae Margo Oge & John Hannon in Support of Respondents, *Texas v. EPA*, Case No. 22-1031 (D.C. Cir. Mar. 8, 2023), ECF No. 1989149, 7-8, 21-22, 26-27 [hereinafter "Oge & Hannon Amicus Br."].

[29] *See* 88 Fed. Reg. at 29232-33; EPA Br. at 7-10, 40-46; State & Pub. Int. Br. at 6-8, 28-29; Carper & Pallone Amicus Br. at 12-16, 19-22.

[30] 42 U.S.C. § 7521(a)(1).

[31] Section 202(a)(4), which references an "emission control device, *system, or element of design*," 42 U.S.C. § 7521(a)(4)(A) (emphasis added), provides further evidence that Congress envisioned that EPA may consider, and that manufacturers may use, a wide variety of emission control technologies and approaches. Electrification is a "system" and an "element of" motor vehicle "design."

[32] Oge & Hannon Amicus Br. at 14-15, 24-25, 28-30.

[33] 65 Fed. Reg. 6698 (Feb. 10, 2000). Even before the Tier 2 standards, EPA included ZEVs in its 1997 National Low Emission Vehicle Program regulation. Those standards, however, were voluntary. 62 Fed. Reg. 31192, 31208, 31211-12, 31224 (June 6, 1997).

[34] 65 Fed. Reg. at 6734.

[35] *Id.*

[36] *Id.* at 6746.

[37] *Id*.

ever-greater portions of the light-duty[38] and heavy-duty fleets[39] since that time.) Later, in a series of GHG emission rulemakings spanning three presidential administrations, the Agency continued to include ZEVs in fleet average standards for light- and heavy-duty vehicles, as shown in the table below. EPA took the same approach in 2014 for its Tier 3 criteria pollutant standards for light-duty vehicles.[40]

Table II.B-1: Electrification, fleet-average standards, and averaging, banking, and trading in prior GHG rulemakings[41]

Rule	Fleet-average standard	Averaging, banking, and trading	Considering electrification
Light-duty (model-year 2011 and later), 75 Fed. Reg. 25324 (May 7, 2010)	25405/1, 25412/1-3	25412/3	25328/3, 25456 (tbl. III.D.6-3)
Heavy-duty (model-year 2014 and later), 76 Fed. Reg. 57106 (Sept. 15, 2011)	57119/1	57238/2-39/1	57204/3-05/2, 57220/1-21/2, 57224/3-25/1, 57246/1
Light-duty (model-year 2017 and later), 77 Fed. Reg. 62624 (Oct. 15, 2012)	62627/3-28/1	62628/1-2	62705/1-06/1, 62852/2-61
Heavy-duty (model-year 2021 and later), 81 Fed. Reg. 73478 (Oct. 25, 2016)	73730/2-3, 73733/2-34/1	73495/2-3, 73568/2-69/3	73751/1-3
Light-duty (model-year 2021 and later), 85 Fed. Reg. 24174 (Apr. 30, 2020)	24246/3-47/3	25206/3-07/1, 25275/1-76/2	24320/1, 24469/1-524/3
Light-duty (model-year 2023 and later), 86 Fed. Reg. 74434 (Dec. 30, 2021)	74446/3-51/1	74453/1-56/1	74493/1-94/3, 74484/2-87/3

Finally, we agree with EPA that recent actions by Congress reinforce the Agency's authority to set emission standards that rely on and accelerate the deployment of zero-emission

[38] EPA, *The 2022 Automotive Trends Report*, at 74, Table 4.1 (2022), https://www.epa.gov/system/files/documents/2022-12/420r22029.pdf (production share by powertrain, showing increasing shares of hybrids, plug-in hybrids, and battery electric vehicles).
[39] 88 Fed. Reg. 25926, 25939-43.
[40] 79 Fed. Reg. 23414, 23454, 23471 (Apr. 28, 2014).
[41] Reproduced from EPA Br. at 16.

vehicle technologies.[42] As members of Congress have emphasized, the BIL and IRA provide "a clear signal of Congress' intent to support vehicle electrification and robust EPA authority to accelerate it."[43] By increasing the market penetration of ZEVs[44] and significantly lowering the cost of zero-emission technologies, the BIL and IRA assist EPA in setting standards that will achieve ambitious reductions in GHG, criteria pollutant, and air toxics emissions.[45] EPA should use its clear authority under the Clean Air Act to do so here by finalizing standards more stringent than it has proposed.

III. Further Reductions in Emissions of GHGs and Criteria Pollutants from Motor Vehicles Are Necessary to Protect Public Health and the Environment.

A. Vehicular emissions of greenhouse gases gravely endanger public health and welfare by intensifying the climate crisis.

Emissions of GHGs from the transportation sector pose mortal dangers to public health and the environment; EPA's exercise of its responsibilities under the Clean Air Act must take account of and mitigate these dangers. Over thirteen years ago, based upon a massive scientific record, the EPA found that new motor vehicles and engines contribute to emissions of GHGs that drive climate change and endanger the health and welfare of current and future generations.[46] Specifically, EPA found that the intensifying climate crisis increased the frequency of warmer temperatures, heat waves, and other extreme weather, worsened air quality by increasing regional ozone pollution, increased the spread of food and water-borne illnesses, increased the frequency and severity of seasonal allergies, and increased the severity of coastal storm events due to rising sea levels.[47]

Since EPA issued the Endangerment Finding in 2009, dire evidence of the current and future impacts of climate change has continued to accumulate. Recent studies demonstrate that climate change continues to cause heat waves and extreme weather events across the United States.[48] Between May and mid-September, 2022, "nearly 10,000 daily maximum temperature

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[42] *See* 88 Fed. Reg. at 29233.
[43] Carper & Pallone Amicus Br. at 29; *see generally id.* At 29-35.
[44] As EPA notes, pre-IRA projections predicted that PEVs would make up nearly 40% of U.S. market share by 2030. 88 Fed. Reg. at 29189. In contrast, post-IRA projections by the International Council on Clean Transportation (ICCT) estimate that battery-electric vehicles will increase to 56 to 67% of market share in the U.S. by 2032. *Id.* at 29189 n.40.
[45] *See* Greg Dotson & Dustin J. Maghamfar, *The Clean Air Act Amendments of 2022: Clean Air, Climate Change, and the Inflation Reduction Act*, 53 Env't L. Rep. 10017, 10018, 10029 (2023).
[46] 74 Fed. Reg. at 66496.
[47] 74 Fed. Reg. at 66525–26.
[48] U.S. Dep't of Health & Hum. Serv. (HHS), Off. Climate Change & Health Equity, *Climate and Health Outlook* (May 2023) [hereinafter HHS, *Climate and Health Outlook*], https://www.hhs.gov/sites/default/files/climate-health-outlook-may-2023.pdf. *See also* Andrew Hoell et al., *Water Year 2021 Compound Precipitation and Temperature Extremes in California and Nevada*, 103 Bull. of the Am. Meteorological Soc'y E2905, E2910 (Dec. 2022), https://journals.ametsoc.org/view/journals/bams/103/12/BAMS-D-22-0112.1.xml?tab_body=fulltext-display

records were broken."[49] Additionally, 2022 was "one of the top 10 hottest years on record for daily maximum temperatures" in 13 states, as well as one of the top 10 hottest for daily minimum (nighttime low) temperatures for 31 states.[50] Warmer temperatures endanger public health by increasing the risk of heart disease, worsening asthma and chronic obstructive pulmonary disease from increases of ground-level ozone, and causing dehydration and many other ailments.[51] Studies have also found that heat waves and extreme weather events cause severe psychiatric and mental health impacts.[52] Climate change continues to lead to higher than normal pollen concentrations and earlier and longer pollen seasons, causing worse allergies and asthma.[53] The intensifying climate crisis also increases the risk of drought across the U.S, which impacts water supply, agriculture, transportation, and energy, and increases the risk and magnitude of wildfires.[54] And recent projections show that sea level rise is anticipated to be on the high end of model projections.[55] Studies have found that many of the dangers wrought by climate change exact a higher toll on people with low incomes and people of color.[56]

(human-caused climate change led to increased extreme high temperatures in 2021 in California and Nevada); Kristy Dahl, Union of Concerned Scientists, *Summer of 2022 Was a Hot One. What was Climate Change's Impact on Heat?*, The Equation (Sept. 21, 2022), https://blog.ucsusa.org/kristy-dahl/summer-of-2022-was-a-hot-one-what-was-climate-changes-impact-on-heat/.

[49] Dahl.

[50] *Id*.

[51] HHS, *Climate and Health Outlook*, at 2; Christopher Nolte et al., U.S. Global Change Rsch. Program, *Air quality*, in II *Impacts, risks, and adaptation in the United States: Fourth national climate assessment* 512, 515 (2018), https://nca2018.globalchange.gov/downloads/NCA4_Ch13_Air-Quality_Full.pdf (climate change leads to worsened air quality by increasing concentrations of ozone and particulate matter in many parts of the U.S.); Am. Lung Ass'n, *State of the Air 2023 Report* 19 (2023), https://www.lung.org/getmedia/338b0c3c-6bf8-480f-9e6e-b93868c6c476/SOTA-2023.pdf?ext=.pdf (describing worsened air quality resulting from climate change).

[52] *See, e.g.*, Amruta Nori-Sarma et al., *Association Between Ambient Heat and Risk of Emergency Department Visits for Mental Health Among US Adults, 2010 to 2019*, 79 JAMA Psychiatry 341 (2022), https://jamanetwork.com/journals/jamapsychiatry/fullarticle/2789481?; Marshall Burke et al., *Higher temperatures increase suicide rates in the United States and Mexico*, 8 Nature Climate Change 723 (2018), https://gspp.berkeley.edu/assets/uploads/research/pdf/s41558-018-0222-x.pdf; Sarita Silveira et al., *Chronic Mental Health Sequelae of Climate Change Extremes: A Case Study of the Deadliest Californian Wildfire*, Int'l J. Env't Rsch. & Pub. Health, Feb. 4, 2021, https://www.mdpi.com/1660-4601/18/4/1487 (demonstrating that climate-related extreme weather events such as wildfires can have severe mental health impacts).

[53] HHS, *Climate and Health Outlook*, at 5.

[54] *See* Marco Turco et al., *Anthropogenic climate change impacts exacerbate summer forest fires in California* PNAS, June 12, 2023, https://www.pnas.org/doi/10.1073/pnas.2213815120; Ctr. for Climate & Energy Sol., *Drought and Climate Change*, https://www.c2es.org/content/drought-and-climate-change/ (last visited June 2, 2023). *See also* Nolte et al., at 521.

[55] Benjamin Hamlington et al., *Observation-based trajectory of future sea level for the coastal United States tracks near high-end model projections*, Commc'n Earth Env't, Oct. 6, 2022, https://www.nature.com/articles/s43247-022-00537-z.

[56] *See, e.g.*, Sameed Khatana et al., *Association of Extreme Heat With All-Cause Mortality in the Contiguous US, 2008-2017*, JAMA Network Open, May 19, 2022, at 1 https://jamanetwork.com/journals/jamanetworkopen/fullarticle/2792389 (finding extreme heat was associated with higher mortality in the U.S., particularly among older adults and black individuals); Adam Schlosser et al., *Assessing Compounding Risks Across Multiple Systems and Sectors: A Socio-Environmental Systems Risk-Triage Approach*, Frontiers in Climate, Apr. 24, 2023, at 09, https://www.frontiersin.org/articles/10.3389/fclim.2023.1100600/full (identifying hot spots where flood risks and water stress disproportionately impact low-income and nonwhite communities); Dahl ("[M]ore than 80% of the counties with the most frequent heat alerts—21 or more days of heat

The transportation sector has been responsible for an increasing percentage of GHG emissions in the U.S. since 2009, thereby playing an outsized role in intensifying the climate crisis. When EPA made its Endangerment Finding for GHGs, the transportation sector was responsible for 23% of total annual U.S. GHG emissions.[57] Since then, transportation sector GHG emissions have only increased as a share of U.S. emissions, surpassing the electric power sector as the largest U.S. source of GHG emissions and contributing 27.2% of total GHG emissions in 2020[58] and 28.5% in 2021.[59] After dipping in 2020 due to the COVID-19 pandemic, carbon dioxide (CO_2) emissions from the transportation sector increased by 11.5% between 2020 and 2021.[60] Transportation as an end use sector "account[ed] for 1,757.4 [million metric tons] CO_2 in 2021 or 37.9% of total CO_2 emissions from fossil fuel combustion."[61] Adopting stringent GHG emission standards for light- and medium-duty vehicles will lead to massive public health benefits by limiting these pollutants.[62]

The IPCC's most recent synthesis of its Sixth Assessment Report confirms the danger to public health and welfare posed by GHG emissions from the transportation sector. The report found that global surface temperature was around 1.1°C higher in 2011-2020 than it was in 1850-1900.[63] While average annual GHG emissions growth has slowed in certain sectors such as energy supply and industry, growth in GHG emissions from the transportation sector has remained relatively constant at about 2% per year.[64] The latest IPCC report warned that "[d]eep, rapid and sustained GHG emissions reductions, reaching net zero CO_2 emissions and including strong emissions reductions of other GHGs . . . are necessary to limit warming to 1.5°C . . . or less than 2°C . . . by the end of the century."[65] To have a chance at limiting global temperature increase to 1.5℃ and avoid the worst impacts of climate change, current GHG emissions from the transportation sector must drop by 59% by 2050 compared to 2020 emissions.[66]

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alerts over the course of the summer—have moderate to high levels of social vulnerability."). *See generally* EPA, *Climate Change and Social Vulnerability in the United States, A Focus on Six Impacts* (2021), https://www.epa.gov/system/files/documents/2021-09/climate-vulnerability_september-2021_508.pdf.

[57] 74 Fed. Reg. at 66499.

[58] EPA, *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2020*, EPA 430-R-22-003, at ES-21 (2022), https://www.epa.gov/system/files/documents/2022-04/us-ghg-inventory-2022-main-text.pdf.

[59] EPA, *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2021*, EPA 430-R-23-002, at 2-19, 2-28 (2023), https://www.epa.gov/system/files/documents/2023-04/US-GHG-Inventory-2023-Main-Text.pdf.

[60] *Id.* at 2-13.

[61] *Id.* at 2-17.

[62] *See generally* Am. Lung Ass'n, Driving to Clean Air: Health Benefits of Zero-Emission Cars and Electricity (June 2023), https://www.lung.org/getmedia/9e9947ea-d4a6-476c-9c78-cccf7d49ffe2/ala-driving-to-clean-air-report.pdf.

[63] Intergovernmental Panel on Climate Change (IPCC), *Synthesis Report of the IPCC Sixth Assessment Report (AR6): Longer Report*, at 6 (2023), https://report.ipcc.ch/ar6syr/pdf/IPCC_AR6_SYR_LongerReport.pdf.

[64] *Id.* at 10.

[65] *Id.* at 33.

[66] IPCC, *Climate Change 2022: Mitigation of Climate Change* 32 (2022), https://www.ipcc.ch/report/ar6/wg3/downloads/report/IPCC_AR6_WGIII_FullReport.pdf.

B. Emissions of criteria pollutants from light- and medium-duty vehicles harm the public health.

EPA's proposed reductions of non-methane organic gases ("NMOG") plus NOx, as well as particulate matter, are crucial to protecting the public from harmful air pollutants. As EPA notes, "[e]mission sources impacted by [its] proposal, including vehicles and power plants, emit pollutants that contribute to ambient concentrations of ozone, PM, NO2, SO2, CO, and air toxics."[67] These pollutants are linked to premature death, respiratory illness (including childhood asthma), cardiovascular problems, and other adverse health impacts. In particular, NOx emissions increase levels of ozone, because ground-level ozone forms when there are high concentrations of ambient NOx and VOCs, and when solar radiation is high.[68] NOx emissions also impact particulate matter by forming secondary particles through atmospheric chemical reactions.[69] Reductions in NOx emitted from LDVs will therefore result in reduced ambient levels of ozone and PM and improved health and environmental outcomes.

Air pollution has become so significant that the public health burdens attributable to air pollution are "now estimated to be on a par with other major global health risks such as unhealthy diet and tobacco smoking, and air pollution is now recognized as the single biggest environmental threat to human health."[70] Researchers at the University of Chicago studied the impact of air pollution on life expectancy and found that "the impact of particulate pollution on life expectancy is comparable to that of smoking, more than three times that of alcohol and unsafe water and sanitation, six times that of HIV/AIDS, and 89 times that of conflict and terrorism."[71]

There is consistent evidence showing the relationship between short-term exposure to PM and mortality, particularly cardiovascular and respiratory mortality. Short- and long-term exposure to $PM_{2.5}$ can cause harmful health impacts such as heart attacks, strokes, worsened asthma, and early death.[72] In addition, short-term PM exposure has been linked to increases in infant mortality, hospital admissions for cardiovascular disease, hospital admissions and emergency visits for chronic obstructive pulmonary disease, and severity of asthma attacks and

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[67] 88 Fed. Reg. at 29211.
[68] Am. Lung Ass'n, State of the Air 2023 Report (2023) at 26, https://www.lung.org/getmedia/338b0c3c-6bf8-480f-9e6e-b93868c6c476/SOTA-2023.pdf?ext=.pdf.
[69] DRIA at 7-10.
[70] World Health Organization (WHO), WHO Global Air Quality Guidelines (2021) at xiv, https://apps.who.int/iris/bitstream/handle/10665/345329/9789240034228-eng.pdf.
[71] Michael Greenstone, Christa Hasenkopf, & Ken Lee, Air Quality Life Index Annual Update, Energy Policy Institute at the University of Chicago (2022) at 6-7, https://aqli.epic.uchicago.edu/wp-content/uploads/2022/06/AQLI_2022_Report-Global.pdf/.
[72] *See* EPA, Supplement to the 2019 Integrated Science Assessment for Particulate Matter (Final Report, 2022), at ES-ii, 2-3, 2-4, https://cfpub.epa.gov/ncea/isa/recordisplay.cfm?deid=354490; EPA, Integrated Science Assessment (ISA) for Particulate Matter (Dec. 2019), https://cfpub.epa.gov/ncea/isa/recordisplay.cfm?deid=347534.

hospitalization for asthma in children. Year-round exposure to PM is associated with elevated risks of early death, primarily from cardiovascular and respiratory problems such as heart disease, stroke, influenza, and pneumonia.[73] These findings show the critical need for EPA to minimize the harmful emissions from the transportation sector. Doing so will only improve public health and the environment.

C. More stringent standards would bring greater benefits to environmental justice communities.

This rulemaking will provide benefits to environmental justice communities by reducing harm from climate change and pollution exposure. And Alternative 1, with a faster ramp rate after 2030, would bring even greater benefits to vulnerable populations that suffer the brunt of pollution and climate change harms. EPA appropriately recognizes that environmental justice communities are disproportionately affected by climate change and pollution impacts related to light- and medium-duty vehicles and upstream emissions. Addressing these harms by providing these communities relief more quickly—a priority for this Administration—is a compelling reason why EPA should adopt Alternative 1 with a faster ramp rate after 2030.

Given the vast history of disproportionate environmental and public health burdens placed on communities of color and low-income communities, EPA appropriately included consideration of environmental justice, energy justice, and equity in its Proposal.[74] Communities that are overburdened with pollution from sources such as major roadways, industrial sites, and agriculture are predominantly low-income, and a large percentage of residents of these communities are people of color and non-English speakers.[75] With the improvements described in this comment letter, this rulemaking could bring about significant air quality and health improvements in communities that are disproportionately burdened with air pollution from motor vehicles and overburdened from pollution more broadly.[76]

EPA should set strong emissions standards to meet its obligations under presidential directives on environmental justice. Under Executive Order 12,898, EPA "shall make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs,

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[73] Am. Lung Ass'n, State of the Air 2023 Report (2023) at 25, https://www.lung.org/getmedia/338b0c3c-6bf8-480f-9e6e-b93868c6c476/SOTA-2023.pdf?ext=.pdf.

[74] For more information on the history and definition of the environmental justice movement, see Initiative for Energy Justice, Section 1—Defining Energy Justice: Connections to Environmental Justice, Climate Justice, and the Just Transition (Dec. 23, 2019), https://iejusa.org/section-1-defining-energy-justice/.

[75] *See* Gina M. Solomon et al., Cumulative Environmental Impacts: Science and Policy to Protect Communities, 83 Annual Review of Public Health (Jan. 6, 2016), https://pubmed.ncbi.nlm.nih.gov/26735429/.

[76] *See* EPA, ISA for Particulate Matter at Ch. 12: Populations and Lifestages Potentially at Increased Risk of a Particulate Matter-Related Health Effect; Section 5: Sociodemographic Factors, https://www.epa.gov/isa/integrated-science-assessment-isa-particulate-matter.

policies, and activities on minority populations and low-income populations." 59 Fed. Reg. 7629 (Feb. 11, 1994). And Executive Order 14,008 directs EPA to develop "programs, policies, and activities to address the disproportionately high and adverse human health, environmental, climate-related and other cumulative impacts on disadvantaged communities, as well as the accompanying economic challenges of such impacts." 86 Fed. Reg. 7619, 7629 (Jan. 27, 2021). It also establishes the Administration's policy "to secure environmental justice and spur economic opportunity for disadvantaged communities that have been historically marginalized and overburdened by pollution." *Id*.

1. Reductions in greenhouse gas emissions will bring climate change benefits to environmental justice communities.

Reducing GHG emissions from light- and medium-duty vehicles will help reduce the significant harm that climate change inflicts on environmental justice communities. By 2055, the Proposed Standards would avoid 7,300 million metric tons (MMT) of CO_2 emissions, 88 Fed. Reg. at 29198, tbl. 3, and EPA's calculations show the Proposal would produce climate benefits of between $82 and $1,000 billion in 2020 dollars by 2055, depending on the values used for GHG emission reductions. *Id*. at 29200, tbl. 6 (using a 3% discount rate). As compared to the Proposed Standards, by 2055 Alternative 1 would achieve an additional 800 MMT of CO_2 savings, 88 Fed. Reg. at 29203, tbl. 14, and increase climate benefits by between $9 and $100 billion. *Id*. at 29205, tbl. 17. And adopting Alternative 1 with a faster ramp rate after 2030 would bring even more climate benefits to environmental justice communities. *See infra* Section V (detailing the societal benefits of more stringent standards).

These reductions are significant on a national and global scale because greenhouse gas emissions from light- and medium-duty vehicles are a consequential portion of both national and international GHG emissions. Emissions from the transportation sector are the largest source (29%) of GHGs in the country, and light- and medium-duty vehicles are the largest portion of that.[77] The United States is responsible for a large portion of global CO_2 emissions—approximately 14% as of 2019—and is the second largest emitter in the world.[78] Reducing GHG emissions from light- and medium- duty vehicles is therefore one of the most consequential steps EPA—or the United States—can take to mitigate climate change harm. And, as the Supreme Court found in *Massachusetts v. EPA*, "[a] reduction in domestic emissions would slow the pace of global emissions increases, no matter what happens elsewhere." 549 U.S. 497, 500 (2007).

[77] EPA, Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2021, EPA 430-R-23-002, at 2-35 (Apr. 2023). https://www.epa.gov/system/files/documents/2023-04/US-GHG-Inventory-2023-Main-Text.pdf.
[78] UCS, Each Country's Share of CO_2 Emissions (updated Jan. 14, 2022), at https://www.ucsusa.org/resources/each-countrys-share-co2-emissions.

Reducing climate harm will benefit environmental justice communities because, as EPA has aptly described, climate change disproportionately affects these communities. 88 Fed. Reg. at 29393-95. EPA recognized in the 2009 Endangerment Finding that vulnerable populations, including economically and socially disadvantaged communities and Indigenous or minority populations, are especially vulnerable to climate change. *Id.* at 29393. Reports from the U.S. and international climate bodies over the last decade add evidence to the conclusion that climate change disproportionately impacts environmental justice communities, including by "altering exposures to heat waves, floods, droughts, and other extreme events; vector-, food- and waterborne infectious diseases; changes in the quality and safety of air, food, and water; and stresses to mental health and well-being." *Id.* at 29394. Notably, the 2016 scientific assessment on the Impacts of Climate Change on Human Health predicts that people of color will suffer a disproportionate impact of climate exacerbations of air pollution. *Id.* at 29395. It also describes unique vulnerabilities of Native American communities because of expected impacts to their cultural resources, customs, and traditional subsistence lifestyles, including expected declines in food security for Alaskan Indigenous Peoples. *Id.*

Though EPA has included a significant number of publications in its literature review, it should also include its 2021 analysis of the disproportionate climate impacts on vulnerable populations. The study quantifies the increased risks of climate change on socially vulnerable populations in six categories: Air Quality and Health; Extreme Temperature and Health; Extreme Temperature and Labor; Coastal Flooding and Traffic; Coastal Flooding and Property; and Inland Flooding and Property, using data on where people live as an indicator of exposure.[79] The report concludes that Black and African American individuals will likely face higher impacts of climate change for all six impacts analyzed compared to all other demographic groups. Black and African Americans are 40% more likely to live in communities with the highest increase in premature mortality from extreme temperatures, and 34% are more likely to live in areas with the highest increases in $PM_{2.5}$ childhood asthma diagnoses with 2°C (3.6°F) of global warming.[80] Hispanic and Latinos are also significantly more likely to live in areas where impacts are projected to be highest.[81] Low-income individuals and those without a high school diploma have 25-26% greater risk of living in areas with the highest extreme temperature labor hours lost.[82]

And as we witness time and again with each unfolding disaster, vulnerable populations suffer the most from climate change-fueled extreme events. Taking recent events in this country as illustrative examples, economically disadvantaged individuals, low-wage outdoor workers,

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79 EPA, Climate Change and Social Vulnerability in the United States: A Focus on Six Impacts, EPA 430-R-21-003 (2021) at 9 (Six Impacts), https://www.epa.gov/system/files/documents/2021-09/climate-vulnerability_september-2021_508.pdf.
80 *Id.* at 79.
81 *Id.* at 76.
82 *Id.* at 77.

and homeless and elderly people died from heat stroke in the Northwest heat wave in 2021,[83] an event that researchers found would have been "virtually impossible without human-caused climate change."[84] In New Orleans, the people who could not evacuate before disastrous Hurricanes Katrina and Ida struck land are those who did not have the means or ability to do so.[85] In New York City, many people who could only afford to live in illegal basement apartments died as a result of flooding during Ida.[86] During western wildfire season, those without homes or means do not have the luxury of filtered air to protect their lungs.[87] To help address the urgency of the climate crisis and its impacts on vulnerable populations, EPA must adopt the more stringent Alternative 1 with a faster ramp rate after 2030.

2. Reductions in criteria pollution emissions will bring health benefits to environmental justice communities.

This rulemaking presents a critical opportunity to mitigate the adverse health impacts plaguing communities that are overburdened by air pollution from motor vehicles and other sources. According to the American Lung Association's (ALA) 2023 State of the Air report, which grades counties on daily and long-term measures of particle pollution and daily measures of ozone, more than 119 million Americans live in places that received failing grades for unhealthy levels of ozone or PM in their air.[88] The report notes:

> Although people of color are 41% of the overall population of the U.S., they are 54% of the nearly 120 million people living in counties with at least one failing grade. And in the counties with the worst air quality that get failing grades for all three pollution measures,

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[83] *E.g.*, Irfan, U., Extreme heat is killing American workers, Vox (Jul. 21, 2021), https://www.vox.com/22560815/heat-wave-worker-extreme-climate-change-osha-workplace-farm-restaurant.; Geranios, N.K., Pacific Northwest strengthens heat protections for workers (Jul. 9, 2021), https://apnews.com/article/business-science-health-environment-and-nature-washington-c463fc55ab6b601cf70b2fd73644f973; Peterson, D., New data shows scope of heatwave-related homeless deaths, (Jul. 23, 2021), https://www.koin.com/news/special-reports/new-data-shows-scope-of-heatwave-related-homeless-deaths/; Bella, T., Historic heat wave in Pacific Northwest has killed hundreds in U.S. and Canada over the past week (Jul. 1, 2021), https://www.washingtonpost.com/nation/2021/07/01/heat-wave-deaths-pacific-northwest/

[84] World Weather Attribution, Western North American extreme heat virtually impossible without human-caused climate change (Jul. 7, 2021), https://www.worldweatherattribution.org/western-north-american-extreme-heat-virtually-impossible-without-human-caused-climate-change/.

[85] *E.g.,* Willingham, L., "We can't afford to leave": No cash or gas to flee from Ida, (Aug. 29, 2021), https://www.denverpost.com/2021/08/29/hurricane-ida-no-money-evacuate/*see also* Wade, L., Who Didn't Evacuate for Hurricane Katrina?, Pacific Standard (Aug, 31, 2015), *at* https://psmag.com/environment/who-didnt-evacuate-for-hurricane-katrina.

[86] Haag M. & J.E. Bromwich, Most of the apartments where New Yorkers drowned were illegal residences, New York Times (Sept. 3, 2021), https://www.nytimes.com/live/2021/09/03/nyregion/nyc-flooding-ida#nyc-illegal-basement-apartment-ida.

[87] *E.g.,* Kardas-Nelson, M., Racial and Economic Divides Extend to Wildfire Smoke, Too, (Sept. 21, 2020), *at* https://www.invw.org/2020/09/21/racial-and-economic-divides-extend-to-wildfire-smoke-too/.

[88] Am. Lung Ass'n, State of the Air 2023 Report (2023) at 12, https://www.lung.org/getmedia/338b0c3c-6bf8-480f-9e6e-b93868c6c476/SOTA-2023.pdf?ext=.pdf.

72% of the 18 million residents affected are people of color, compared to the 28% who are white.[89]

In addition to the disproportionate impact on people of color noted above, ALA outlines other "high-risk" groups that are impacted by the pollution in these regions. For example, low-income communities are particularly vulnerable and at risk of health impacts from pollution. More than 14.6 million people whose incomes meet the federal definition for living in poverty reside in counties that received a failing grade on at least one of the ALA's pollutant indicators, while nearly 2.6 million people living in poverty reside in counties that received failing grades on all three pollutant measures.[90] In addition, around 27 million children (under age 18) and 18 million older adults (age 65 or older) live in counties that received a failing grade on at least one pollutant.[91]

In fact, it is well established that communities of color and economically disadvantaged communities are disproportionately exposed to environmental burdens from a variety of sources. The White House Council on Environmental Quality (CEQ) released (and recently updated) a Climate and Economic Justice Screening Tool, which identifies communities around the country that are "marginalized, underserved, and overburdened by pollution"[92] and would therefore qualify for Justice40[93] investments (President Biden's key environmental justice initiative). The Screening Tool identifies census tracts as "disadvantaged" if they are above the threshold for one or more environmental or climate indicators (e.g., exposure to diesel PM or $PM_{2.5}$, traffic proximity and volume, or proximity to hazardous waste sites) and above the threshold for socioeconomic indicators related to income and education.[94] A recent analysis found that 64% of the population in census tracts the Screening Tool identifies as disadvantaged are Hispanic/Latino, Black or African American, or American Indian or Alaskan Native.[95] Overall, 50% of Hispanic/Latino, Black or African American, and American Indian or Alaskan Native

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[89] *Id.*
[90] *Id.* at 20.
[91] *Id.*
[92] The White House, Biden-Harris Administration Launches Version 1.0 of Climate and Economic Justice Screening Tool, Key Step in Implementing President Biden's Justice40 Initiative (Nov. 22, 2022) https://www.whitehouse.gov/ceq/news-updates/2022/11/22/biden-harris-administration-launches-version-1-0-of-climate-and-economic-justice-screening-tool-key-step-in-implementing-president-bidens-justice40-initiative/. *See* CEQ, Preliminary Climate and Economic Justice Screening Tool, https://screeningtool.geoplatform.gov/en/#3/33.47/-97.5.
[93] The White House, *The Path to Achieving Justice40* (July 20, 2021), https://www.whitehouse.gov/omb/briefing-room/2021/07/20/the-path-to-achieving-justice40/.
[94] CEQ, *Climate and Economic Justice Screening Tool: Technical Support Document*, (Nov. 2022) at 4–8, https://static-data-screeningtool.geoplatform.gov/data-versions/1.0/data/score/downloadable/1.0-cejst-technical-support-document.pdf.
[95] Emma Rutkowski et al., Justice40 Initiative: Mapping Race and Ethnicity, Rhodium Group (Feb. 24, 2022), https://rhg.com/research/justice40-initiative-mapping-race-and-ethnicity/.

individuals in the country reside in disadvantaged communities, compared to just 17% of White, Non-Hispanic/Latino individuals.[96]

3. Significant decreases in vehicle and upstream non-GHG emissions over time will provide benefits to environmental justice communities.

In addition to securing GHG reductions, the Proposal will reduce non-GHG tailpipe emissions over time as well as upstream emissions from refineries, both of which will benefit environmental justice communities. 88 Fed. Reg. at 29393. Compared to the Proposal, Alternative 1 provides greater reductions in criteria pollutants and air toxics. *Compare id*. at 29198–99, tbls. 4 and 5, *with id*. at 29204–05, tbls. 15-16. EPA should adopt Alternative 1 with a faster ramp rate after 2030 to bring more relief more quickly to environmental justice communities.

Notably, the immediate benefits more stringent standards would provide from reductions over time in tailpipe and upstream refining emissions vastly outweigh any potentially small non-GHG emissions increases from upstream electric generation. By one measure, reducing refinery emissions may be more beneficial to environmental justice communities as a whole than reducing emissions from electric generation. EPA has concluded that refineries have far higher health benefits per ton of emission reductions than do electric generating units, due in part to greater proximity to populations.[97]

EPA correctly concludes that environmental justice communities are disproportionately harmed by the non-GHG criteria and air toxics emissions associated with vehicles and upstream sources, and therefore these communities will especially benefit from reduced tailpipe emissions. 88 Fed. Reg. at 29395–97. After conducting a literature review and its own analysis, EPA recognizes that higher percentages of communities of color and low-income communities live or attend school near major roadways, suffering the largest share of their emissions and associated adverse health impacts. *Id.* EPA also recognizes that higher percentages of communities of color and low-income communities live near electric generating units and refineries. *Id*. at 29397. EPA should, however, strengthen its statement that "[a]nalysis of populations near refineries also indicates there *may* be potential disparities in pollution-related health risk from that source." *Id*. (emphasis added). The study of socioeconomic factors near refineries cited by EPA itself concludes that "[m]inority and African American percentages are approximately twice as high as

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[96] *Id*.

[97] EPA, Office of Air and Radiation, Office of Air Quality Planning and Standards, Technical Support Document, Estimating the Benefit per Ton of Reducing PM2.5 Precursors from 17 Sectors, at 6, 16 (Feb. 2018), available at https://www.epa.gov/sites/production/files/2018-02/documents/sourceapportionmentbpttsd_2018.pdf (valuing electricity-generation-unit emissions of particulate matter in 2020 at $150,000–350,000 per ton and corresponding refinery emissions at $360,000–830,000 per ton).

national percentages" for cancer risk as a result of petroleum refinery emissions.[98] That study alone is enough evidence to warrant a conclusion that such populations *do* experience disparities in health risk. For further evidence, please see NGO coalition comments on the Proposed SAFE Vehicles Rule for Model Years 2021-2026.[99] Additionally, EPA should recognize here, as it did in its Proposed Rule for MY 2023-2026 Passenger Cars and Light Trucks, that "most anthropogenic sources of PM2.5, including industrial sources, and light- and heavy-duty vehicle sources, disproportionately affect people of color."[100] Finalizing strong standards will help mitigate these harms.

IV. EPA's Own Analysis Shows that Additional Stringency Is Feasible and Would Produce Greater Societal Benefits.

While we support the Proposed Standards, EPA must go further—specifically, by adopting Alternative 1 with a steeper increase in stringency after 2030 to ensure the country is on track to reach 100% new ZEV sales by 2035. As detailed throughout this comment letter, such standards are feasible and offer significantly more air pollution reductions, consumer savings, and societal benefits. And as EPA itself acknowledges, adopting less stringent standards where more stringent ones are achievable "would forgo feasible emissions reductions that would improve the protection of public health and welfare." 88 Fed. Reg. at 29201. In this section, we explain how EPA's own data show that final standards more stringent than the Proposed Standards are warranted. In the sections that follow, we detail the feasibility and superiority of Alternative 1 with a steeper increase in stringency after 2030.

Looking just at EPA's analysis (which did not analyze the costs and benefits of any standards more stringent than Alternative 1), standards more stringent than the Proposed Standards are feasible and would produce greater societal benefits. While average incremental vehicle costs increase under Alternative 1, those costs are recouped by the vehicle purchaser through reduced fueling, maintenance, and repair costs. And as EPA notes, "consumer savings would be … somewhat higher under Alternative 1" than under the Proposed Standards. *Id*. at 29203. The annualized vehicle technology costs through 2055 are $15 billion under the Proposed Standards and $17 billion under Alternative 1, using a 3% discount rate, or a difference of $2 billion. *Id*. at 29364-65, tbl. 160. But the annualized pretax fuel savings under Alternative 1 are

[98] EPA, Risk and Technology Review—Analysis of Socio-Economic Factors for Populations Living Near Petroleum Refineries. Office of Air Quality Planning and Standards, Research Triangle Park, North Carolina at 6 (Jan. 2014).
[99] *See* NGO comment, Dkts. NHTSA-2018-0067, EPA-HQ-OAR-2018-0283, at 232-34, *available at* https://downloads.regulations.gov/EPA-HQ-OAR-2018-0283-5070/attachment_2.pdf. *See also* EIP, Monitoring for Benzene at Refinery Fencelines, 10 Oil Refineries Across U.S. Emitted Cancer-Causing Benzene Above EPA Action Level (Feb. 6, 2020), https://www.environmentalintegrity.org/wp-content/uploads/2020/02/Benzene-Report-2.6.20.pdf.
[100] 86 Fed. Reg. 43726, 43802 n. 213 (citing C.W. Tessum, D.A. Paolella, S.E. Chambliss, J.S. Apte, J.D. Hill, J.D. Marshall, PM2.5 polluters disproportionately and systemically affect people of color in the United States. Sci. Adv. 7, eabf4491 (2021)).

$5 billion higher than those under the Proposed Standards, at $51 billion under Alternative 1 and $46 billion under the Proposed Standards, also using a 3% discount rate. *Id*. at 19366, tbl. 164. Similarly, consumers' maintenance and repair costs are further decreased under Alternative 1—from an annualized value of $29.9 billion in savings under the Proposed Standards to $33.3 billion in savings under Alternative 1, both at a 3% discount rate.[101]

Alternative 1 also provides greater pollution reductions and societal benefits than the Proposed Standards. Under EPA's modeling, Alternative 1 would avoid 8,100 million metric tons (MMT) of CO_2 emissions through 2055 relative to the No Action scenario, *id*. at 29203, tbl. 14, in contrast to the 7,300 MMT avoided under the Proposed Standards, *id*. at 29198, tbl. 3. Alternative 1 also provides greater reductions in criteria pollutants and air toxics. *Compare id*. at 29198-99, tbls. 4 and 5, to *id*. at 29203-05, tbls. 13-16. In addition, Alternative 1 has greater societal net benefits: ranging from $1,500-2,500 billion through 2055, *id*. at 29205-06, tbl. 17 (3% discount rate), depending on the values used for the GHG emission reductions, versus a range of $1,400-2,300 billion under the Proposed Standards. *Id*. at 29200, tbl. 6.

EPA's analysis shows that Alternative 1 is also feasible. It relies on the same existing technology—vehicle electrification—at the core of the Proposed Standards, and the share of battery-electric vehicles (BEVs) in the new vehicle fleet projected by EPA under Alternative 1 is very similar to those under the Proposed Standards, with the share under Alternative 1 never exceeding those under the Proposed Standards by more than 3 percentage points through 2032. *Id*. at 29333, tbl. 99 (BEV penetration of 60% under the Proposed Standards in 2030, versus 63% under Alternative 1). While we are recommending that EPA finalize a modified version of Alternative 1 (which would yield higher levels of BEV penetration, as detailed in Section V below), EPA's analysis at least shows that BEV levels associated with Alternative 1 are eminently feasible.

According to the Alliance for Automotive Innovation, in the first quarter of 2023, there were 55 BEV models and 40 Plug-in Hybrid (PHEV) models available in the United States, representing a variety of vehicle types, including sedans, crossovers, SUVs, and light-duty trucks.[102] The technology is only improving, and the number of models of plug-in electric vehicles (PEVs, which include both BEVs and PHEVs) available in the U.S. is projected to reach 197 by the end of 2025.[103] Higher levels of PEV adoption are already driven by strong consumer

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[101] *See* 88 Fed. Reg. at 29385-86, tbls. 196 and 197, adding $21 billion in avoided maintenance costs and $8.9 billion in avoided repair costs under the Proposed Standards, and the analogous values of $24 billion and $9.3 billion, respectively, under Alternative 1.

[102] Alliance for Automotive Innovation, *Get Connected: Electric Vehicle Quarterly Report, First Quarter, 2023* (2023), https://www.autosinnovate.org/posts/papers-reports/Get%20Connected%20EV%20Quarterly%20Report%202023%20Q1.pdf

[103] Rachel MacIntosh et al., *Electric Vehicle Market Update*, Environmental Defense Fund and ERM 7 (April 2023), https://www.edf.org/sites/default/files/2023-05/Electric%20Vehicle%20Market%20Update%20April%202023.pdf; *see also* Jeff S. Bartlett & Ben Preston, *Automakers are Adding Electric Vehicles to Their Lineups. Here's What's*

demand and greater model choice. And as is discussed throughout these comments, the charging infrastructure, electric grid, and vehicle supply chain will be able to accommodate the projected levels of BEVs—indeed, sending a strong regulatory signal will facilitate that process. Moreover, given the flexibility in EPA's program, as well as the fact that EPA's modeling did not include any PHEVs or improvements to combustion vehicle greenhouse gas emissions (and in fact projects increasing GHG emissions from the combustion vehicle fleet, as discussed in Section VI.A), it is likely that the levels of BEVs would be lower in the real-world than EPA projected as automakers employ such technologies to comply with the final standards. That is because making even minor improvements in combustion vehicle GHG emissions—or even simply holding the average emissions of the combustion vehicle fleet constant—or manufacturing PHEVs will allow automakers to achieve compliance with relatively fewer levels of ZEVs than EPA projected.

V. Outside Analysis Demonstrates the Significant Benefits of Stronger Emission Standards, Particularly Alternative 1 with a Steeper Increase in Stringency After 2030.

Outside analysis also shows the benefits of adopting final standards stronger than EPA proposed. Environmental Resources Management, Inc (ERM), one of the largest sustainability consultancies globally, was commissioned by NRDC to provide an independent, third-party analysis of EPA's proposed standards and alternative proposals, as well as a recommended approach. ERM's methodology, assumptions, and results are described throughout this section, and the ERM report is attached to this comment letter.[104] ERM's analysis shows that Alternative 1 with a steeper increase in stringency after 2030 would produce significant societal benefits.

ERM's analysis employed a modeling framework that leveraged EPA's tools to inform and develop inputs to ERM's Benefit-Cost Analysis (BCA) framework. It is important to note that while this analysis is based on EPA's "baseline" scenario, we believe this "baseline" is ultimately not an accurate reflection of a "No Action" scenario, as it is overly conservative. We explore this further in Section XV, but ultimately the most relevant of the analyses that EPA considered supports baseline ZEV sales greater than the baseline levels projected in the "*EPA No Action*" scenario.

Where possible, ERM mirrored EPA's methodology to keep its analytical approach and resultant comparisons consistent with EPA's approach in the Proposal, and to allow for an apples-to-apples comparison.

Coming, Consumer Reports (Jan. 6, 2023), https://www.consumerreports.org/hybrids-evs/why-electric-cars-may-soon-flood-the-us-market-a9006292675/.

[104] Dave Seamonds, et al., ERM, *Impacts of EPA Light-& Medium-Duty Multi-Pollutant Standards: National Scenario Results*, June 2023 [hereinafter ERM, *Impacts Report*] (attached to this comment letter).

A. Policy Scenarios

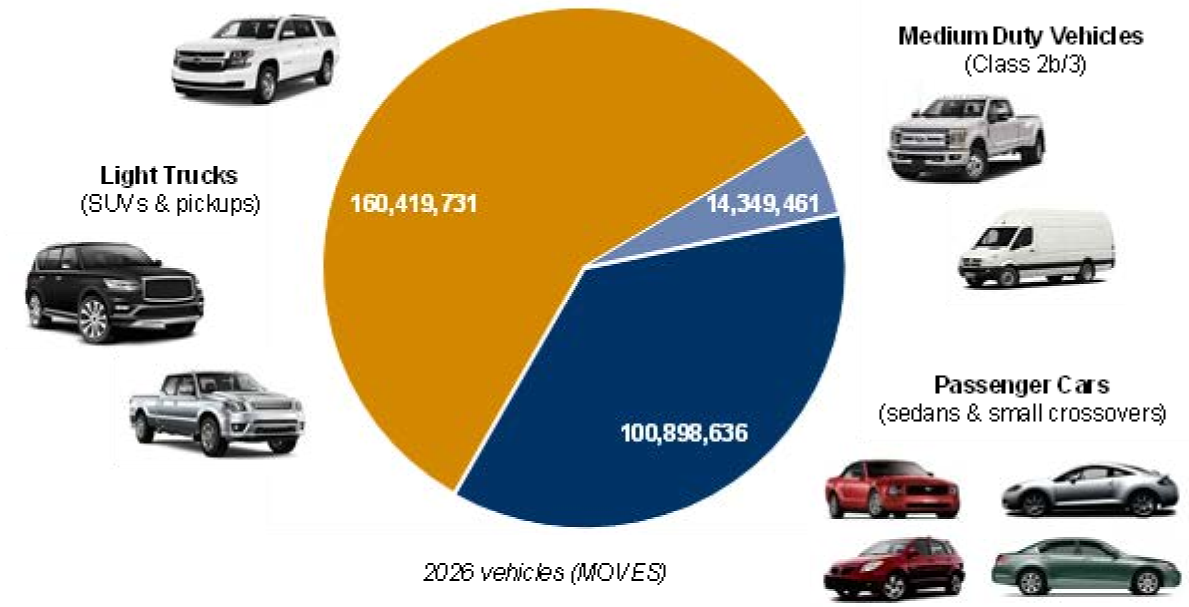
ERM investigated five different policy scenarios: EPA's no action "baseline" ("*EPA No Action*"); EPA's preferred approach ("*EPA Main Proposal*"); our recommended approach, which reflects greater increases in stringency after model year 2030 ("*Alternative 1+*"); EPA's strongest option ("*EPA Alternative 1*"); and EPA's weakest option ("*EPA Alternative 3*").

B. Modeling Background

EPA's updated MOVES model (MOVES3.R3[105]) was utilized to model electric vehicle (EV) adoption rates (sales and in-use), vehicle miles traveled (VMT), and pollutant emissions by vehicle type. Cost assumptions (battery costs, incremental vehicle costs, charging equipment costs, etc.) and vehicle classification/identification information and sales shares were incorporated into both ERM's BCA framework and its modification and application of MOVES3.R3 data outputs. ERM's BCA framework was applied to compare and evaluate the impacts across several policy scenarios as compared to the *EPA No Action* case.

[105] Although MOVES3.R1 was used for L/MD rulemaking, MOVES3.R3 reflects an updated version of MOVES3.R1 but maintains relevant L/MDV data and assumptions.

Figure V.B-1: National Light- and Medium-Duty Vehicle Fleet[106]



This pie chart is based on EPA's modified version of MOVES. EPA projects that the majority of vehicles subject to the rule will be SUVs and light trucks (~160 million), followed by passenger cars (i.e., sedans), which are projected to number just over 100 million vehicles. The remainder is made up of Class 2b (chassis-certified only) and Class 3 medium-duty vehicles, projected to number around 14 million vehicles nationwide; note that "incomplete" class 2b/3 vehicles covered by the proposed Phase 3 heavy-duty rulemaking were not included in this analysis.

ERM utilized EPA's CO-Benefits Risk Assessment (COBRA) Health Impacts Screening and Mapping Tool to assess the public health benefits of the scenarios.

ERM conducted five interconnected analyses as part of this BCA:

- **Fuel Use and Emissions**: Specifically, ERM assessed changes in fuel consumption (for diesel, gasoline, and electricity) and the tailpipe and upstream emissions associated with each fuel change for GHGs (CO_2, CH_4, N_2O) and criteria pollutants (NOx and PM) for the various policy scenarios. Reductions in emissions are then monetized using EPA's COBRA model and EPA's Social Cost of GHGs.[107] Because EPA's analysis (which this is intended to mirror) neither reflects any policies to clean up the grid nor a future grid consistent with the administration's climate goals, this likely understates disparities between scenarios with differing electric car/light-truck deployment.

[106] ERM, *Impacts Report* at 6.
[107] ERM utilized the interim social cost of GHG values presented by EPA in DRIA Tables 10-13, 10-14, and 10-15 (3 percent discount rate). Costs were escalated to 2021$ to be consistent with other costs in the ERM model.

- **Health Impacts**: This analysis assumes reductions in NOx and PM under the various policy scenarios to understand the resulting public health implications associated with reducing these emissions and calculates changes in premature deaths, hospital visits, and lost workdays. The analysis also monetizes these net health benefits. As above, these impacts are inherently understated in an effort to mirror EPA's work.

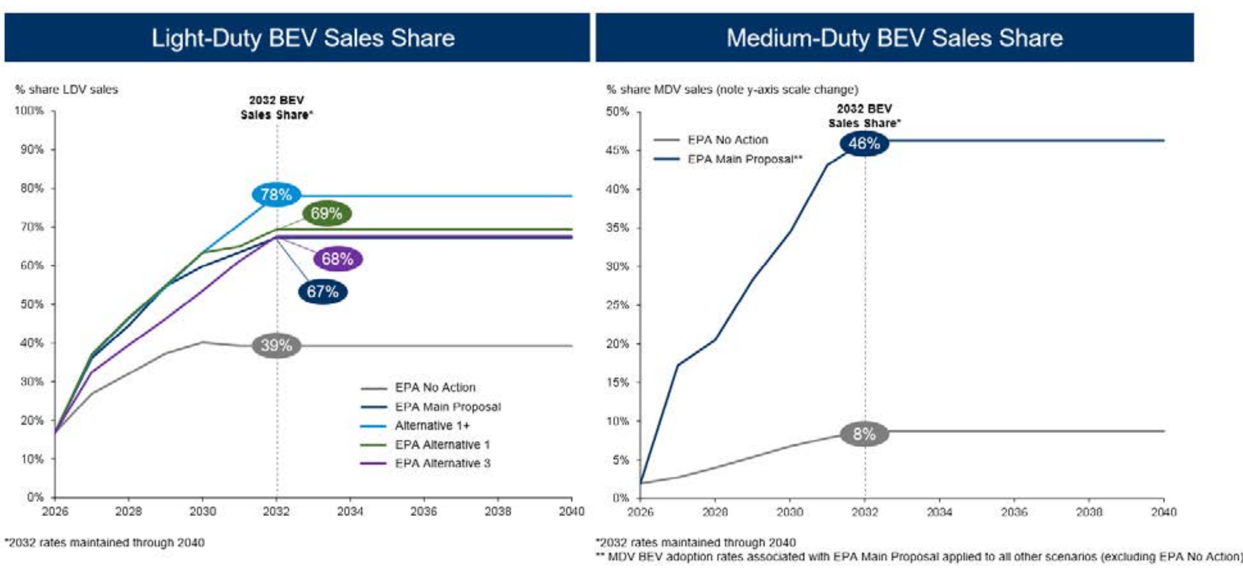
- **Economic Analysis**: ERM assessed changes in consumer purchasing behaviors and vehicle costs, fuel costs, and maintenance practices, and how these factors could change in a more electrified fleet. This analysis also examines capital expenditures for charging infrastructure investments (i.e., purchase, installation, and maintenance).

- **Utility Impacts Analysis**: ERM assessed impacts on utilities and their customers, including an analysis of electricity used to charge vehicles and the incremental load to the grid. The analysis also calculates utility net revenue (revenue minus costs) and potential reduction in electric bills for all utility customers that results from this net revenue. The gap analysis shows the infrastructure needs and associated costs under the different policy scenarios.

C. *Alternative 1+* Results in the Highest BEV Sales Share of All Scenarios

Alternative 1+ results in the highest BEV sales share of all scenarios at 78% by 2032, which helps spur higher in-use BEV share by 2040 (as depicted in Figure V.C-1). The BEV sales share for *Alternative 1+* is almost 10 percentage points more than what is projected to occur under *EPA Alternative 1* and 13 percentage points more than what is projected to occur under the *EPA Main Proposal* and *EPA Alternative 3* policy scenarios.

Figure V.C-1: Comparison of BEV Adoption Rate Scenarios: Sales Share[108]



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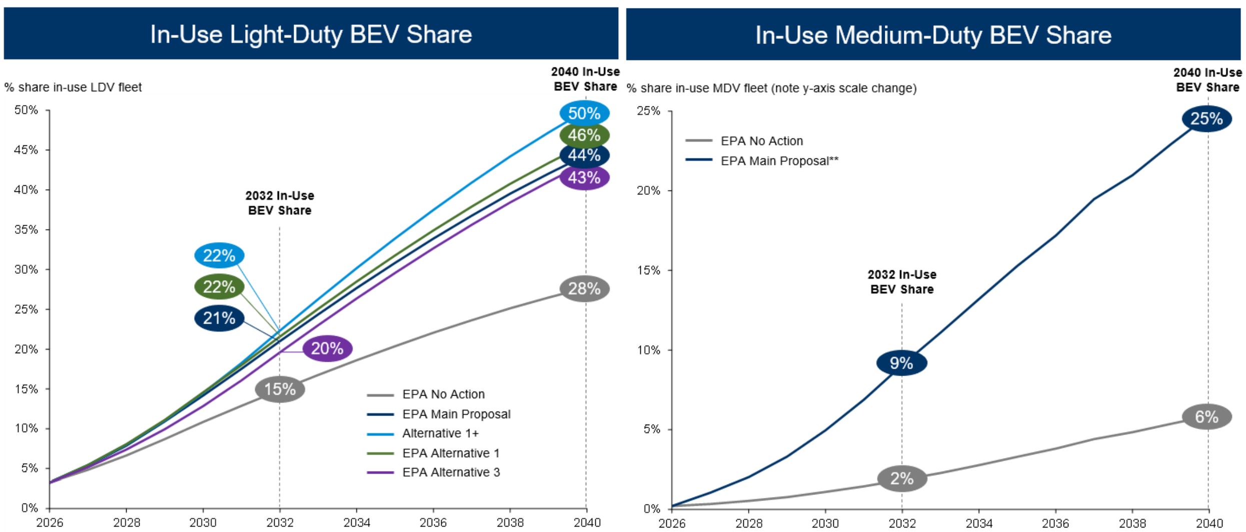
[108] ERM, *Impacts Report* at 7-8.

Based on Sales Share (shown in the left side graph), in-use ZEVs will continue to increase under the Alternative 1+ scenario such that the 2040 in-use share is incrementally higher than all other scenarios analyzed.

D. *Alternative 1+* Achieves the Largest Share of In-Use BEVs of All Scenarios

The graphs in Figure V.D-1 show projected shares of in-use vehicles through 2040. As shown, a policy approach implementing our recommended *Alternative 1+* provides the highest in-use ZEV percentages of any scenario analyzed. Under this policy scenario, 50% of the light- and medium-duty (L/MD) vehicles on the road are expected to be BEVs by 2040.

Figure V.D-1: Comparison of BEV Adoption Rate Scenarios: In-Use Share[109]



E. *Alternative 1+* Results in Greater Emissions Reductions and Public Health Impacts than EPA's Preferred Approach

The ERM modeling results regarding GHG tailpipe and upstream emissions, shown below in Figure V.E-1, show the emissions reductions possible by taking an *Alternative 1+* approach from 2026-2040, as well as the cumulative reductions from the other policy scenarios and the monetized value of these reductions (shown in Table V.E-1). These benefits are compared to *EPA's No Action* scenario, which is quite conservative in its projections for what market conditions are expected to be in a no action scenario.

A final rule aligned with our recommended approach would be expected to achieve more than a 52% reduction in emissions of CO_2 by 2040 compared to 2026 and result in almost $148 billion in climate benefits by 2040 – approximately $35 billion more than would be possible from an *EPA Main Proposal* approach during the same timeframe. Accordingly, EPA's failure to

109 *Id.* at 7-8.

finalize a rule that aligns with our recommended approach would unnecessarily leave significant climate benefits on the table.

Figure V.E-1: Comparison of Projected Climate Benefits[110]

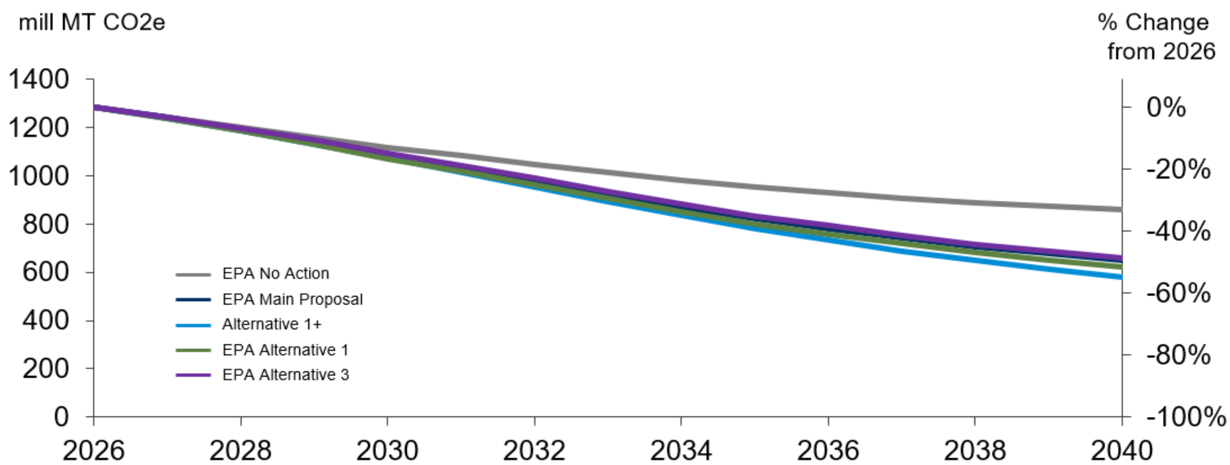


Table V.E-1: Projected Cumulative Reduction and Monetized Value (per policy scenario)[111]

Policy Scenario	Cumulative Reduction (million MT CO2e)		Monetized Value (2021$ bill)	
	2026 - 2032	2026 - 2040	2026 - 2032	2026 - 2040
EPA Main Proposal	211.3	1,544.5	$14.2	$113.1
Alternative 1+	268.6	2,018.1	$18.0	$147.8
EPA Alternative 1	275.3	1,793.2	$18.3	$130.8
EPA Alternative 3	143.6	1,373.2	$9.7	$101.1

COMPARED TO EPA's BASELINE

ERM analysis used EPA's identified Social Cost of Carbon as the basis for monetized social benefits. This analysis also used a 3% average discount rate and escalated the monetary values to 2021 levels to be consistent with other costs contained within the benefit cost model.

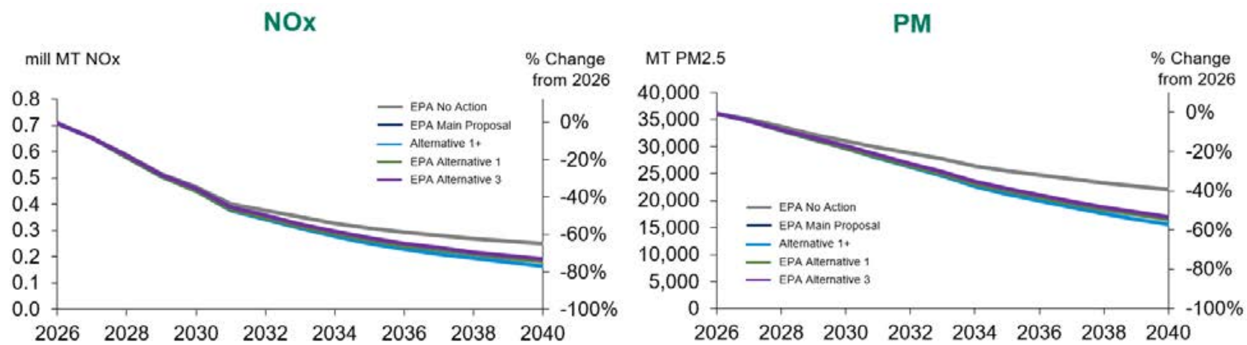
F. Comparison of Criteria Emissions and Possible Health Benefits

For this part of the analysis, ERM utilized EPA's COBRA model to estimate the public health benefits associated with all the policy scenarios. ERM's analysis shows that stricter standards and increased deployment of clean L/MD vehicles results in greater gains in terms of consumer savings and avoided public health impacts (such as premature death, hospital admissions and emergency room visits, respiratory symptoms, and reduced activity and lost

[110] *Id.* at 11.
[111] *Id.*

workdays). The policy scenario reflective of our *Alternative 1+* recommended approach achieves the most reductions: nearly an 80% reduction in NOx and a 60% reduction in PM in 2040 compared to 2026 levels. An *Alternative 1+* approach is also projected to achieve almost $42 billion in monetized value of reductions: nearly $8.5 billion more in monetized value than would occur under *EPA's Main Proposal* and preferred approach (as shown in Figure V.F-1).

Figure V.F-1: Comparison of Possible Health Benefits[112]



ERM's analysis incorporates: EPA's assumed changes in tailpipe emission reductions, EPA's upstream assumptions that rely upon the Integrated Planning Model (IPM) for electricity generated units, and ERM assumptions on changes from reduced demand on refining of finished products for diesel (and gasoline) based on the use of Argonne National Laboratory's Greenhouse Gases, Regulated Emissions, and Energy Use in Technologies (GREET) model.

The benefits associated with the *Alternative 1+* approach are further depicted in Table V.F-1, which shows the various scenario criteria emissions (NOx and PM) aggregated from 2026-2040 for each of the policy scenarios, as well as possible reduced health incidents, and the monetized value of these reductions (if realized) compared to *EPA's No Action* scenario.[113]

[112] *Id.* at 12.

[113] ERM's analysis results in slightly lower cumulative reductions of NOx and PM compared with EPA's net air pollutant impacts for the *EPA Main Proposal*, *Alternative 1*, and *Alternative 3* policy scenarios (Tables 9-37, 9-38 and 9-40 of the DRIA). However, despite the difference, *Alternative 1+* would correspond with approximately a 25% increase in benefits relative to the *EPA Main Proposal* and a similar increase would be expected under EPA's methodology.

Table V.F-1: Comparison of Possible Health Benefits[114]

Policy Scenario	2026 - 2040 Cumulative Reduction (MT)		Cumulative Reduced Incidents			2026 – 2040 Monetized Value (2021$ bill)
	NOx	PM	Mortality	Hospital	Minor	
EPA Main Proposal	648,558	47,320	2,909	2,729	1.7 million	$33.6
Alternative 1+	808,052	55,241	3,427	3,213	2.1 million	$42.0
EPA Alternative 1	696,420	49,687	3,058	2,868	1.8 million	$37.4
EPA Alternative 3	585,618	44,464	2,712	2,545	1.6 million	$33.2

COMPARED TO EPA's BASELINE

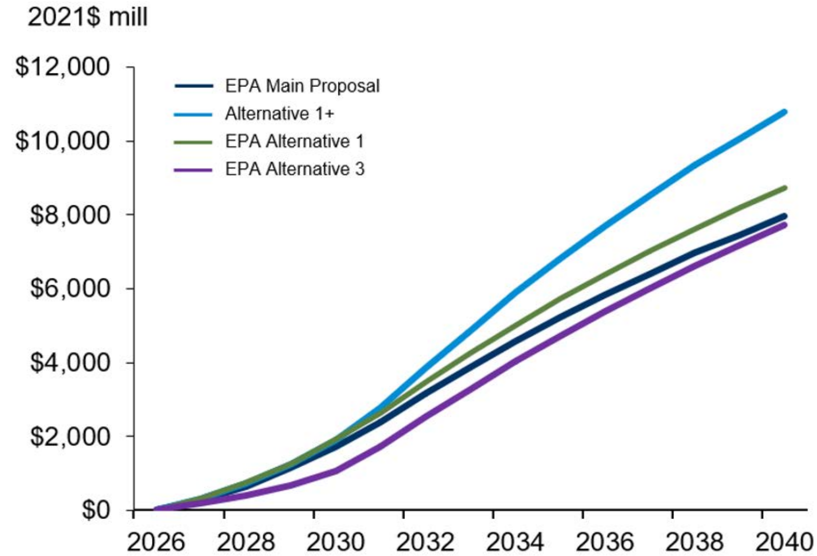
G. Comparison of Utility Impacts

ERM's results also point to the potential for net revenue (revenue in excess of the costs of serving PEV load) from PEV charging to reduce utility bills for all customers (see Figure V. G-1). Since most PEV charging can be accomplished when there is spare capacity on the grid, charging can spread the costs of maintaining the system over a greater volume of electricity sales, reducing the per-kilowatt-hour price of electricity to the benefit of all customers. Public utility regulations require additional revenues in excess of authorized revenue to be returned to all utility customers in the form of reduced rates and bills.

Electrifying L/MD vehicles (especially at the levels projected under an *Alternative 1+* approach) could lead to between $7.7 to $11.3 billion in net utility revenue, which could reduce electricity rates by 2.1% to 3.1% ($0.004/kWh to $0.006/kWh). This could save the average U.S. household $35 to $60 per year and the average commercial customer $253 to $428 per year on their electricity bills. This phenomenon has already been observed in the real world. PEV drivers have already contributed $1.7 billion in net revenue that has been returned to all utility customers in the form of rates and bills that are lower than they otherwise would have been.[115]

[114] ERM, *Impacts Report* at 12.
[115] Synapse Energy. 2022. "Electric Vehicles Are Driving Electric Rates Down." https://www.nrdc.org/sites/default/files/media-uploads/ev_impacts_december_2022_0.pdf.

Figure V.G-1: Incremental Reduced Utility Bills from L/MDV Charging[116]



This analysis looks at all of the costs associated with providing and distributing electricity, as well as any revenue based on the identified utility rate from the Energy Information Administration (which is approximately 10.4 cents per kilowatt hour for commercial customers and 12.7 cents per kilowatt hour for residential customers).[117]

H. Comparison of Incremental Fleet Costs and Savings

While some manufacturers have raised unfounded concerns about the costs associated with shifting to ZEVs, the ERM analysis overall shows that the average BEV reaches life-cycle cost parity with diesel and gasoline vehicles before MY 2027. Additionally, from a cost and savings perspective, purchasing an average MY 2032 BEV would save an owner over $18,000 over the life of the vehicle (as seen in Figure V.H-1).

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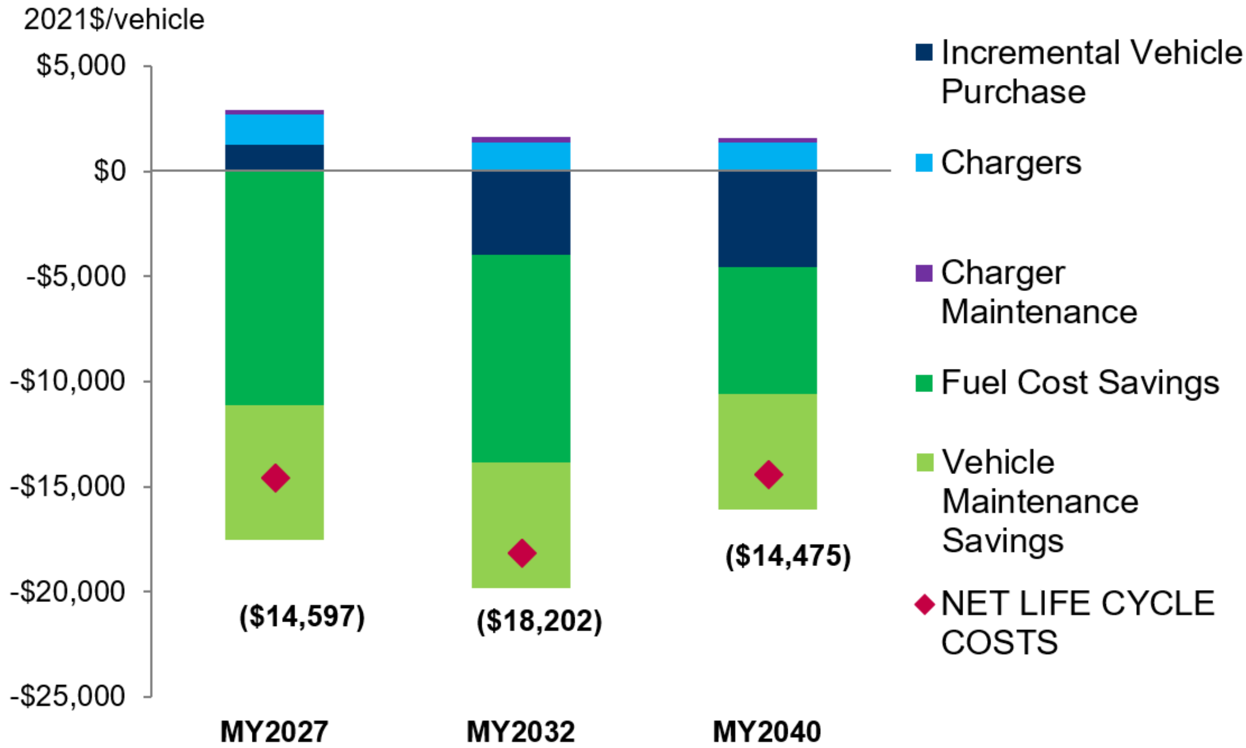
[116] *Id.* at 14.

[117] These electricity rates come from EIA's Annual Electric Power Industry Report (Form EIA-861 for 2021), using the State data tab and adding all Sales (MWh) divided by the Revenues (Thousand $) to obtain the average price ($/kWh) for both Residential and Commercial customers. https://www.eia.gov/electricity/data/eia861/

Figure V.H-1: Possible Net Lifecycle Costs of a BEV vs. a Comparable Diesel or Gasoline Alternative[118]



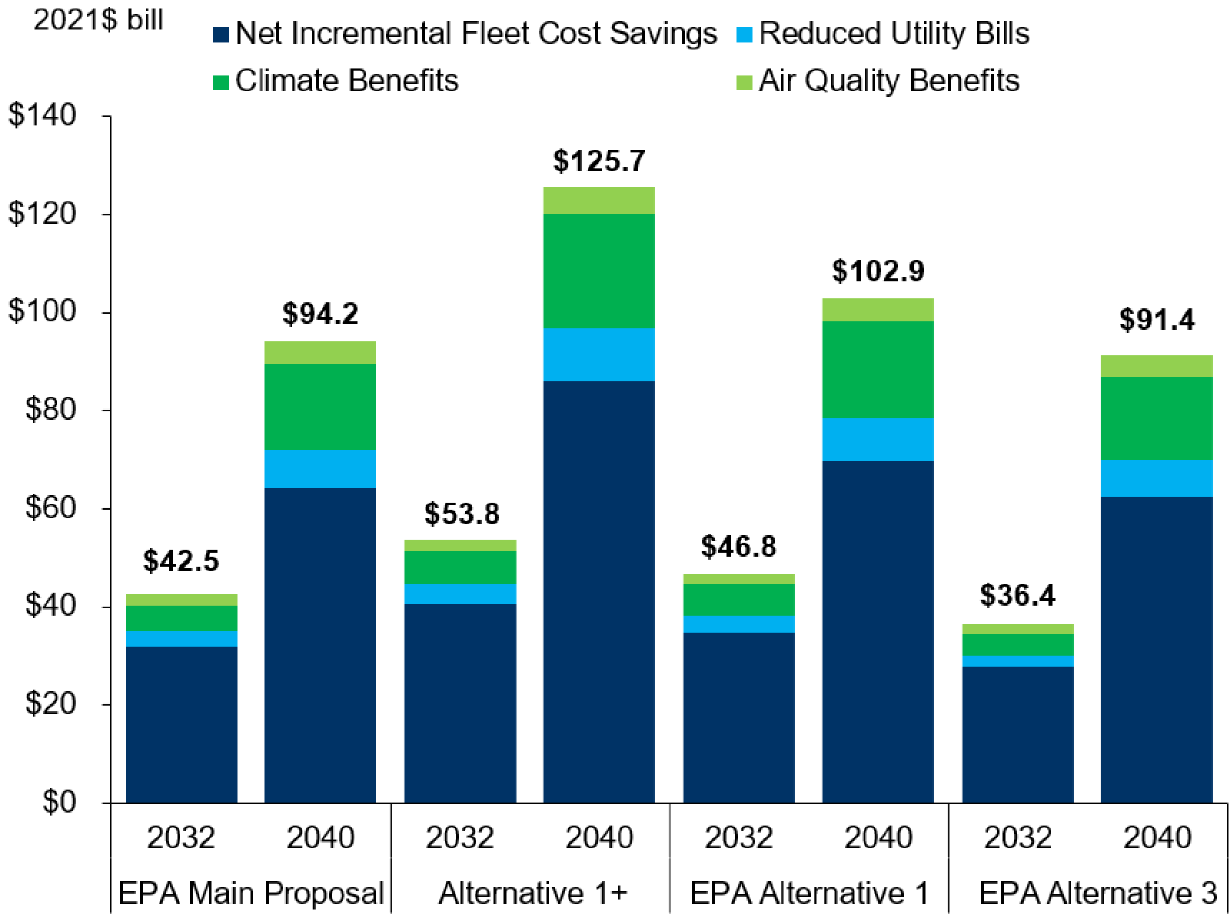
The analysis depicted in Figure V.H-1 incorporates several different cost categories (including purchasing chargers, charger maintenance, incremental purchase price between combustion vehicles and BEVs, vehicle maintenance savings associated with BEVs, and the difference in fuel costs between purchasing gasoline and diesel fuel versus electricity). For this calculation, fuel and maintenance cost savings are discounted at 3% over 16 years.

I. Comparison of Overall Societal Benefits

The results from ERM's analysis (depicted in Figure V.I-1) show that on a net societal basis—inclusive of the costs to fleets as well as air quality benefits, climate benefits, and reduced utility bills—the greatest benefits are seen with *Alternative 1+* at about $125.7 billion through the 2040 timeframe.

[118] *Id.* at 13.

Figure V.I-1: Comparison of Possible Annual Net Societal Benefits[119]



This figure depicts net annual societal benefits (which incorporates net incremental fleet cost savings, climate benefits, air quality benefits, and reduced utility bills).

VI. EPA's Proposed Standards Are Technologically Feasible at Reasonable Cost, as Are Alternative 1 Standards with a Faster Ramp Rate After 2030.

Not only does Alternative 1 with increasing stringency after 2030 yield significant societal benefits, it is also technologically feasible at reasonable cost. In this section, we detail the combustion vehicle and zero-emission technologies that can secure additional emissions reductions from the light-duty fleet, comment on EPA's modeling, and address technology costs. We also offer recommendations for the Tier 4 NMOG+NOx standards and PM requirements.

[119] *Id.* at 15.

A. EPA's modeling should more fully incorporate combustion vehicle technologies that reduce greenhouse gas emissions, which would further demonstrate technological feasibility and available compliance pathways.

1. EPA's modeling does not account for the full range of combustion vehicle technology availability and effectiveness.

The technologies EPA assesses to curb GHG emissions from light-duty vehicles are significantly reduced in number and effectiveness compared to the technology assessment supporting the MY 2023-2026 Rule, for which EPA used CCEMS as its modeling tool. In particular, OMEGA2, the modeling tool EPA now employs, omits the following technologies when modeling compliance: advanced 10-speed transmissions, turbocharging with cooled exhaust gas regulation, variable compression ratio engines, and others.[120] Moreover, the Agency has adopted many fewer technology packages: in contrast to the 6,500 packages available in the CCEMS modeling for each of the 10 vehicle types, the OMEGA2 modeling is limited to 108 packages for cars and 60 packages for trucks.[121]

In and of themselves, these changes might not have a significant impact on the modeling if the technologies contained within the packages were sufficiently representative of the relative technical potential for reducing emissions from combustion vehicles. However, there are significant differences between the effectiveness of the packages analyzed by the OMEGA2 and CCEMS models, as well as the maximum improvement they can deliver (Figure VI.A-1).[122] Because the OMEGA2 model calculates absolute emissions, effectiveness of the packages is considered relative to the base gasoline package modeled in OMEGA2 for each body type, a direct-injection engine with continuously variable valve timing and five-speed automatic transmission.

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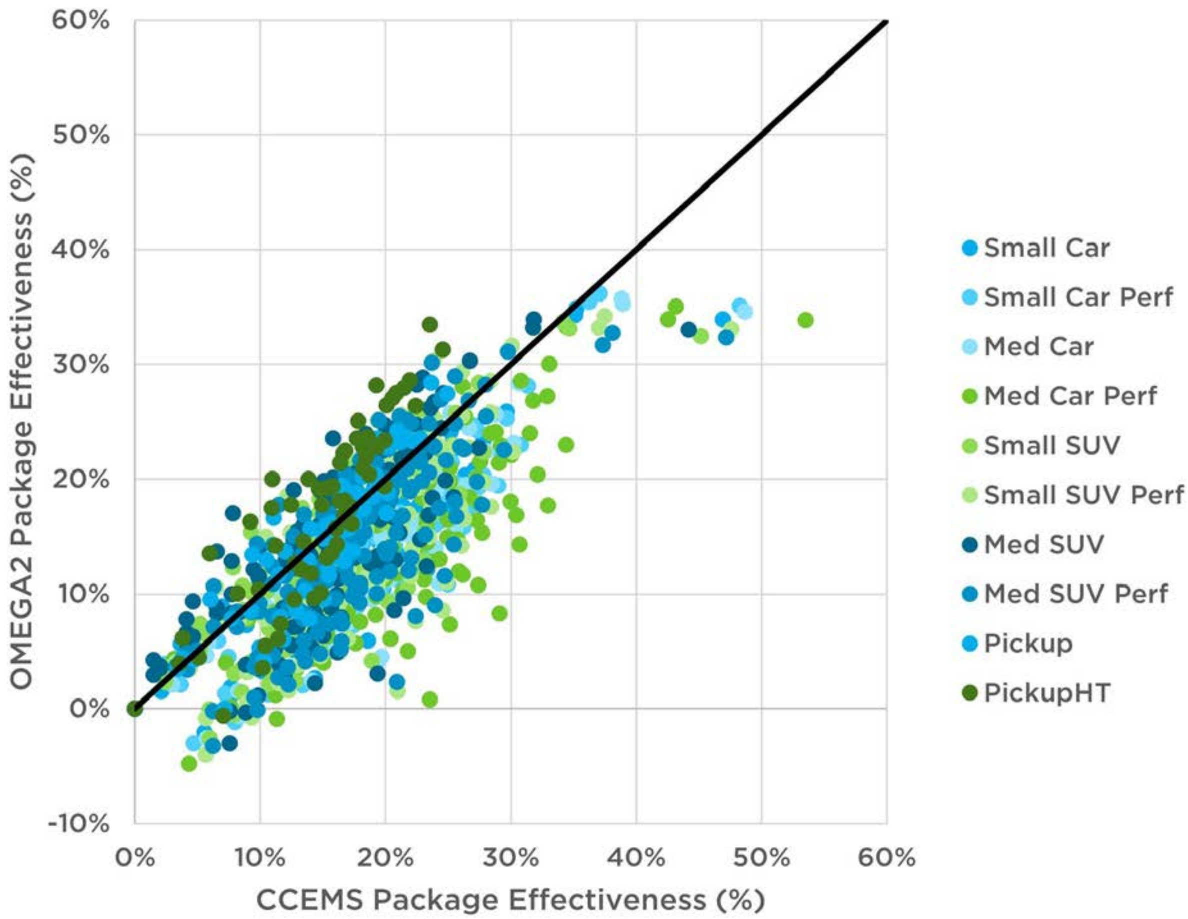
[120] Compare DRIA Table 2-21 with the "Technologies" tab in technologies_NoHCR_LowBEV200_BatteryAdj2023_YearShift.xlsx, a file accompanying the Agency's final modeling supporting the FRIA, as well as Figures 2, 3, and 4 in NHTSA's 2020 CAFE Model Documentation, the documentation included with the agency's CAFE Compliance and Effects Modeling System (CCEMS). NHTSA, CAFE Model Documentation, DOT HS 812 934, EPA-HQ-OAR-2021-0208-0138 (Mar. 2020), at 24-28, Figs 2-4.

[121] Here we refer solely to changes in the powertrain. Throughout this section, we do not consider differences in how the road load reduction was modeled, since while that effect was considered discretely in the CCEMS modeling, it was modeled separately and continuously in the OMEGA2 model.

[122] Owing to differences in the model's architecture, we use representative vehicles from each of the CCEMS classes to obtain the OMEGA2 results using the response surface equations provided. The relevant parameters include the road load coefficients, test weight, and maximum horsepower. Representative vehicles were selected by sales volume, using the classification from the CCEMS model. The identified representative vehicles are: Toyota Corolla, Small Car; Hyundai Elantra, Small Car Perf; Ford Fusion, Med Car; Mercedes C 300, Med Car Perf; Honda CR-V, Small SUV; Ford Escape Titanium, Small SUV Perf; Mercedes GLC 300 4 MATIC, Med SUV; Jeep Grand Cherokee, Med SUV Perf; Toyota Tacoma, Pickup; and Ford F-150 4WD 3.5L EcoBoost, Pickup HT. For the car categories, only unibody packages were defined. For the pickups, only the truck packages were calculated. For SUVs, which can fall into either category, both the car and truck packages were included in the comparison, even if the representative vehicle itself may have been classified as only a light truck.

Figure VI.A-1: Comparison of the effectiveness of packages modeled by EPA to reduce emissions in the Proposal and the MY 2023-2026 Rule



The technology packages modeled in the Proposal using OMEGA2 show a markedly reduced effectiveness compared to the same packages modeled using the CCEMS supporting the MY 2023-2026 rulemaking, as indicated by the increased share of data falling below the X=Y line (black). 74% of the packages modeled in OMEGA2 show a reduced effectiveness. On average, a given OMEGA2 package shows a 3.9 ± 0.3% increase in emissions compared to the prior CCEMS modeling. The most efficient packages show an even greater disparity, with the maximum effectiveness for OMEGA2 showing just a 36% improvement compared to a 53% improvement in CCEMS.

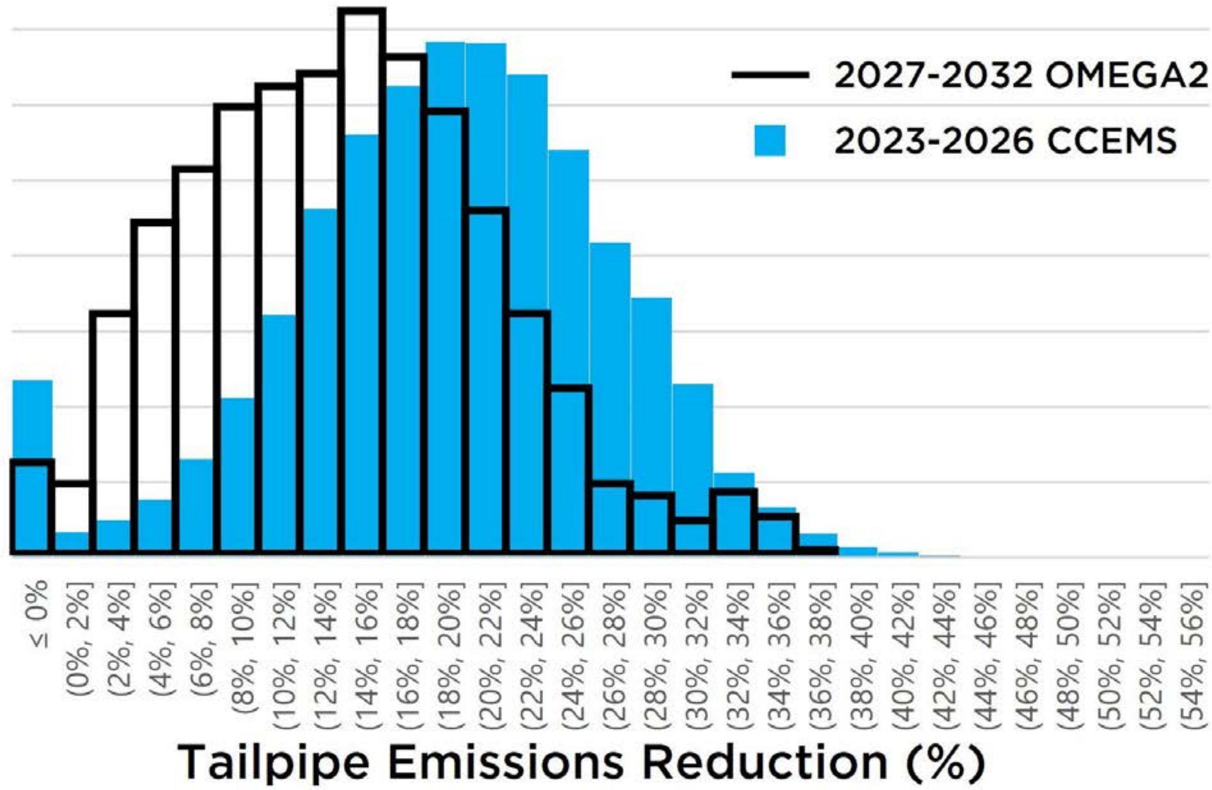
Looking at the relative effectiveness of the modeled packages, it is clear that the CCEMS modeling generally finds a greater level of improvement than the more recent OMEGA2 modeling. Because the benchmark data for the ALPHA modeling supporting OMEGA2 is almost identical to that used to support the previous rulemaking (excepting the Volvo Miller cycle engine, which corresponds most accurately to the prior variable-geometry turbo technology package), and because the changes to the ALPHA model (vis-à-vis the response surface equations) are generally reasonable, as supported by the peer review process, the reason for the disparity in EPA's analysis is unclear. There are some general trends that may be illustrative in assessing the flaws in EPA's more recent modeling. Across all categories of vehicle, the 5-speed automatic transmission package (TRX10) was found to be more efficient than the basic 6-speed automatic (TRX11), which seems implausible and may speak to problems with how the scaling algorithm matches a modeled vehicle's transmission to different engine maps—all the more perplexing since the Agency claims to use the same model as before.[123] Similarly, there appears to be little difference in the effectiveness of any of the three hybrid packages, despite significant differences in the underlying engines.[124] This is particularly perplexing given that strong hybrids have continued to evolve with each successive generation, and yet, according to EPA's modeling, they appear to be stuck at the efficiency levels of the MY 2019 power-split fleet.[125]

In addition to the packages' lack of effectiveness, we question whether these packages cover a sufficiently robust opportunity for reductions from the internal combustion engine. Unfortunately, the answer appears to be that they are also now covering a narrower range than previous modeling (Figure VI.A-2, *infra*). As expected based on the results discussed above, the shift in the distribution of effectiveness for the current modeling is below that of the CCEMS, but the packages are also overweighted towards less effective packages, in contrast to the symmetric/Gaussian distribution of the CCEMS data. Also of note is the lack of a long tail out to higher effectiveness; as noted previously, while the few hybrid packages available in the CCEMS model can reduce emissions by over 50%, the OMEGA2 packages max out at 36%. This means that about one-third of the assessed maximum potential improvement previously modeled to be available to manufacturers for their combustion vehicle fleets has been eliminated due to unknown factors.

We believe that once these issues have been addressed, it will become apparent that the standards are considerably more feasible than EPA states; that combustion vehicle emissions can be reduced to a much larger degree than EPA assumes; and that even more technologically diverse compliance pathways are available to manufacturers, enabling them to meet the standards at PEV penetration levels lower than EPA projects.

[123] DRIA at 2-29.
[124] *Id.* at Table 2-2.
[125] *Id.* at Section 2.4.8.6.

Figure VI.A-2: Available technology packages at different levels of effectiveness



A histogram comparing the share of packages in the current (OMEGA2) and previous (CCEMS) compliance modeling efforts from EPA, grouped by total package effectiveness relative to a GDI engine paired with a 5-speed transmission. It is clear that not only do manufacturers have significantly more package options at, on average, higher effectiveness, but the total absolute range has been condensed as well for the current modeling effort, limiting compliance flexibility for manufacturers in the model that does not reflect the broader range of options available.

2. The OMEGA2 model produces unlikely results for combustion vehicles.

As noted above, the OMEGA2 model suffers from significant shortcomings in terms of capturing the potential improvement available from technologies applicable to combustion vehicles. However, there is also a problem with the way in which the OMEGA2 model assumes manufacturers then apply those technologies: not only can manufacturers add new technology, but they can remove it. The level of so-called "decontenting" that occurs in the OMEGA2 model is neither unrealistic, and it drastically underestimates the improvements from combustion vehicles that would likely be deployed for a given PEV scenario.

In the Proposal modeling, 40% of the combustion vehicle models have worse 2-cycle tailpipe GHG emissions in 2032 than in 2022. On average, that 40% of the fleet has increased its emissions by 13%, or 27 g/mi. For reference, this decline in emissions performance approximates a return to 2016 levels of tailpipe emissions for those vehicles (i.e., those vehicles would achieve no net progress over a 16-year period). Of course, the remaining combustion vehicle fleet sees plenty of backsliding in this time as well. While manufacturers may not have fully slipped back to 2022 levels, OMEGA2 modeling finds that through the course of the 2022-2032 period, manufacturers are more than twice as likely to make the direct CO_2 emissions from a combustion vehicle *worse* year-to-year, increasing year-to-year emissions 22% of the time, keeping them unchanged 69% of the time, and reducing emissions just 9% of the time. And this percentage increases dramatically between the years governed by the current standards and the Proposal: the modeling shows that manufacturers are much more likely to decrease the emissions of a combustion vehicle to achieve compliance with the MY 2023-2026 standards (15%, compared to 9% for the proposed MY 2027-2032 standards), and are 6 times more likely to decontent a combustion vehicle in the 2027-2032 period than in the 2023-2026 period.

Notably, the modeling of manufacturer behavior described above does not distinguish between the magnitudes of the reduction/increase in emissions. On average, emissions reductions from the combustion vehicle fleet under the existing standards greatly outweigh the average increases, since improving combustion vehicles is a significant compliance mechanism for the current standards. Interestingly, the magnitude of the average increase vs. decrease does not vary substantially over the entire decade (2022-2032). Instead, the disparity in outcome (combustion vehicles increasing, rather than decreasing, emissions) is entirely driven by the massive increase in decontenting that begins to occur in the modeling in the post-2026 period.

EPA provides no explanation for this rapid shift in modeled manufacturer behavior in the documentation for the rule, and such behavior makes little sense, particularly when examining cases of decontenting that occur in the modeled compliance for the Proposal. To the extent that manufacturers may consolidate engine platforms as they reduce the number of available combustion vehicles, that consolidation is not likely to happen on the oldest, lowest technology options but rather on the newest engine platforms, in order to avoid accelerated depreciation of new investments. While there may be some simplification, it is more likely that the simplification would be elimination of a lower-volume technology package, such as a high-performance (and higher emission) option, which again would not result in increases in emissions. Below we present two examples to illustrate the unrealistic aspects of the compliance model for technology content, in consideration of industry behavior.

a. Example: Volvo S60

The Volvo S60 is available in multiple configurations and is represented by three different vehicles in the OMEGA2 model: two conventional vehicles (one of which is a high-performance trim with greater horsepower), and one strong hybrid (incidentally utilizing the Miller cycle engine benchmarked by EPA). The modeled technology packages for these vehicles are illustrated in Table VI.A-1. In 2026, the first redesign opportunity is available for the model. The vehicles undergo one major change to the platform (a shift from steel to aluminum cuts a significant amount of weight), and then the three engines move to the same exact configuration, a 48V mild hybrid with a high compression ratio (HCR) engine utilizing discrete cylinder deactivation. The power output for the former-hybrid and the high-performance trim are virtually identical, which is why the emissions numbers are so similar in 2026, effectively reducing the trims available to two. This type of consolidation could happen, though eliminating the high-tech Miller cycle engine (part of one of the most efficient technology packages implemented by EPA) from the vehicle after just one product cycle is unlikely. And, at least in this case, on net the former-hybrid vehicle still sees a reduction in emissions due to the weight reduction.

Table VI.A-1: Comparison of technology packages, fuel economy, and emissions for the Volvo S60 at each redesign

Volvo S60 T8 (313 hp)				
Year	Tech package	Body Material	Tailpipe CO_2 (lab) [g/mi]	Label Fuel Economy [mpg]
2021	SHEV-PS, Miller cycle	Steel	194	35.4
2026	MHEV (P0), HCR + continuous cyl. deac., advanced 8-speed AT	Aluminum	181	38.9
2031	HCR + continuous cylinder deactivation, 5-speed AT	Steel	236	33.5
Volvo S60 T5 (316 hp)				
Year	Tech package	Body Material	Tailpipe CO_2 (lab) [g/mi]	Label Fuel Economy [mpg]
2021	Start-stop, Turbo, advanced 8-speed AT	Steel	225	32.7
2026	MHEV (P0), HCR + continuous cyl. deac., advanced 8-speed AT	Aluminum	183	38.2
2031	HCR + continuous cylinder deactivation, 5-speed AT	Steel	268	30.7
Volvo S60 T4 (250 hp)				
Year	Tech package	Body Material	Tailpipe CO_2 (lab) [g/mi]	Label Fuel Economy [mpg]
2021	Start-stop, Turbo, advanced 8-speed AT	Steel	206	34.4
2026	MHEV (P0), HCR + continuous cyl. deac., advanced 8-speed AT	Aluminum	170	40.1
2031	HCR + continuous cyl. deac., 5-speed AT	Steel	237	32.2

In 2031, however, the vehicle platform reverts from aluminum back to steel, gaining weight in the process. All three vehicles drop the mild hybrid configuration but introduce three completely distinct engine technologies, again less efficient than the prior offerings, and now paired with a 2007-era 5-speed transmission instead of the advanced 8-speed transmission of the previous generation. To summarize, under EPA's modeling, the S60 in 2031 will: 1) revert to an old body platform and an ancient transmission; 2) adopt engine technology that will reduce fuel economy for consumers by 8 mpg, below what the vehicle started at in 2022 for all configurations; and 3) not do anything to consolidate engines or platforms, or do anything else that could justify decontenting, because there remain three distinct engine offerings. There is little reason to suppose that Volvo (or any other manufacturer) would be able to find consumers for a combustion vehicle, such as the modeled S60, that gets notably worse over time.

b. Example: Jeep Cherokee

A similar trajectory is observed in the case of the Jeep Cherokee (Table VI.A-2). In this case, the modeled vehicle does not correspond directly to each of the real vehicle's trims but is instead averaged into a high- and low-throughput engine option for the 2WD and 4WD versions.[126] However, the pattern of vehicle change in the modeling is the same: each vehicle is first upgraded and then downgraded, with 3 of the 4 model variants ending up worse than they started a decade prior.

Table VI.A-2: Comparison of technology packages, fuel economy, and emissions for the Jeep Cherokee at each redesign

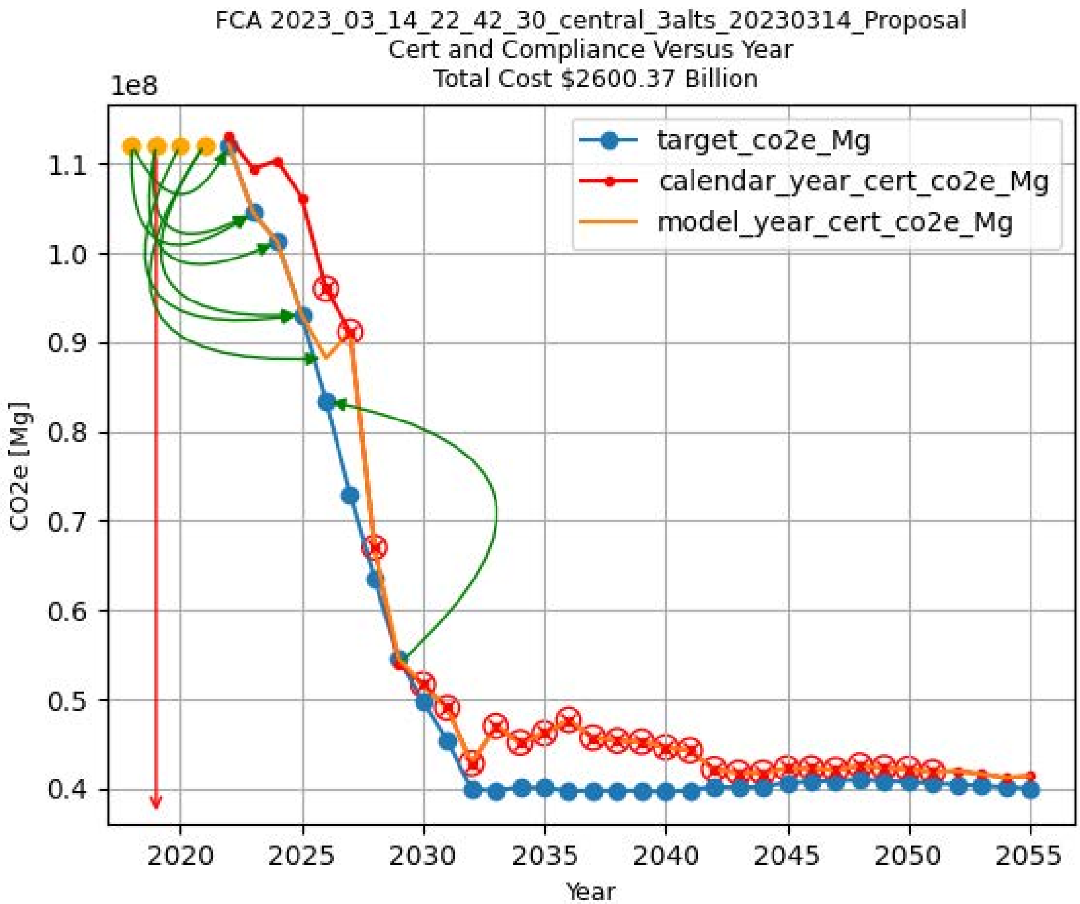
Jeep Cherokee 4x4 Premium (270 hp)				
Year	Tech package	Body Material	Tailpipe CO_2 (lab) [g/mi]	Label Fuel Economy [mpg]
2021	Start-stop, Turbo, advanced 8-speed AT	Steel	238	27.3
2026	HCR + continuous cylinder deactivation, advanced 8-speed AT	Steel	231	28.9
2031	HCR, 5-speed AT	Steel	276	26.4
Jeep Cherokee 4x4 Base (245 hp)				
Year	Tech package	Body Material	Tailpipe CO_2 (lab) [g/mi]	Label Fuel Economy [mpg]
2021	Start-stop, SGDI, advanced 8-speed AT	Steel	267	26.2
2026	HCR + continuous cylinder deactivation, advanced 8-speed AT	Steel	225	29.6
2031	HCR, 5-speed AT	Steel	266	27.1
Jeep Cherokee 4x2 Premium (256 hp)				

[126] While Jeep has since dropped the 2WD version of the Cherokee, this is not reflected in EPA's model due to the use of a 2019 baseline fleet.

Year	Tech package	Body Material	Tailpipe CO_2 (lab) [g/mi]	Label Fuel Economy [mpg]
2021	Start-stop, Turbo, advanced 8-speed AT	Steel	218	30.7
2026	HCR + continuous cylinder deactivation, advanced 8-speed AT	Steel	210	32.4
2031	Turbo, 5-speed AT	Steel	252	29.4
Jeep Cherokee 4x2 Base (196 hp)				
Year	Tech package	Body Material	Tailpipe CO_2 (lab) [g/mi]	Label Fuel Economy [mpg]
2021	Start-stop, SGDI, advanced 8-speed AT	Steel	233	29.8
2026	HCR + continuous cylinder deactivation, advanced 8-speed AT	Steel	200	33.1
2031	HCR, 5-speed AT	Steel	233	29.4

What makes this behavior particularly unrealistic in the case of the Jeep Cherokee is that the parent company (Stellantis) is, according to the model, purchasing credits from other manufacturers in order to comply with the standards after the 2029 model year (Figure VI.A-3). In other words, the model projects that it is in Stellantis' interest to increase emissions from its combustion-powered vehicles (even though there is no concurrent improvement in performance-related vehicle attributes), and this strategy results in the manufacturer falling short of its regulatory requirements, which then forces the company to purchase credits from its competitors.

Figure VI.A-3: Year-over-year average certification for Stellantis (formerly FCA), from EPA's Proposal modeling run



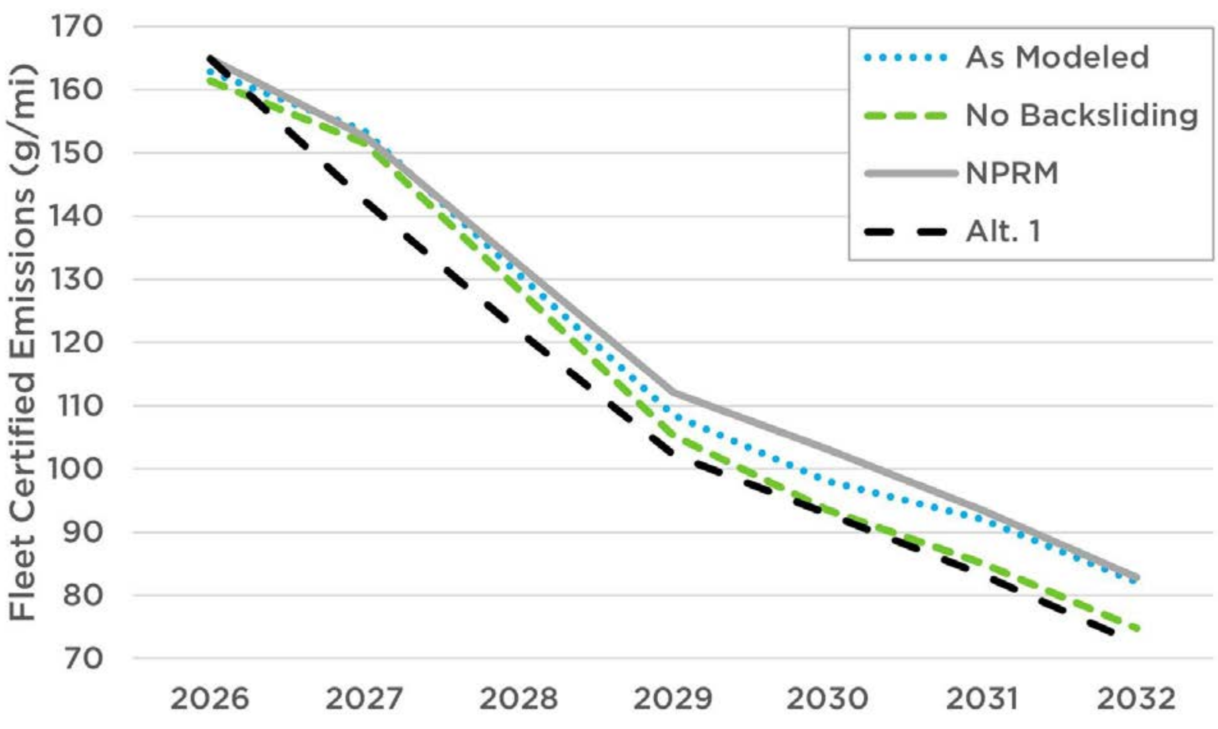
In all years modeled, Stellantis is reliant upon banked credits in order to comply with the standards, as indicated by the difference between the target curve (blue dots) and the calendar year certification (red circles). Stellantis is able to use its own banked credits (indicated through credit transactions via arrows) in order to comply with the standards through the 2026 model year, indicated by the overlap between the model year certification (orange line) and target curve. However, beginning with the 2026 model year, those credits (including credits carried back from the 2029 model year) are no longer sufficient for Stellantis to meet its requirements. Therefore, Stellantis is required to make up the remaining gap between model year and target year curves with credits purchased on the general market (not modeled explicitly by the Agency).

3. In allowing combustion vehicles to backslide, the OMEGA2 model fails to capture readily achievable emissions reductions; adjusting these features would further support the feasibility of stronger standards.

By allowing combustion vehicles to backslide in its modeling, EPA fails to consider a significant pathway for potential emissions reductions. By 2032, this backsliding results in nearly a 10% increase in tailpipe emissions from the fleet. In terms of feasibility, it is beyond question that the decontented combustion vehicle technologies can be deployed in the timeframe of the rule, since these technologies had previously been on those vehicles. Since manufacturers will not incur any new costs for research and development and will simply be elongating the period for which they can utilize their investments, it would be more reasonable for the model to assume that manufacturers would not remove such technologies, thus preserving emissions levels already achieved.

We urge EPA to take this "no backsliding" approach in its modeling for the final rule. The impact would be significant: if manufacturers simply adopted a strategy of not removing technology from their combustion vehicle fleet, they could nearly achieve the more stringent Alternative 1 standards with no increase in ZEV sales as compared to ZEV sales in the modeling supporting the Proposed Rule (Figure VI.A-4).

Figure VI.A-4: Fleet-wide average certification levels, as modeled compared to a scenario where manufacturers do not remove technology from combustion vehicles



4. Summary of available improvement for combustion vehicles

By leaving a significant amount of available and feasible combustion vehicle emission reduction technologies on the table—including technology improvements EPA identified in prior rulemakings—the Agency has underestimated the potential emissions reductions available to the fleet. This problem is compounded because the Agency's compliance model assumes that a large share of the combustion vehicle fleet will get worse over time, even for manufacturers that the model projects will fall short of compliance and therefore will be dependent upon purchasing credits from their competitors.

By adjusting its modeling to reflect the full range of combustion vehicle technology improvements available to manufacturers, and by aligning its modeled manufacturing behavior with a strategy that reflects continued deployment of the technologies already available and incorporated into vehicles instead of allowing backsliding, EPA's modeling would better capture the full range of emissions reductions pathways that are feasible. Improving the OMEGA2 modeling in this way will affirm that manufacturers can easily achieve a standard at least as stringent as Alternative 1, with little to no increase in ZEV penetration compared to the model runs supporting the Proposal.

5. Automakers can feasibly and inexpensively improve combustion vehicle emissions simply by shifting sales to the cleanest trims of popular models.

Yet another pathway that automakers could use to comply with stronger standards lies in shifting their sales to the cleanest trims of their popular combustion vehicle models. In 2022, 8.6 million sales – more than half of all new automotive sales – were from just twelve combustion vehicle nameplates. These top-selling vehicles were sold by five automakers: Ford, General Motors, Honda, Stellantis, Toyota. Within each nameplate, the automakers provided different powertrain options (such as engine size, transmission gearing, hybridization and other characteristics), and each had their own emissions performance – some better than others. These vehicle options are all in production, and selling more of any one powertrain could lead to reductions in sales volumes of the same nameplate with a different powertrain. These changes in volumes within a nameplate are a regular feature of the automobile market.

An automaker could improve the emissions performance of its vehicles simply by shifting sales within a nameplate to versions with cleaner powertrains. This shift could achieve emissions reductions without an investment in new emissions technologies or large-scale capital expenditures for factory retooling. Similar emissions improvements could also be achieved due to a consolidation or reduction in powertrain options as ZEVs replace sales of these combustion vehicle nameplates.

We estimated the emissions savings that could be achieved by shifting production in a nameplate from the mix of powertrains sold in 2022 to the cleanest powertrain currently available in that nameplate. Table VI.A-5 shows the top-selling twelve nameplates analyzed and the emissions reductions that could be achieved.

Table VI.A-5: Emissions Reductions in Top-Selling Nameplates by Focusing Sales on Cleaner Powertrains[127]

Automaker	Top-Selling Models	Fraction of Automaker's Sales	Emission Savings with Shift to Cleanest Models (gCO2/mi)	% Improvement from 2022 Automaker Fleet Average
Ford	F-150, Explorer	47%	39	13%
General Motors	Silverado, Sierra, Equinox	43%	15	5%
Honda	CRV	25%	32	14%
Stellantis	Ram pickup, Jeep Cherokee	44%	63	20%
Toyota	RAV4, Camry, Highlander, Tacoma	51%	42	17%

The high-volume nameplates analyzed comprise between 25% to 51% of each automaker's total sales in 2022. Adjusting sales within these nameplates toward the versions with the cleanest powertrains would provide significant emissions reductions.

B. EPA should include PHEVs in its modeling.

While EPA did not include any PHEVs in its modeling for the Proposal, we urge it to do so for the final rule. Modeling PHEVs will both account for manufacturers' plans and help demonstrate the technical and economic feasibility of strong final standards. Although BEVs are likely to continue to be the most common electric vehicle, PHEVs are part of some automakers' stated plans for achieving emissions reductions. PHEVs are currently more commonly used as a powertrain option for larger and less efficient vehicle models, and that trend is likely to continue with future models. Therefore, EPA should include PHEVs as a powertrain option in the final rule, but should focus on pickup trucks and SUVs as the most likely candidates to offer a PHEV variant.

When modeling PHEVs, EPA should examine vehicle parameters that span a range of battery capacities. In particular, EPA should examine vehicles with battery capacity that meets the minimum capacity (7 kWh) requirements for the IRA § 30D credit. PHEVs that are eligible for the full amount of that credit ($7,500) and have the required minimum capacity battery pack are likely to have a lower net cost than conventional vehicles with similar compliance CO_2 value.

[127] This analysis relies on sales estimates of each powertrain version within each nameplate and total sales per manufacturer provided by Baum & Associates. Emissions rates per nameplate version were accessed from www.fueleconomy.gov.

When considering costs for PHEVs, EPA should assume L1 charging infrastructure for these vehicles with 50-mile or lower electric-only range. The traction battery capacity for these vehicles will likely be in the range of 7-25 kWh, and therefore they can be fully recharged in 4-13 hours using a L1 EVSE connected to a 20-amp, 120V circuit.

C. Battery costs will continue to decline, and EPA should include lithium-iron phosphate batteries in its modeling of battery pack costs.

Developments in battery technology and reductions in battery costs also support the promulgation of strong standards. EPA is correct that battery costs will continue to decline. Improvements in battery chemistries are one reason for that, and EPA should include batteries with lithium-iron phosphate (LFP) chemistry in its modeling.

1. EPA should include lithium-iron phosphate battery chemistries in its BatPaC modeling of battery pack costs.

When modeling the cost of BEV batteries, EPA should consider the use of iron-phosphate cathodes. The use of LFP batteries in current BEV models is growing; these batteries have potential benefits beyond lower material prices, including higher fast-charging rates and greater durability.[128]

EPA cites the lower specific energy and energy density of LFP batteries as being less appropriate to the 300-mile range BEVs modeled in its analysis. While there is demand for longer-range BEVs, there is still likely to be a role for BEVs with a range of 200-300 miles; in fact, many current BEV models have a rated range of less than 300 miles. Even if the average range of BEV vehicles is 300 miles, the actual product mix will include vehicles with ranges both above and below that average. And as fast-charging infrastructure with higher-power (>300 kW) EVSE is deployed, consumers may be more willing to choose a BEV with less than 300 mile range, as mid-trip recharging would require less time. Vehicles with lower range are good candidates for LFP batteries.

For these reasons, EPA should evaluate the potential cost savings if a portion of PEV models use LFP batteries. Using BatPaC version 5,[129] switching to LFP from the default of NMC811 reduces battery pack cost 7-10%, depending on battery production volume assumptions and battery capacity. As supported by findings in BloombergNEF's latest Electric Vehicle

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[128] Ford Media Center, Ford Taps Michigan for New LFP Battery Plant; New Battery Chemistry Offers Customers Value, Durability, Fast Charging, Creates 2,500 More New American Jobs (Feb. 13, 2023), at https://media.ford.com/content/fordmedia/fna/us/en/news/2023/02/13/ford-taps-michigan-for-new-lfp-battery-plant--new-battery-chemis.html (last accessed July 3, 2023).

[129] U.S. EPA, Battery Cost Estimation Spreadsheets for US EPA LMDV NPRM, EPA-HQ-OAR-2022-0829-0356_attachment_3, available at https://www.regulations.gov/document/EPA-HQ-OAR-2022-0829-0356.

Outlook, LFP batteries are forecasted to be used in an increasing number of passenger BEVs in the United States, reaching around 30% of new demand in 2032.[130]

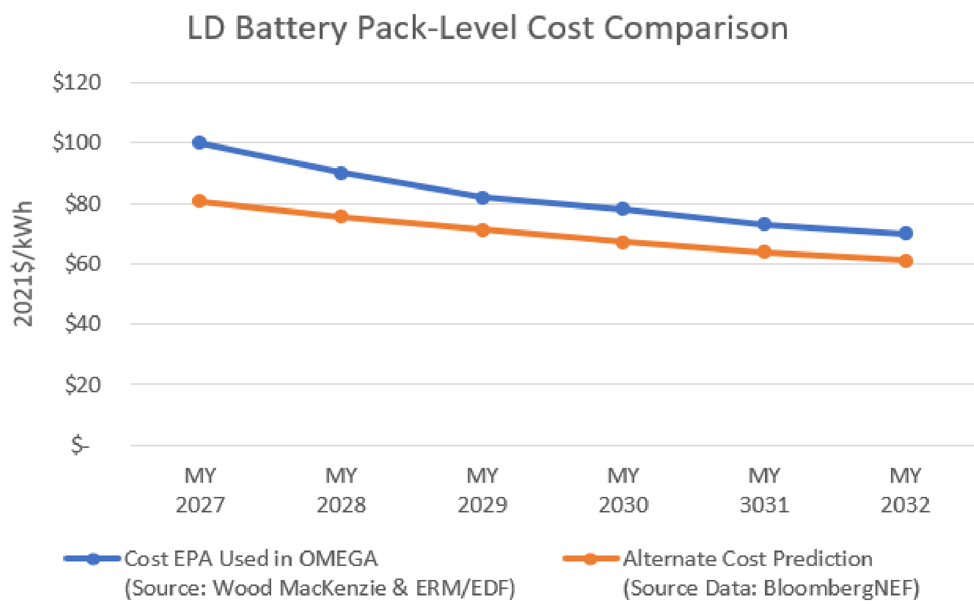
2. Battery costs will continue to decline.

We concur with EPA's assessment that battery costs will continue to decline. We provide support for EPA's battery cost-per-kWh inputs for its OMEGA modeling and the continued downward price trend of batteries.

In its modeling, EPA used an average battery cost ($/kWh) at the pack-level based on a proprietary analysis by Wood Mackenzie and a report by the Environmental Defense Fund (EDF) and Environmental Resources Management (ERM) compiling battery cost projections from a number of sources.[131] The Agency also noted that according to BloombergNEF, global average pack prices were expected to reach $100/kWh by 2026, as the price increase in 2022 due to mineral price volatility will be resolved within a couple of years.[132] We believe these costs are an appropriate representation of the market. Our own analysis based on data available to BloombergNEF subscribers in the Electric Vehicle Outlook 2023 yields numbers just slightly below the costs EPA used in its modeling, as shown in the table and figure below, assuming that EPA's costs were shown in 2021$.

Pack-Level Cost Comparison (2021$/kWh)						
	MY 2027	MY 2028	MY 2029	MY 2030	MY 3031	MY 2032
Cost EPA Used in OMEGA (Source: Wood MacKenzie & ERM/EDF)	$ 100	$ 90	$ 82	$ 78	$ 73	$ 70
Alternate Cost Prediction (Source Data: BloombergNEF)	$ 81	$ 76	$ 71	$ 67	$ 64	$ 61

130 Dr. Andy Leach, Lithium-Ion Batteries: State of the Industry 2022, *US demand, chemistry mix, and recycling Capacity*, BloombergNEF, Sept. 9, 2022. Subscription required.
131 *See* DRIA at 2-50.
132 88 Fed. Reg. at 29323



To develop our estimates, we used battery global cost data (2022$/kWh) for BEVs, global battery demand forecasts, and the most updated learning rate used by BloombergNEF after the 2022 price increase, as well as a 7.02% inflation rate between June 2021 and June 2022 to convert the data back to 2021$/kWh.[133]

Lastly, as EPA noted, its analysis does account for access to § 45X Advanced Manufacturing Production tax credits, but there are several other tax credits from the IRA available to battery manufacturers that will reduce costs below what is represented in EPA's analysis, such as the 10% tax credits for electrode active material or critical mineral production. As a result, this is a conservative assumption, which further supports the reasonableness of EPA's battery cost projections.

In sum, EPA's forecast of battery cost per unit of battery power output ($/kWh) aligns with the best available knowledge and prediction of the market at this time. However, EPA's forecast of some of the other factors related to battery technologies, like specific energy, are behind where the market is currently and where it is trending for the future. These inputs can therefore cause the full cost of a passenger BEV and the associated mineral demand to be modeled higher than the most likely real-world scenarios. Therefore, even though the cost per kWh input is appropriate, the cost and minerals needed per BEV are likely overestimated under the EPA's current approach meaning that technological feasibility and benefits are higher than predicted by the EPA.

[133] Evelina Stoikou, 2022 Lithium-Ion Battery Price Survey, BloombergNEF (Dec. 6, 2022), at 13-15 & 24-27 (Subscription required).

D. EPA should revise its non-battery BEV powertrain costs.

EPA should use the most recent data available to estimate non-battery BEV powertrain costs. The choice of electric motor cost equation used in the OMEGA modeling does not reflect the most recent data and will overestimate the cost of the BEV powertrain, especially in vehicles with higher-power electric motors. In the 2023 draft report "Cost Modeling for BEV Powertrain" by FEV Consulting, Inc., the cost for both induction and permanent magnet electric motors is estimated to have both a fixed cost and a power-dependent variable cost.[134] In contrast, the cost assumptions used in OMEGA for motors have no fixed costs and only have a power-dependent variable cost.[135] The effect of this choice is that OMEGA will overestimate the motor (and powertrain) costs relative to the most recent FEV Consulting analysis for BEVs as the power of the motors increases. This overestimation of costs will likely create the largest penalty for electric-drive pickups and SUVs, which will require higher-power electric motors in the modeling. Additionally, the FEV Consulting analysis differentiates the cost of gearboxes, wiring harnesses, and coolant circuits for sedans, SUVs, and pickups, which is not reflected in the OMEGA modeling. EPA should revise these costs in its modeling for the final rule, which would more accurately show the feasibility of strong standards.

E. EPA should revisit the teardown study it relied on for the proposed rule.

EPA must also ensure that teardown studies it relies on for its final rulemaking are accurate and defensible. While the use of teardown studies is appropriate to generate combustion vehicle and BEV manufacturing cost estimates, it is important that the comparison vehicles chosen are similar and that any performance differences are quantified. The report "Cost and Technology Evaluation, Conventional & Electrical Powertrain Vehicles, Same Vehicle Class and OEM" by FEV Consulting, Inc. prepared for EPA, presents a detailed comparison between combustion and battery-electric vehicles of similar size made by the same manufacturer.[136] While these vehicles have many similarities, there are major performance differences that were not quantified or assigned a cost. The largest variance in performance is in the power, torque, and resulting acceleration performance. The combustion model (VW Tiguan) has a 0-60 mph time of 9.7 seconds, while the more powerful BEV model (VW ID.4) accelerates to 60 mph in 5.4 seconds. If the BEV was designed to have similar performance as the combustion model, there would be downscaling of motor and power electronics, resulting in lower BEV powertrain costs. The teardown analysis should be revised to estimate the cost reductions associated with components that have similar performance as the combustion vehicle model. Similarly, the BEV model chosen has higher towing capacity than the combustion vehicle model, which results in

[134] FEV Consulting, Cost Modeling for BEV Powertrain (prepared for U.S. EPA) (Apr. 10, 2023), available at https://www.regulations.gov/document/EPA-HQ-OAR-2022-0829-0384 (as Attachment 1).
[135] DRIA at 2-74, Tbl. 2-39.
[136] FEV Consulting, Cost and Technology Evaluation, Conventional & Electrical Powertrain Vehicles, Same Vehicle Class and OEM (prepared for U.S. EPA) (Feb. 24, 2023), available at https://www.regulations.gov/document/EPA-HQ-OAR-2022-0829-0402 (as Attachment 3).

higher costs (e.g., from heavier bumpers). EPA should consider the value of the increased towing performance or adjust the costs of the BEV model to estimate the cost to build a vehicle with the same performance as the combustion vehicle model chosen.

F. EPA should strengthen the Tier 4 NMOG+NO_X standards and finalize the proposed PM requirements.

We now turn to EPA's proposed criteria pollutant standards for LDVs. As detailed below, while the proposed $PM_{2.5}$ requirements are appropriate, EPA should strengthen the NMOG+NO_X standards and consider ways to limit over-crediting.

1. EPA should increase the stringency of the proposed NMOG+NO_X standards.

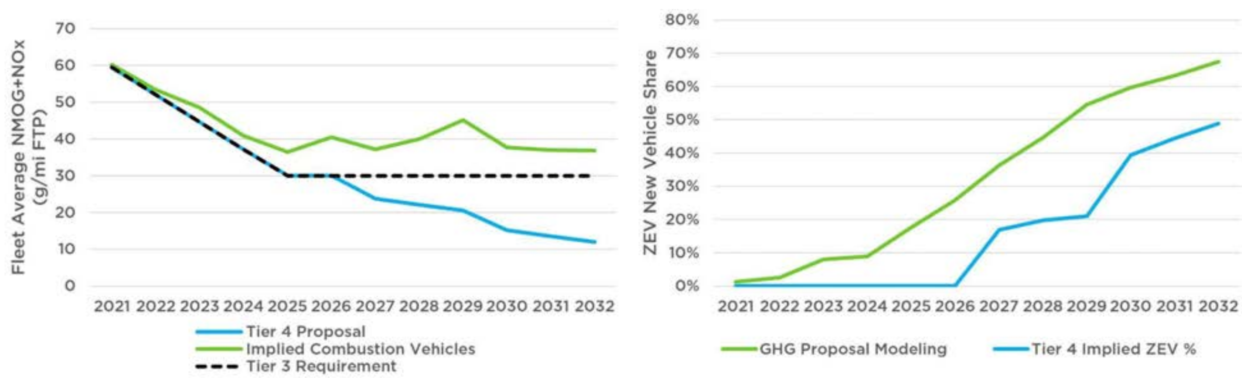
a. EPA should strengthen the NMOG+NO_x standards to better reflect available, feasible, and cost-effective technologies.

EPA's 2014 Tier 3 emissions standards were set based on the deployment of technologies applicable to combustion vehicles. The NMOG+NO_x standards are meant to continuously phase in from 2017-2025, ultimately reaching a fleet average of 30 mg/mile on the FTP and 50 mg/mile on the SFTP. However, over this time period, an increasing share of BEVs will be sold, which are certified to 0 mg/mile NMOG+NO_x. While the deployment of BEVs will not alter the tailpipe emissions reductions anticipated under the Tier 3 program, the additional BEVs, counted as 0 mg/mile, substantially reduce manufacturers' incentives to deploy the full extent of technologies EPA identified in the Tier 3 rulemaking to their combustion vehicles.

Two responses are possible from manufacturers: they either (1) deploy the same suite of internal combustion engine technologies to their combustion vehicle fleet, and therefore generate a significant amount of overcompliance credits that can be used to reduce their compliance obligations under the Tier 4 standards EPA is now proposing; or (2) reduce the deployment of technologies as EPA originally envisioned when setting the Tier 3 standards, leaving emissions reductions for their combustion vehicle fleet on the table. Either response weakens compliance with the standards. Strengthening the Tier 4 standards will help avoid these problems.

Therefore, EPA's proposed NMOG+NO_x standards leave a significant gap between the feasible deployment of zero-emission technologies (indicated by the share of BEVs modeled for GHG compliance) and the feasible deployment of improvements to combustion vehicles (indicated by the achievement of a Tier 3 fleet average standard without the deployment of BEVs). Figure VI.F-1 illustrates, on the left, the implicit requirements on combustion vehicles under the proposed NMOG+NO_x standards with EPA's modeled adoption of BEVs under the GHG standards; and, on the right, the implied share of BEVs required by the proposed Tier 4 standards if combustion vehicles achieve Tier 3 compliance. If BEVs are deployed at levels modeled by the Agency to comply with its GHG Proposal, NMOG+NO_x emissions from combustion vehicles would remain about 30% higher than the Tier 3 requirement over the timeframe of the rule. If, instead, the combustion vehicle fleet matches the Tier 3 requirements in 2027-2032, far fewer BEVs would need to be deployed to meet the Tier 4 proposed targets. These scenarios demonstrate that numerous technological pathways are available to manufacturers to comply with the Tier 4 standards and that stronger standards are entirely feasible.

Figure VI.F-1. Emissions performance and ZEV market share implied by the combination of achieving the proposed GHG standards and Tier 3 / Proposed Tier 4 NMOG+NO_x standards



If manufacturers deploy ZEVs consistent with EPA's projection of compliance with the GHG standards, tailpipe emissions performance from the remaining combustion vehicles will exceed Tier 3 standards (left). If combustion vehicles instead achieve Tier 3 emissions standards, far fewer ZEVs will be required to meet the proposed Tier 4 fleet average standards than are modeled to comply with the GHG standards (right).

EPA should close this gap in relative stringency by setting a standard that reflects the full emissions reductions of the combustion vehicle technologies it has already identified as feasible (and which are readily available). Aligning the Agency's assessment of ZEV deployment and its analysis (covered primarily in the Tier 3 rulemaking) of what is achievable to reduce NMOG+NO_x emissions from combustion vehicles would yield a 2032 target of 10 mg/mi, a 17% reduction from its Proposal. Interim targets would then be adjusted accordingly.

Such a standard for LDVs would still be technology-neutral: The target corresponds to the lowest non-zero bin in the Proposal (Tier 4 Bin 10),[137] and the Agency has already identified combustion vehicles that have certified FTP emissions below 10 mg/mi.[138] Moreover, we expect that manufacturers seeking to comply with the multipollutant standards primarily through combustion vehicle technologies would be investing in further emission-reduction technologies from those vehicles, such as by ensuring their vehicles are more in line with the emissions

[137] 88 Fed. Reg. at 29419.
[138] DRIA at 3-41, Tbl. 3-14.

profiles of the industry-leading vehicles, including through deployment of hybridization and other EPA-identified strategies to reduce tailpipe emissions. Alternatively, for manufacturers that want to comply with the multipollutant standards through greater deployment of zero-emission technologies, this pathway would still allow flexibility for their combustion vehicle fleet to fall short of the Tier 3 requirements, provided they sell ZEVs beyond EPA's modeled industry average.

EPA has embarked on a multipollutant rulemaking precisely because technologies exist to simultaneously achieve reductions in GHGs and criteria pollutants.[139] Reducing the stringency of the final standards to 10 mg/mi NMOG+NO_x better aligns with the feasible and cost-appropriate technologies already identified by the Agency.

b. EPA should consider ways to limit over-crediting.

Figure VI.F-1 (left side) shows a non-monotonic behavior—that is, the allowable emissions profile of the combustion vehicles (green line) first increases significantly from 2026-2029, then decreases. This is largely due to the delay in increasing stringency for LDT3, LDT4, and MDPV classes (Class 2 light trucks), the result of EPA's interpretation of lead time requirements under the Clean Air Act.[140] The Agency has offered an optional "early compliance" pathway for manufacturers; however, this pathway increases the total stringency over the six years covered by the proposal, reducing the likelihood of manufacturers choosing this path to compliance.[141]

In an effort to induce manufacturers to align with the early compliance pathway and to acknowledge the reduced emissions benefits of the stagnant standard for Class 2 light trucks from 2025-2029 (a full five-year window corresponding to the lifetime of Tier 3 credits) under the default compliance pathway, EPA should condition manufacturers' full utilization of credits in this time period on their utilization of the early compliance pathway. For example, EPA could set a limit on the amount of averaging, banking, and trading (ABT) credits that could be utilized for compliance, in order to limit windfall credits from reductions in fleet emissions that occur during the 4-year period of stagnation. This would also ensure that manufacturers do not artificially prolong compliance through an overreliance on such credits.

2. The proposed $PM_{2.5}$ requirements are appropriate.

EPA is also proposing to set a limit on the allowable particulate matter ($PM_{2.5}$) emissions from all LDVs. This is an appropriate step under the Agency's authority and is well-grounded in both the need for additional emissions reductions and technical feasibility.

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[139] 88 Fed. Reg. at 29187.
[140] *See id.* at 29258.
[141] If EPA sets a 10 mg/mile standard in 2032 as recommended in Section VI.F.1.a, and thus reduces the step for Class 2 light trucks to 10 mg/mile, there would presumably be no such gap in stringency between the early and default compliance pathways.

Stoichiometric gasoline direct-injection is deployed in over half the new vehicle fleet in the United States and supports the deployment of turbocharged, downsized engines as well as high-compression ratio engines, both of which are key technologies to reduce GHG emissions.[142] At the same time, moving from port-fuel injection to direct-injection leads to an increase in both the amount of $PM_{2.5}$ and the particle count.[143] Addressing $PM_{2.5}$ emissions from the vehicles deploying these technologies is critical as they become a larger share of the on-road fleet.

Gasoline particulate filters (GPFs) have been successfully deployed globally for years to address these emissions, as EPA has documented in the Draft Regulatory Impact Analysis (DRIA).[144] Additionally, in-cylinder strategies can help mitigate emissions, including through the design of both the injector and the cylinder surface.[145] Aftertreatment design can also be used to mitigate cold-start emissions, in particular.[146] All of the technology developments described above are well-established, and many are analogous to technologies that have been deployed to limit $PM_{2.5}$ emissions from diesel engines.

As part of its Advanced Clean Cars program, California finalized a $PM_{2.5}$ standard of 1 mg/mile, to begin phasing in with the 2025 model year.[147] As part of its review, the California Air Resources Board (CARB) conducted tests demonstrating the feasibility of achieving this standard, including data on particle count, GPF effectiveness, and the ability to measure sub-mg quantities of $PM_{2.5}$.[148] While these standards have not gone into effect, the underlying data support EPA's proposed $PM_{2.5}$ program.

The benefits of the $PM_{2.5}$ standards are significant—depending on the assumed rate of deployment, EPA's Proposed Standards could cut tailpipe $PM_{2.5}$ emissions by up to 90% by 2050.[149] This could lead to cumulative health benefits of \$85 to \$160 billion over that same timeframe, at a 3% discount rate.[150] Importantly, it could also lead to measurable improvements

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[142] *See* U.S. EPA, The 2022 Automotive Trends Report: Greenhouse Gas Emissions, Fuel Economy, and Technology Since 1975, EPA-420-R-22-029 (Dec. 2022), Chapter 4, available at https://www.epa.gov/automotive-trends/download-automotive-trends-report.

[143] Omar I. Awad, et al, Particulate emissions from gasoline direct injection engines: A review of how current emission regulations are being met by automobile manufacturers, *Sci. Total Env.* 718, 137302 (2020), at https://doi.org/10.1016/j.scitotenv.2020.137302 (subscription required).

[144] DRIA, Section 3.2.5.

[145] See Awad. et al. 2020 for a review.

[146] *Id.*

[147] Cal. Code of Regs. Tit. 13, § 1961.2(a)(2)(A).

[148] For measurement capability, see CARB, An Update on the Measurement Of PM Emissions at LEV III Levels, (2015), available at https://ww2.arb.ca.gov/sites/default/files/2020-01/lev_iii_pm_measurement_feasibility_tsd_20151008_ac.pdf. For additional tests on GPF capability, see CARB, California[']s Advanced Clean Cars Midterm Review, Appendix K: PM Emission Testing Results (Jan. 8, 2017), available at https://ww2.arb.ca.gov/sites/default/files/2020-01/appendix_k_pm_test_results_ac.pdf.

[149] Oak Leaf Envtl., Impacts Analysis of a Revised Federal Light-Duty On-Road Particulate Matter Standard, Prepared for the Manufacturers of Emissions Controls Association (MECA) (June 2023), at 20, Fig. 7, available at https://www.meca.org/wp-content/uploads/2023/06/LDV_PM_Standard_Final_Report_06272023.pdf.

[150] *Id.* at 22-23, Figs. 9, 10 & "9" [Fig. 11 appears to be incorrectly labeled as Fig. 9].

in near-roadway air quality,[151] which could be significant for the more than 41 million people living within close proximity of high-traffic roadways.[152]

VII. Revisions to Elements of the Light-Duty Regulatory Program Are Warranted.

In addition to promulgating strong emission standards for light-duty vehicles, EPA should finalize important revisions to the light-duty regulatory program. As detailed below, we recommend that EPA revise the light-duty footprint curves and ensure that the final standards do not incentivize larger BEVs. We also urge EPA not to permanently foreclose the possibility of including upstream emissions in compliance accounting.

A. EPA is correct to address the misaligned incentives present in the current footprint attribute curves.

As EPA identified in its analysis of the market, sales of utility vehicles have greatly outpaced the sales of cars (sedans, coupes, etc.) over the past decade.[153] Unfortunately, the design of the footprint attribute curves underpinning the Agency's GHG standards has played a role in incentivizing manufacturers to shift market share towards utility vehicles, which generally have emissions targets much higher than passenger car equivalents.[154] EPA is appropriately proposing to revise the design of these curves by considering not just what is technically achievable but also how manufacturers would respond to a given attribute curve,[155] rather than starting from a broader view of makeup of the current fleet, as was used to originally define the attribute curves.[156]

1. EPA has appropriately characterized its footprint attribute curve for passenger cars.

In developing the car curve, EPA has appropriately balanced technology-driven emissions reductions for vehicles of different sizes and manufacturers' likely non-technology responses to its attribute curves. EPA should finalize these updates to the car curve.

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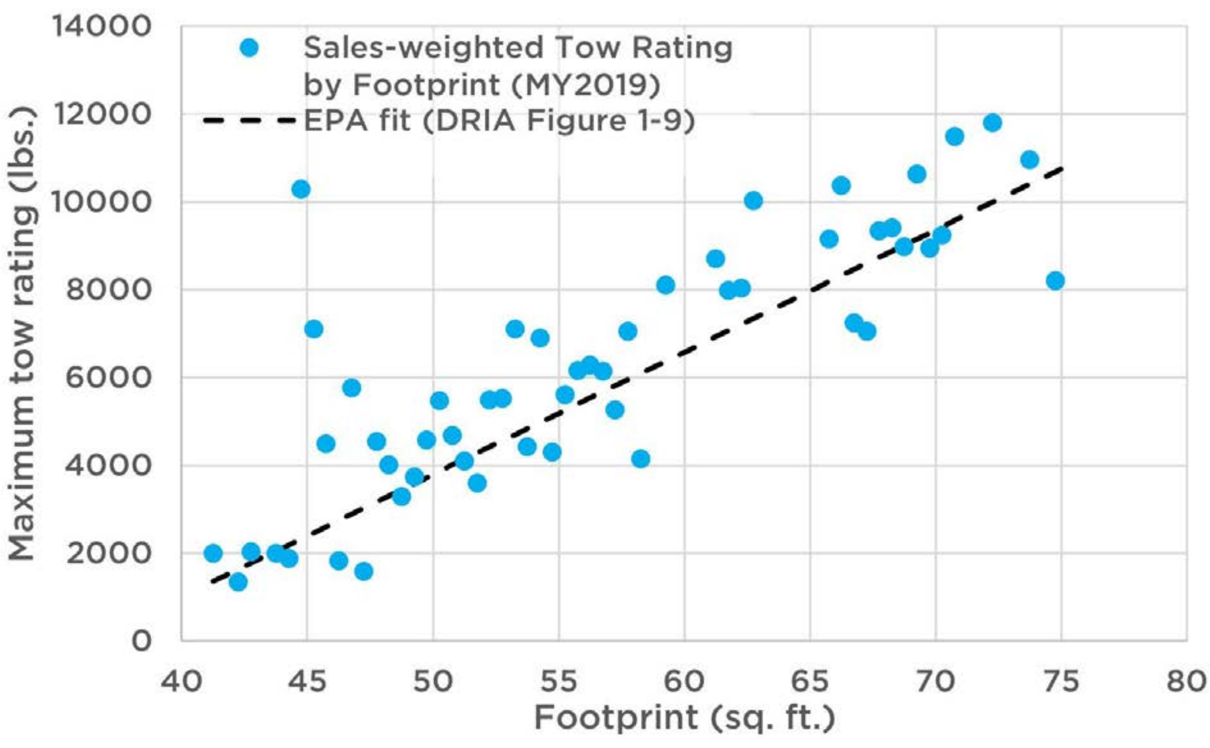
[151] *Id.* at 24, Tbl. 5.
[152] 88 Fed. Reg. at 26060.
[153] DRIA, Section 1.1.1 & 1-4, Figs. 1.1 & 1.2.
[154] A review of this evidence is available at Union of Concerned Scientists, *The SUV Loophole: How a changing sales mix is affecting the efficacy of light-duty vehicle efficiency regulations* (2016), https://downloads.regulations.gov/EPA-HQ-OAR-2015-0827-4016/attachment_2.pdf.
[155] "In determining an appropriate slope for the car curve, EPA modeled a range of car slopes to evaluate the footprint response – that is, to assess the tendency of the fleet to upsize or downsize as a compliance strategy." DRIA at 1-6.
[156] A full discussion is available in Section 3.2 of the RIA to EPA's MY 2012-2016 LDV GHG standards. U.S. EPA, Final Rulemaking to Establish Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards: Regulatory Impact Analysis. EPA-420-R-10-009 (Apr. 2010), available at https://nepis.epa.gov/Exe/ZyPDF.cgi/P1006V2V.PDF?Dockey=P1006V2V.PDF. *See also* U.S. EPA & NHTSA, Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards; Final Rule, 75 Fed. Reg. 35324, 25359-68 (May 7, 2010).

2. EPA has overestimated performance-related emissions when calculating the footprint attribute curves for light trucks.

In determining the shape of the light truck attribute curve, EPA has appropriately started from the passenger car curve, compensating for different features that distinguish a passenger car and light truck. However, EPA has overestimated the impacts of those factors.

The first characteristic it uses to distinguish a light truck is the addition of 4- or all-wheel-drive (4/AWD) to a crossover utility vehicle, which shifts a vehicle from the passenger car to light truck classification.[157] EPA estimated this value in a similar manner to previous work and arrived at a comparable but slightly reduced value for the difference in CO_2 values,[158] likely resulting from improvements in all-wheel-drive packages that have diminished the powertrain losses associated with the driveshaft and differential. This is a reasonable estimate to use as an offset, if the offset is applied solely to the share of light trucks with 4/AWD, as EPA has done.[159]

Figure VII.A-1. Maximum tow rating, by footprint (model year 2019)



The other additional criterion EPA uses to distinguish the light truck curve from the passenger car curve is the application of towing. Considering the maximum towing capacity, we

[157] This is true provided the vehicle also meets the requirements of 49 C.F.R. § 523.5(b)(2).
[158] Compare 12.5 g/mi (EPA, DRIA at 1-9) to 14.2 g/mi from UCS, *The SUV Loophole*, at 3.
[159] "Based on this analysis, EPA's proposed footprint curves reflect an offset between the car and truck curves of 10 g/mi for ICE vehicles equipped with AWD." DRIA at 1-9.

were largely able to reproduce the slope of the curve for maximum towing capacity vs. footprint independently (Figure VII.A-1). However, maximum towing capacity does not actually reflect the real towing capabilities of the fleet because the maximum towing capability for a large share of models is dependent upon additional equipment installation. As a result, EPA is unintentionally incorporating into its regulatory curves excess performance capability—while there may be variance for a vehicle's maximum tow capability based on powertrain and drivetrain, without a tow package (which may include a trailer hitch, changes to wiring to support connection to a trailer, and an upgraded rear axle), a vehicle's ability to tow may be significantly more limited (as illustrated in Table VII.A-1). With one ton or more difference between a vehicle's capability with and without the tow package, ascribing the maximum capability to all vehicles could unreasonably allow more than 20 g/mi additional GHG emissions based on the Agency's estimate of 9 g/mi per 1,000 pounds payload.[160] EPA should apply any adjustment only according to the capability of vehicles as sold in the final rule.

Table VII.A-1. Maximum towing capacity for 10 most popular light trucks with and without tow package[161]

Vehicle Make and Model	Maximum Towing Capacity (lbs.)	
	With Tow Package	Without Tow Package
Ford F-150	14,000	11,300
Chevy Silverado/GMC Sierra	13,300	9,900
Ram 1500	12,750	10,100
Toyota RAV-4	3,500	1,500
Honda CR-V	1,500	n/a
Toyota Tacoma	6,800	3,500
Jeep Grand Cherokee	7,200	3,500
Toyota Highlander	5,000	n/a
Chevy Equinox	1,500	n/a
Ford Explorer	5,600	3,000

In contrast to its application of the 4/AWD emissions factor, EPA did not apply its adjustment for towing-related emissions in a sales-weighted fashion. By instead applying the assumed maximum tow capability regardless of application of the towing package needed to support this, EPA is basing the curve on outsized performance characteristics. Just as EPA did not factor in whether there might be sports cars or high-output luxury models in determining the passenger car attribute curve, EPA should limit its assessment of light truck characteristics to only those features which are actually deployed. While there may be a subset of the market that requires towing performance, which thus differentiates the light trucks from cars, that additional emissions offset should be applied on a sales-weighted basis solely to the respective segment of

[160] DRIA at 1-11.
[161] These towing capacities reflect the trim variant with the highest towing packages, both with and without the vehicle's tow package. Many of these vehicles have engine options that offer lower towing capability.

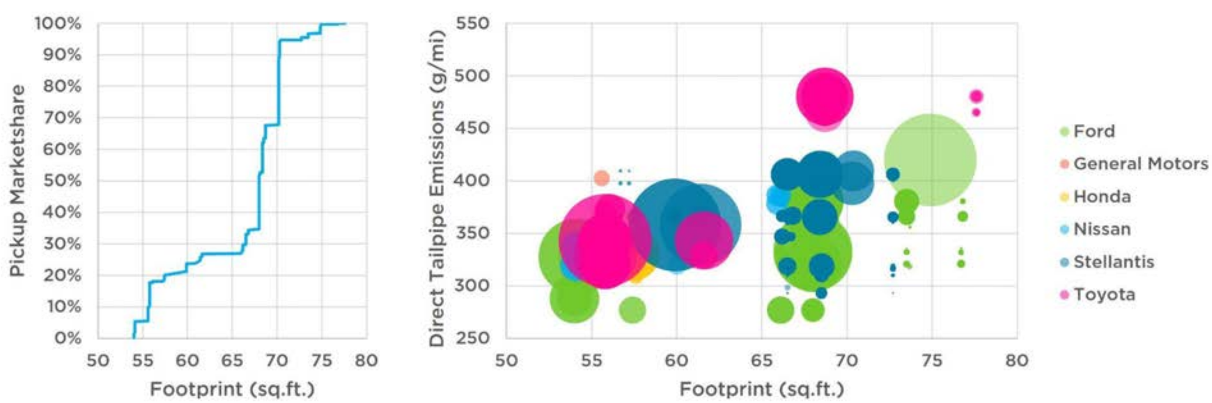
the fleet that is utilizing the maximum tow package. For the remainder of the fleet, only the base tow capability should be considered. This will necessarily reduce the slope of the attribute curve as currently defined.

3. EPA should further reduce the footprint of the cut point for light trucks based on pickup certification.

EPA has proposed phasing down the footprint of the cut point ("elbow") of the light truck attribute curve down to 70 sq. ft. The Agency should reduce it further, faster.

EPA has identified the need for the reduction in the cut point but has mistakenly focused on the average footprint of full-size pickups as the rationale.[162] While it is true that the average footprint has increased, and EPA is right to be concerned about incentives to upsize the pickup fleet, a large part of the reason for this increasing footprint is related to the growing share of four-door pickups. For example, the Ford F-150 has shifted from a mix of standard/extended/crew cab split of 17/50/33 in 2012 to 5/30/65 in 2022,[163] which increases the average wheelbase significantly for a standard bed and, thus, the vehicle's footprint. However, it is not the average footprint that is the relevant factor in setting the location of the cut point, but the relationship between the certified emissions from a full-size pickup truck and its footprint.

Figure VII.A-2. 2020 light-duty pickup market share and emissions, by footprint[164]



(left) While one-quarter of pickup sales are so-called "mid-size" pickups, the full-size pickup market in 2020 was highly concentrated around a footprint of 66 to 70 square feet, with 68% of all pickup sales falling in that narrow range. (right) While some larger pickups exist, those vehicles have virtually the same emissions because they have similar capability as the smaller

[162] DRIA at 1-14 - 1-15.
[163] Data from Wards Intelligence, "U.S. Light Vehicles by Body Style, '22 Model Year" and "'12 Model U.S. Domestic Car and Light Truck Output by Body Style."
[164] MY 2020 data taken from EPA's CCEMS modeling supporting the 2023-2026 final rulemaking. https://www3.epa.gov/otaq/ld/EPA-CCEMS-PostProcessingTool-Project-FRM.zip.

vehicle, even if they have a larger bed and/or cab. This is indicated by horizontal "lines" of dots (proportional to sales) for a given sub-model trim (e.g., the Stellantis pickups with 410 g/mi).

The effect of increasing the footprint at which the cut point occurs is to relax the standard for full-size pickup trucks, particularly those with longer beds and larger cabs, which have larger footprints. This cut point does not reflect the level of technical feasibility or actual certification of those larger pickups, however. As can be seen in Figure VII.A-2, pickups of a given powertrain and towing package configuration are certified to virtually identical fuel economy and emissions standards, as indicated by the flat rows of dots in Figure VII.A-2 spanning a range of footprints. This suggests that these larger pickup trucks should have standards consistent with the smallest full-size footprint vehicles, as was identified when the curves were first designed.

EPA should move swiftly to set the cut point of its standards at the average footprint of full-size pickups with a standard cab and bed because any vehicles with a larger footprint will be certified at virtually identical emissions levels, and it is precisely this flattening that the position of the cut point of the curve is meant to reflect. That footprint would correspond to 68.1 sq. ft. for MY 2022.

B. EPA should ensure that the final standards do not incentivize larger BEVs.

While we support EPA's incorporation of projected BEV penetration into the slopes of the footprint curves for the model years covered by the Proposal, we remain concerned that the Proposal retains the incentive for automakers to manufacture larger BEVs, a trend that has the potential to erode the environmental benefits of EPA's vehicle standards and that EPA anticipates will occur under the Proposed Standards. The final standards should incorporate a regulatory treatment of BEVs that discourages upsizing or selective manufacturing of larger BEVs.

As discussed previously, we support EPA's proposal to reflect projected BEV penetration in developing the slopes of the footprint curves. As EPA explains, the curves' flatter slope is "by design and reflects our projection of the likelihood that a future fleet will be characterized by a greatly increased penetration of BEVs, even in a no-action scenario." 88 Fed. Reg. at 29235. Inclusion of BEVs in establishing the curves has the effect of flattening their slope because BEVs have no tailpipe emissions and therefore factor into the curves at 0 g/mile.

While it is appropriate to reflect projected rates of BEV penetration in setting the slope of the footprint curves, it does not follow that it is appropriate to distinguish BEVs based on their vehicle footprint for purposes of regulatory compliance, effectively "rewarding" larger footprint BEVs. "From a physics perspective, a positive footprint slope for [combustion] vehicles makes sense because as a vehicle's size increases, its mass, road loads, and required power (and corresponding tailpipe CO2 emissions) will increase accordingly." 88 Fed. Reg. at 29235. The corollary, however, is that regulatory distinctions based on vehicle footprint lack a compelling basis for BEVs. As EPA notes, "a fleet of all BEVs would emit 0 g/mi, regardless of their respective footprints." *Id.* "[F]ootprint does not have any relationship with tailpipe emissions from BEVs." DRIA at 1-6.

Currently, manufacturers receive a considerable regulatory compliance benefit from producing larger-footprint BEVs: these BEVs increase the average footprint of the fleet and thus loosen the GHG emissions standard that the overall fleet will be required to meet. Because the GHG benefit of BEVs does not depend on their footprint and there is no practical need for crediting larger-footprint BEVs more robustly than smaller-footprint BEVs, the laxer standards applicable to fleets with larger-footprint BEVs come without any attendant climate benefit. At the same time, larger-footprint BEVs are likely to be heavier and less efficient, requiring more electricity to travel a given distance and typically requiring larger batteries and more of the materials that comprise those batteries, and carrying increased purchase costs. BEV footprint upsizing has adverse consumer, grid-related, and environmental consequences.

Concerns about incentivizing a shift to larger BEVs are well-founded. According to EPA's modeling, BEVs in MY 2032 are projected to increase in size relative to MY 2020. DRIA at 1-13–1-14, Fig. 1-12. The increase is 1.6 sq. feet for sedans, 1.9 square feet for CUVs/SUVs, and 3.3 square feet for pickups. DRIA at 1-13, Tbl. 1-2. Selective manufacturing of larger-footprint BEVs—which similarly raises the average footprint of the fleet—is already occurring. Automaker GM recently ceased production of its lone small-footprint BEV: the Chevy Bolt.[165] GM's remaining near-term BEV offerings are all larger vehicles: SUVs and pickup trucks.[166] A number of other automakers are also selectively manufacturing exclusively larger-footprint BEVs, including Ford, which currently produces only an SUV (the Mustang Mach-E) and a pickup truck (the F-150 Lightning); Rivian, which produces only an SUV (the R1S) and pickup truck (the R1T); and Volvo, which produces only a cross-over (the C40) and three SUVs (the XC40, EX30, and EX90).[167]

EPA's final regulations should include a regulatory mechanism that discourages the manufacture of larger BEVs.

C. EPA should not foreclose the possibility of including upstream emissions in compliance accounting.

The Agency's 2012 rule included net compliance accounting for PEVs' upstream emissions from electricity generation beginning with MYs 2022-2025. 88 Fed. Reg. at 29252; 77 Fed. Reg. at 62816. Under that rule, net upstream emissions were to be determined by "attribut[ing] a pro rata share of national CO_2 emissions from electricity generation to each mile

[165] Khristopher J. Brooks, *GM to stop making Chevrolet Bolt, its best-selling electric vehicle*, CBS News (Apr. 26, 2023), https://www.cbsnews.com/news/chevy-bolt-end-production-gm-vehicle/.
[166] *See* General Motors, Electrification, EV Spotlight, https://www.gm.com/commitments/electrification.
[167] *See* Ford, Explore Going Electric, https://www.ford.com/electric/; Rivian, Vehicles Made for the Planet, https://rivian.com/; Volvo, Our Cars, Our Full Range, https://www.volvocars.com/us/.

driven under electric power minus a pro rata share of upstream emissions" from gasoline production. 88 Fed. Reg. at 29252. EPA justified leaving these emissions unaccounted for through MY 2023 as a then-necessary incentive for EV technology adoption. However, EPA's 2020 rule, effective before MY 2023, removed net upstream accounting requirements through MY 2026. 85 Fed. Reg. at 25208. EPA now proposes to eliminate upstream emissions accounting permanently, reasoning that upstream CO_2 accounting has consistently been absent from the vehicle program since its inception; that Section 202 regulates only tailpipe emissions; and that power plant emissions, regulated under separate statutory programs, are on the decline. EPA also notes that it does account for upstream emissions in its separate analysis of overall estimated vehicle emissions impacts and the projected benefits of its rules, and that any EV upstream accounting for compliance purposes, were it to take place, would have to be accompanied by a calculation of upstream emission impacts of combustion vehicles from refineries. 88 Fed. Reg. at 29252.[168]

If EPA proceeds as proposed, it must undertake a full and comprehensive upstream emissions analysis for all vehicles as part of its cost-benefit analysis. However, as noted above, EPA itself previously (and reasonably) interpreted the statute as granting it discretion to include upstream emissions and has set standards that do so. 88 Fed. Reg. at 29252; 77 Fed. Reg. at 62816. We believe the better option is to include upstream emissions of all vehicles in compliance accounting, particularly as EVs are becoming a larger part of the new vehicle fleet and the proliferation of ever larger and heavier EVs increases their upstream emissions. In either case, as EPA states, any accounting of upstream emissions—whether for compliance purposes or cost-benefit analysis—must be consistent for all vehicles. If the Agency proceeds as proposed,

[168] On a "lifecycle" basis, ZEVs offer superior emissions reductions compared to combustion vehicles. *See generally* Adrian O'Connell et al., Int'l Council on Clean Transp. (ICCT), *A Comparison of the Life-Cycle Greenhouse Gas Emissions of European Heavy-Duty Vehicles and Fuels* (2023), https://theicct.org/wp-content/uploads/2023/02/lca-ghg-emissions-hdv-fuels-europe-feb23.pdf; Lu Xu, *Life Cycle Greenhouse Gas Emissions of Conventional and Alternative Heavy-duty Trucks: Literature Review and Harmonization* (Thesis), at chs. 3-4 (2021), https://hdl.handle.net/1807/108920; Dora Burul & David Algesten, Scania, *Life cycle assessment of distribution vehicles: Battery electric vs diesel driven* (undated), https://www.scania.com/content/dam/group/press-and-media/press-releases/documents/Scania-Life-cycle-assessment-of-distribution-vehicles.pdf; Georg Bieker, ICCT, *A Global Comparison of the Life-cycle Greenhouse Gas Emissions of Combustion Engine and Electric Passenger Cars* (2021), ttps://theicct.org/wp-content/uploads/2021/07/Global-Vehicle-LCA-White-Paper-A4-revised-v2.pdf; Jarod C. Kelly et al., Argonne National Laboratory, *Cradle-to-Grave Lifecycle Analysis of U.S. Light-Duty Vehicle-Fuel Pathways: A Greenhouse Gas Emissions and Economic Assessment of Current (2020) and Future (2030-2035) Technologies*, at ch. 8 & app. B, (2022), https://publications.anl.gov/anlpubs/2022/07/176270.pdf; Fuels Institute, *Life Cycle Analysis Comparison*, (2022), https://www.transportationenergy.org/wp-content/uploads/2022/10/FI_Report_Lifecycle_FINAL.pdf; Maxwell Woody et al., *Corrigendum: The role of pickup truck electrification in the decarbonization of light-duty vehicles*, Env't Rsch. Letters, July 15, 2022, https://iopscience.iop.org/article/10.1088/1748-9326/ac7cfc/pdf; David Reichmuth et al., Union of Concerned Scientists, *Driving Cleaner: Electric Cars and Pickups Beat Gasoline on Lifetime Global Warming Emissions* (2022), https://www.ucsusa.org/sites/default/files/2022-09/driving-cleaner-report.pdf; Florian Knobloch et al., *Net emission reductions from electric cars and heat pumps in 59 world regions over time* (Dec. 1, 2020), https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7308170/pdf/EMS85812.pdf (author manuscript; published in final edited form at 3 Natural Sustainability 437 (2020)).

we strongly urge it *not* to characterize its decision as "permanent." Both the vehicle and power generation industries are currently undergoing rapid changes. Though power generation emissions have been declining, the need for electricity is increasing, and the reduction of EV energy use will become more important as the fleet becomes more electrified. Any decision now to permanently omit fleet upstream emissions compliance accounting would be premature.

VIII. Stronger GHG and Criteria Pollutant Standards for Medium-Duty Vehicles Are Feasible.

We now turn to EPA's proposed emission standards for medium-duty vehicles. Below, we examine the combustion vehicle and zero-emission technologies that can further reduce GHG emissions from the medium-duty fleet, comment on EPA's modeling, address economic considerations, and make suggestions on certain aspects of EPA's regulatory program. We also offer recommendations for the Tier 4 NMOG+NOx standards and PM requirements. As detailed below, strong GHG and criteria pollutant emission standards for MDVs are feasible and cost-reasonable.

A. EPA must strengthen its GHG standards for MDVs.

EPA's proposed GHG standards for MDVs significantly underestimate the potential for feasible emissions reductions from the Class 2b-3 fleet, particularly pickup trucks. EPA has primarily focused on the electrification of MDVs in setting its standards.[169] However, not only has it underestimated the share of MDVs that could be electrified, it has underestimated the technologies available to reduce GHG emissions from gasoline- and diesel-fueled vehicles. EPA should adopt more stringent final standards for MDVs that reflect greater application of both the zero-emission powertrain and conventional emission control technologies that are feasible and widely available.

1. The combustion vehicle technology pathways show the feasibility of stronger standards.

EPA proposes as its 2027 standard the current (Phase 2) standards for diesel pickups and vans, and then adjusts those standards in the future based on assumptions about the level of electrification within the fleet. In fact, in EPA's modeling, combustion MDVs actually increase average direct tailpipe emissions by 1.5% between 2022 and 2032, with the increase being even larger for the Phase 2 baseline. The modeling thus indicates that no technological improvements to combustion MDVs are needed to comply with even the existing Phase 2 standards through 2027.[170]

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[169] DRIA at 1-21: "The feasibility of the 2027-2032 GHG standards is based primarily upon an assessment of the potential for a steady increase in MDV electrification, primarily within the van segment."

[170] This remains true for the "No IRA" sensitivity, though there is virtually no difference in the assumed production of electric MDVs between the default modeling run and this sensitivity case, indicating the degree to which electrification is expected to take off in the commercial van space due to improved TCO.

Subsequent to finalization of the Phase 2 standards in 2016, a number of technologies have been developed that EPA did not originally consider in establishing those standards; nor were the Phase 2 standards predicated on the full adoption of even those technologies that *were* identified at the time. As EPA noted in its Phase 3 heavy-duty vehicle proposal: "In developing the Phase 2 CO_2 emission standards, we developed technology packages that were premised on technology adoption rates of less than 100%. There may be an opportunity for further improvements and increased adoption through MY 2032 for many of these technologies included in the heavy-duty (HD) GHG Phase 2 technology package used to set the existing MY 2027 standards."[171]

By ignoring technologies for Class 2b-3 combustion vehicles that could achieve emissions reductions beyond the Phase 2 standards, EPA is setting its MDV standards below a level of readily achievable technology adoption (and, indeed, many of these technologies are already being deployed). Below, we walk through a number of the technologies that EPA should assume will be deployed by MDV manufacturers in the timeframe of the MDV Proposal.

a. EPA should consider additional compression-ignition (diesel) engine technologies.

Manufacturers of diesel engines for Class 2b-3 pickups and vans will deploy new engines in order to meet the 2027 NO_X standards that EPA finalized last year.[172] However, the Agency's modeling assumes that diesel vehicles will reduce GHG emissions by less than 1% from 2022 to 2032. This leaves a tremendous amount of technology on the table, not just from what the Agency identified in the Phase 2 rulemaking and assumed would be needed to meet the standards already on the books, but also from additional improvements that have been developed since then.

Diesel engine efficiency continues to increase, with HHD (Class 8) diesel engines demonstrating up to 55% brake-thermal efficiency (BTE) in response to the second phase of the SuperTruck program. The Navistar and Cummins/Peterbilt teams demonstrated 55% BTE, compared to the 50% target for the first phase, while Daimler, Volvo, and PACCAR all demonstrated over 50% BTE, with a clear pathway towards the 55% target. The PACCAR team's progress is particularly illuminating, as they undertook an additional challenge to meet "ultra low NO_X" targets consistent with EPA's recent regulation as part of their overall efficiency effort, indicating that these levels of thermal efficiency are not incompatible with achieving the 2027

[171] 88 Fed. Reg. at 25960.
[172] *See* 88 Fed. Reg. 4296.

NO_X standards.[173]

Significant improvements in efficiency are not limited to the largest engines and can also be feasibly deployed on Class 2b-3 vehicles. Ford's latest iteration of its 6.7L Power Stroke diesel engine cut GHG emissions by 3.5% over the previous generation when it was introduced in 2020, and 2023 saw an additional 3% improvement due to a revised injection system.[174] General Motors released its new 6.6L Duramax diesel engine in 2023 with improved cylinder heads, fuel injection, and other features in a design that is meant to increase both power and efficiency, particularly at higher output.[175] These engine improvements are already being deployed today but are not captured in the Agency's OMEGA2 modeling.

Mild electrification also offers increased emissions reduction capabilities. Eaton demonstrated that it is possible to outperform simultaneously the 2027 NO_x standards and the Phase 2 CO_2 standards through a number of different aftertreatment and powertrain combinations,[176] including those applicable to Class 2b-3 vehicles. A recent research paper by Eaton demonstrates various combinations of control technologies manufacturers can target CO_2 and NO_x emissions levels over different regulatory cycles to develop a technology package that

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[173] *See* Zukouski, Russ, *Navistar SuperTruck II: Development and demonstration of a fuel-efficient class 8 tractor & trailer*, DOE Annual Merit Review, (Jun. 21-23, 2022) https://www1.eere.energy.gov/vehiclesandfuels/downloads/2022_AMR/ace103_%20Zukouski_2022_o_4-29_1232pm_ML.pdf; Mielke, David, *2022 Annual Merit Review: Cummins/Peterbilt SuperTruck II*, DOE Annual Merit Review, (Jun. 21-23, 2022) https://www1.eere.energy.gov/vehiclesandfuels/downloads/2022_AMR/ace102_dickson_2022_o_rev2%20-%20TrailLife-GCCC%20IN0110%20REVISED.pdf; Bashir, Murad, et al., *Daimler: Improving transportation efficiency through integrated vehicle, engine, and powertrain research - SuperTruck 2*, DOE Annual Merit Review, (Jun. 21-23, 2022) https://www1.eere.energy.gov/vehiclesandfuels/downloads/2022_AMR/ace100_Villeneuve_2022_o_4-30_1116am_ML.pdf; Bond, Eric, et al, *Volvo SuperTruck 2: Pathway to cost-effective commercialized freight efficiency*, DOE Annual Merit Review, (Jun. 23, 2022) https://www1.eere.energy.gov/vehiclesandfuels/downloads/2022_AMR/ace101_bond_2022_o_5-1_129pm_ML.pdf; Meijer, Maarten, *Development and demonstration of advanced engine and vehicle technologies for class 8 heavy-duty vehicle ([PACCAR] SuperTruck II)*, DOE Annual Merit Review (Jun. 21-23, 2022), https://www1.eere.energy.gov/vehiclesandfuels/downloads/2022_AMR/ace124_Meijer_2022_o_4-29_1056pm_KF.pdf.

[174] To assess these improvements, we refer to the combined transient cycle certification results for the MHD Power Stroke family of diesel engines available in the chassis cab/F-650 and F-750 configurations. The engines available in the heavy-duty pickups are not required to certify to isolated engine tests, but are likely to see similar levels of improvement, even with the higher power output, since they also have the same underlying technology.

[175] GMC Pressroom, *The Ultimate Heavy Duty: GMC Introduces its Most Luxurious, Advanced and Capable Sierra HD Ever* (Oct. 6, 2022), https://media.gmc.com/media/us/en/gmc/home.detail.html/content/Pages/news/us/en/2022/oct/1006-sierra.html. It is difficult to compare apples-to-apples between the new and old Duramax engines due to limited certification data and because some of that efficiency improvement was used to reduce tailpipe NOx, since the new diesel-equipped Silverado/Sierra HD 2500 have a reduced NMOG+NOx bin of 200 vs. 250 mg/mile. Additionally, because the standards are set by "work factor," the increase in power used to raise towing capacity by 4000 pounds increases the allowable emissions for the engine, which means that despite an apparent increase in certified CO_2 emissions of 2.4%, there could be a net improvement in compliance of up to nearly 5% as the result of up to a 7% increase in the model year 2023 emissions target.

[176] *See generally* Dorobantu, Mihai, *Eaton considerations on MD/HD GHG Phase 3*, OIRA-Eaton meeting, (Mar. 23, 2023), https://www.reginfo.gov/public/do/eoDownloadDocument?pubId=&eodoc=true&documentID=215442.

is suitable for compliance, including packages that can achieve CO_2 reductions beyond Phase 2 while meeting EPA's future 2027 NO_x standards.[177]

One of the strategies deployed by Eaton is a 48V electric heater, which could be deployed easily with a 48V mild hybrid powertrain, again illustrating the complementary technology packages available to manufacturers to simultaneously meet GHG and NO_x standards. The 48V mild hybrid powertrain can power accessories, including those related to emissions control, and can also help reduce engine-out NO_x. This was also demonstrated through testing by FEV as a strategy particularly relevant to medium-heavy-duty vehicles that share chassis and power requirements with the Class 2b-3 pickups and vans covered by this proposal.[178] Such developments should be incorporated into the Agency's analysis of the level of emissions reductions achievable from diesel-powered Class 2b-3 vehicles.

In the Phase 2 rulemaking, EPA excluded cylinder deactivation from medium-duty diesel engines,[179] but its own analysis now shows that manufacturers are likely to deploy that technology to meet the heavy-duty NO_x standards.[180] Similarly, a recent report by Roush identified cylinder deactivation as a likely engine configuration for many Class 2b-3 vehicles.[181] The Agency should consider this technology in its OMEGA2 modeling, further increasing the available emissions reductions technologies for diesel-powered vehicles.

b. EPA should consider additional spark-ignition (gasoline) engine technologies.

Another significant opportunity for increased improvement to combustion vehicles lies in spark-ignition (SI) engines, for which Phase 2 required no engine improvements beyond the 2016 SI engine standard. While this is somewhat rectified in EPA's move to a fuel-neutral standard for Class 2b-3 pickups and vans—which effectively results in a 5-6% increase in stringency for MDVs—this still does not fully recognize the potential improvement available

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[177] McCarthy, J., et al. 2023. "Technology levers for meeting 2027 NOX and CO2 regulations." *SAE Technical Paper* 2023-01-0354. https://doi.org/10.4271/2023-01-0354.

[178] Fnu, D., *et al.* 2023. "Application of 48V mild-hybrid technology for meeting GHG and low NOX regulation for MHD vehicles." SAE Technical Paper 2023-01-0484. https://doi.org/10.4271/2023-01-0484.

[179] 81 Fed. Reg. at 73754, Table VI-4. Note, however, that the agencies did consider a "right-sizing" of diesel engines, based on a 4-cylinder vs. 6-cylinder engine, and cylinder deactivation could be seen as a control-based attempt to yield the equivalent improvement without altering the maximum output. *See* NHTSA, *Commercial medium- and heavy-duty truck fuel efficiency technology study – Report #2*, U.S. Dep. of Transportation, 52–53 (Feb. 2016), https://www.nhtsa.gov/sites/nhtsa.gov/files/812194_commercialmdhdtruckfuelefficiency.pdf.

[180] EPA, *Control of Air Pollution from New Motor Vehicles: Heavy-Duty Engine and Vehicle Standards, Regulatory Impact Analysis*, at 108–131 (Dec. 2022), https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P1016A9N.pdf.

[181] Himanshu Saxena et al., *Electrification Cost Evaluation of Class 2b and Class 3 Vehicles in 2027–2030*, Roush, at 24-25, 28-30 (May 2023), https://cdn.mediavalet.com/usva/roush/r0YBSBBv00edOiBP759yoA/3Hcv7F_W-0G9ek0ODPgNMg/Original/Electrification%20Cost%20Evaluation%20of%20Class%202b-3%20Vehicles%20in%202027-2030_ROUSH.pdf. [hereinafter Saxena et al., *Electrification Cost Evaluation*].

from gasoline engines. And in fact, in the Agency's modeling, gasoline vehicles see, on average, 5% *higher* emissions in 2032, compared to 2022.[182]

The weakness in EPA's Phase 2 targets for SI engines and vehicles is apparent in looking at manufacturers' growing bank of compliance credits to-date, particularly for Ford Motor Company, the largest SI engine supplier. Ford has run a credit surplus in every year of the vocational engine program, but this surplus exploded in MY 2020 with the release of its latest 7.3L V8 engine, codenamed "Godzilla."[183] Even though the engine platform is relatively low-tech (naturally aspirated, pushrod V8), by utilizing variable cam timing and a variable-displacement oil pump, Ford's engine achieved a significant improvement in efficiency. The engine was also designed with fuel economy at load in mind for applications like towing. A smaller engine built on the same platform replaced the older base engine in 2023, no doubt increasing Ford's overcompliance and increasing the efficiency of even more of the MDV fleet.

General Motors is not standing still, either—its fifth-generation small-block V8 platform is getting a next generation update to a 5% improvement over the current generation,[184] and the current generation is already a credit generator for GM's heavy-duty vehicles under the Phase 2 program.[185] No further details are available about the heir to the current iron-block direct-injection L8T variant found in GM's heavy-duty offerings.

Note that neither of these new improvements reflect technology adoption that was further anticipated for gasoline engines when the Phase 2 regulations were finalized. EPA assumed that cylinder deactivation (discrete or continuous), downsizing, and mild and strong hybridization would be used to meet those standards,[186] yet none have yet been deployed in Class 2b-3 pickups and vans. This further underscores the significant amount of emissions reductions that are still readily achievable for Class 2b-3 vehicles.

2. The electrification technology pathway shows the feasibility of stronger standards.

When it comes to electrification, EPA's OMEGA2 modeling applies electrification almost exclusively to commercial vans, with the model assuming just 236,000 Class 2b-3 electric pickups will be sold out of more than 5.2 million Class 2b-3 pickups sold between 2022-2032

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[182] Because the model preferentially selects vans for electrification, some of this decrease is related to a shift in the vehicles included in the remaining gasoline fleet. However, even when limited to gasoline pickups there is an apparent backsliding in emissions, with an increase of 3%. This is similar to the backsliding that appears in the modeling of light-duty vehicles (see Section VI.A.2).
[183] EPA, *Final Phase 1 EPA Heavy-Duty Vehicle and Engine Greenhouse Gas Emissions Compliance Report (Model Years 2014-2020)*, Appendix B, at 40-42 (Nov. 2022) https://nepis.epa.gov/Exe/ZyPDF.cgi/P1016962.PDF?Dockey=P1016962.pdf.
[184] Wren, Wesley, T*his is why GM is launching a new small block V8*, Autoweek, (Feb. 3, 2023) https://www.autoweek.com/news/industry-news/a42746723/why-gm-is-launching-a-new-small-block-v8/.
[185] EPA, *Final Phase 1 EPA Heavy-Duty Vehicle and Engine Greenhouse Gas Emissions Compliance Report (Model Years 2014-2020)*, Appendix B, at 43.
[186] 81 Fed Reg. at 73776, Table VI-13.

(4.5%). On the other end of the spectrum, the model shows sales of just over 1.2 million electric vans out of just under 2.8 million total sales over the same period (43.4%), with electric vans achieving a 98% market share by 2032. The reasons for such a broad disparity are entirely artificial—for example, the model's 25% cap on production of Class 2b-3 BEV pickups—and do not reflect the latest available data on technology or cost.[187]

a. EPA's modeling should better reflect the favorable economic case for electric pickup trucks.

A recent report by Roush examined the potential for electrification of MDVs under a range of scenarios, finding that electrification is cost-competitive in the great majority of them.[188] It is clear that some amount of the difference between the uptake of Class 2b-3 pickups and vans in the OMEGA2 modeling stems from the far lower range assumed for vans (150 miles) compared to that of pickups (300 miles). But as illustrated in Table VI.A-1 below,[189] Roush finds that by 2030, even when comparing a low-cost combustion powertrain to the most costly battery chemistry (NMC811) deployed in a 400-mile electric Class 3 pickup,[190] the electric pickup still achieves total cost of ownership (TCO) parity within the typical loan length for a new vehicle (7 years). And when comparing a Class 3 pickup with a low-cost battery (LFP) to a high-cost internal combustion engine powertrain, a 400-mile electric pickup would pay off within 1 year, well within the payback period assumed for consumers by manufacturers within EPA's OMEGA2 model.

Table VIII.A-1. Time to achieve TCO parity for Class 2b-3 BEVs with a 2027 and 2030 purchase timeframe

Vehicle Type	BEV Range	2027			2030		
		Scenario 1	Scenario 2	Scenario 3	Scenario 1	Scenario 2	Scenario 3
Class 2b Van	BEV150	< 1 year	< 1 year	2 years	< 1 year	< 1 year	< 1 year
	BEV250	< 1 year	4 years	End of life	< 1 year	1 year	4 years

[187] In its OMEGA2 modeling, EPA has set an artificial cap of 25% on the maximum production of Class 2b-3 BEV pickups, identified in the production_constraints-body_style_MD.csv input file. There is no sufficient justification for this cap in the DRIA or preamble, with the exclusive reference found on p. 1-21 of the DRIA, for which the Agency writes: "The primary assumptions within the work factor based GHG standards for MDV from 2028 to 2032 include an approximately 8 percent year over year improvement, to a large degree from electrification of MDV vans and to a lesser degree electrification of a small fraction (<25 percent) of MDV pickups and adoption of other technologies."
[188] Saxena et al., *Electrification Cost Evaluation* at 26.
[189] Table VI.A-1 is adapted from Saxena et al., *Electrification Cost Evaluation*, Tbl. 24, at 145. Scenario 1 represents the adoption of low-cost BEV and high-cost combustion vehicle technologies; Scenario 2, medium-cost BEV and combustion vehicle technologies; and Scenario 3, high-cost BEV and low-cost combustion vehicle technologies. *Id.* at 28-29.
[190] Roush used an LFP battery for its low-cost BEV, an NMC811 battery for its medium-cost BEV, and a "10% costlier" NMC811 battery for its high-bost BEV. *Id.* at 30-31.

Class 3 Pickup Truck	BEV150	< 1 year	< 1 year	1 year	< 1 year	< 1 year	< 1 year
	BEV250	< 1 year	2 years	6 years	< 1 year	< 1 year	2 years
	BEV300	< 1 year	4 years	9 years	< 1 year	1 year	4 years
	BEV400	1 year	6 years	End of life	< 1 year	3 years	7 years
Class 3 Van	BEV150	< 1 year	< 1 year	4 years	< 1 year	< 1 year	< 1 year
	BEV250	< 1 year	5 years	End of life	< 1 year	2 years	6 years

When accounting for the impacts of the IRA, the economic case for electrification of Class 2b-3 pickups is even clearer, as shown in Table VI.A-2. Here the impact of the full § 30D credit is shown, which is also the maximum allowable limit of the § 45W (commercial clean vehicle) credit for Class 2b-3 vehicles.[191] Roush's analysis finds that purchase price parity is achieved for virtually all BEV classes in the timeframe of the analysis, so the § 45W commercial vehicle credit is not applicable in the later years of their analysis.[192] In fact, Roush finds that, with the application of IRA credits, by MY 2027 all BEVs except the 400-mile pickup will be priced at or below a comparable combustion vehicle[193]; and that *all* MY 2027 BEVs will achieve TCO parity within the first two years of vehicle ownership.[194] Here it is worth noting that, despite the large share of MDVs that are purchased for commercial fleets, EPA did not directly include the § 45W credit in its analysis, instead applying the same combination of the § 30D and § 45W credit as it did for LDVs.[195] Because the § 45W credit is based on the lesser of $7500 or the difference in purchase price, this credit should act to hedge uncertainty in the Agency's analysis, though that is not how it was treated within the OMEGA2 modeling runs.

Table VIII.A-2. Time to achieve TCO parity with IRA § 30D credits for MYs 2023 and 2027[196]

	BEV Range	2023		2027	
		Original	with IRA credits	Original	with IRA credits
		Scenario 2	Scenario 2	Scenario 2	Scenario 2
Class 2b Van	BEV150	11 years	4 years	< 1 year	< 1 year
	BEV250	End of life	End of life	4 years	< 1 year

[191] *Id.* at 175-79. The § 45W credit is based on 30% of the basis of a vehicle not powered by a gasoline or diesel internal combustion engine, or the difference in purchase price between a qualified clean vehicle and a comparable combustion vehicle. In the case of vehicles that have a GVWR less than 14,000 pounds (which includes Class 2b-3 vehicles), the total credit is capped at $7500.
[192] *Id.* at 195.
[193] *Id.*
[194] *Id.* at 197-98.
[195] This is not immediately apparent in the text of the preamble or DRIA but can be assessed by comparing the contents of the vehicle_price_modifications_20230314b.csv input files from the LDV and MDV modeling runs, which are identical.
[196] This table is adapted from Saxena et al., *Electrification Cost Evaluation*, Tbl. 30, at 193.

Class 3 Pickup Truck	BEV150	7 years	3 years	< 1 year	< 1 year
	BEV250	End of life	10 years	2 years	< 1 year
	BEV300	End of life	End of life	4 years	< 1 year
	BEV400	End of life	End of life	6 years	2 years
Class 3 Van	BEV150	End of life	6 years	< 1 year	< 1 year
	BEV250	End of life	End of life	5 years	< 1 year

The Roush report is not the only analysis to find a strong economic rationale for the adoption of zero-emission MDVs. A recent report from the National Renewable Energy Laboratory (NREL) found that cost parity will be achieved before 2035 (even in the absence of the IRA) for medium- and heavy-duty vehicles, including Class 3 vans and Class 4-5 vehicles that share a platform with Class 2b-3 pickups (which were not part of that analysis).[197] Similarly, a recent International Council on Clean Transportation (ICCT) report on electric MDVs finds that purchase price parity with diesel MDVs will be achieved prior to 2032 for 300-mile and lower BEVs, even in the absence of IRA funding.[198] And when IRA funding is considered, even 400-mile BEV pickups would achieve purchase price parity in the timeframe of this rule.[199]

There is some difference in costs between EPA's assessment and other studies such as those described above: on average, according to EPA, Class 2b-3 combustion pickups will cost about $5,000 less (from a purchase price standpoint) than a comparable electric pickup. However, with the Agency's application of an average IRA credit of $6,000 in 2032, this would still yield cost parity, on average, so even EPA's higher cost assessment cannot fully explain the reason for Class 2b-3 pickups electrifying at such a reduced rate in the Agency's modeling. Even more than that, this disparity is almost entirely influenced by the relative price difference of gasoline and diesel pickups in EPA's modeling, with the Agency's BEV300 pickups just $1,100 more expensive than diesel pickups without the IRA incentives, not far off ICCT's conclusion that BEV300 pickups will achieve cost parity with diesel pickups by 2031.[200] Despite this, the model's conversion rate of combustion vehicle sales to electric vehicle sales is virtually indistinguishable between gasoline and diesel pickups, at roughly 20% for each, seemingly indicating that neither purchase price nor TCO parity have a significant impact on sales. Given that many Class 2b-3 vehicles are purchased for commercial use,[201] such modeling behavior is inconsistent with the economically-driven decisionmaking that would be expected to occur in the real world.[202]

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[197] Catherine Ledna et al., NREL, *Decarbonizing medium- and heavy-duty on-road vehicles: Zero-emission vehicles cost analysis*, Mar. 2022, at 2, 46 https://www.nrel.gov/docs/fy22osti/82081.pdf.
[198] Eamonn Mulholland, ICCT, *Cost of electric commercial vans and pickup trucks in the United States through 2040* (Working Paper 2022-01), Jan. 2022, at 11 (Fig. 5), https://theicct.org/wp-content/uploads/2022/01/cost-ev-vans-pickups-us-2040-jan22.pdf.
[199] *See id.*
[200] *Id.*
[201] *See id.* at 1; Saxena et al., *Electrification Cost Evaluation*, at 49.
[202] For example, EPA's own analysis of the heavy-duty market assumed a conversion rate of 80% when cost parity is achieved. 88 Fed. Reg. at 25992, Tbl. II-23. And analysis from NREL finds this number to be nearly 100%; see

Based on EPA's own modeling, BEV variants for over 71% of the Class 2b-3 market achieve first cost parity with their combustion-powered equivalent by 2032 when including IRA incentives, including 57% of the Class 2b-3 pickup truck market.[203] This is a substantially higher share of vehicles than the model assumes will be deployed.

For all of these reasons, EPA's modeling does not accurately reflect the favorable economic case for commercial MDV electrification, particularly for pickups. While some of these modeling problems can be ascribed to differences in battery costs and EPA's unreasonable choice to include an artificial 25% production cap on BEV pickups, other problems are intrinsic to assumptions made within the model that do not reflect the Agency's own assessment of likely adoption of electrification for commercial vehicles, particularly considering the incentives available under the IRA.

b. EPA should more fully account for the impact of state regulations on the adoption of Class 2b-3 ZEV pickups and vans.

In addition to market forces, state regulatory requirements will have a significant impact on the adoption of Class 2b-3 ZEV pickups and vans, not just through ZEV sales requirements but through the corresponding industrial development and production that will occur to meet related demand. EPA does not appear to have considered the relative impact of such state regulations as part of its OMEGA2 modeling.[204]

Under the Advanced Clean Trucks (ACT) regulation, manufacturers must ensure that 40% of their sales of Class 2b-3 vehicles are ZEVs by 2032, en route to an eventual target of 55% ZEV sales in 2035.[205] ACT has already been adopted in eight states as of the date of this comment letter, and these states make up nearly 20% of the heavy-duty market (including Class 2b-3 vehicles) overall.[206] While there are no strict requirements on the mix of vehicles a manufacturer must sell in order to achieve these targets, the sheer size of the Class 2b-3 pickup market means that manufacturers cannot simply rely on the widespread deployment of ZEV commercial vans in order to meet the ACT-required level of ZEV adoption.

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comparison at pp. 59-60 of EDF, *Comment Letter on GHG Standards for HD Vehicles*, June 16, 2023, https://downloads.regulations.gov/EPA-HQ-OAR-2022-0985-1644/attachment_1.pdf (data from Ledna et al. 2022).

[203] This was established using the output files for the OMEGA2 MDV runs, using the vehicles file (2023_03_14_22_42_30_central_3alts_20230314_Proposal_vehicles.csv) to compare in a given model year BEV variants with their combustion equivalent, sharing a base-year vehicle ID.

[204] While the Agency has conducted a sensitivity analysis around the Advanced Clean Cars II program, for which California has not yet received a waiver, it has not similarly included any sensitivity or analysis incorporating into its compliance modeling the Advanced Clean Trucks regulation, for which California has already been granted a waiver.

[205] Table A-1, California Code of Regulations § 1963.1.

[206] Based on new vehicle registration data from Polk/IHS Markit for 2019-2021 Class 2b-8 trucks, by state, obtained from Atlas Public Policy.

These state regulations will yield a base level of Class 2b-3 ZEVs, even in the absence of EPA standards, that the Agency has not adequately considered in its No Action scenario or in its modeling. As a separate matter, these regulations (and the ZEV development and deployment efforts that manufacturers have already undertaken to achieve compliance with them) also validate the Agency's assessment that electrification will be a critical emissions control technology in the MDV space moving forward.[207]

3. EPA should finalize a fuel-neutral standard and a maximum cap on the work factor.

EPA has made two significant changes to its GHG program for Class 2b-3 pickups and vans: 1) setting a fuel-neutral standard; and 2) setting a maximum cap on the work factor.[208] As described below, both such changes are appropriate.

During the rulemaking process for the Phase 2 standards, numerous commenters opposed setting separate emissions standards for diesel and gasoline engines, with Cummins, Honeywell, Daimler, Bosch, and the Motor and Equipment Manufacturing Association all supporting a single fuel-neutral standard.[209] As noted in the sections above on gasoline- and diesel-powered MDVs, there is a significant overlap in the available technologies to reduce emissions from either powertrain (e.g., variable geometry turbocharging, cylinder deactivation, hybridization). And technological advancements since finalization of the Phase 2 standards, including the advancement of zero-emission technologies, supports setting a single standard for the fleet that well exceeds the Phase 2 requirements for either gasoline- or diesel-powered Class 2b-3 vehicles. For these reasons, we support EPA setting a fuel-neutral standard for MDVs.

We also support EPA setting a maximum cap on the work factor. As noted in Section VIII.A.1.a regarding GM's latest Duramax diesel engine, manufacturers continue to prioritize increases in power for new engines for Class 2b-3 pickups. Unfortunately, the existing work factor structure creates no disincentive to this path, and may actually encourage manufacturers to try to game the system by increasing tow capacity across their fleets in order to increase the allowable emissions of their fleet, particularly since tow capacity is not captured in the emissions certification tests. EPA's proposal to cap the work factor at least creates a limit to this behavior. While concerns may remain about the safety and emissions impacts from manufacturers' efforts to out-spec their competition, a cap on the work factor would limit regulatory incentives for such behavior.

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[207] 88 Fed. Reg. at 29341-42; DRIA at 3-12–3-18.
[208] 88 Fed Reg. at 29242.
[209] 81 Fed. Reg. at 73738-39.

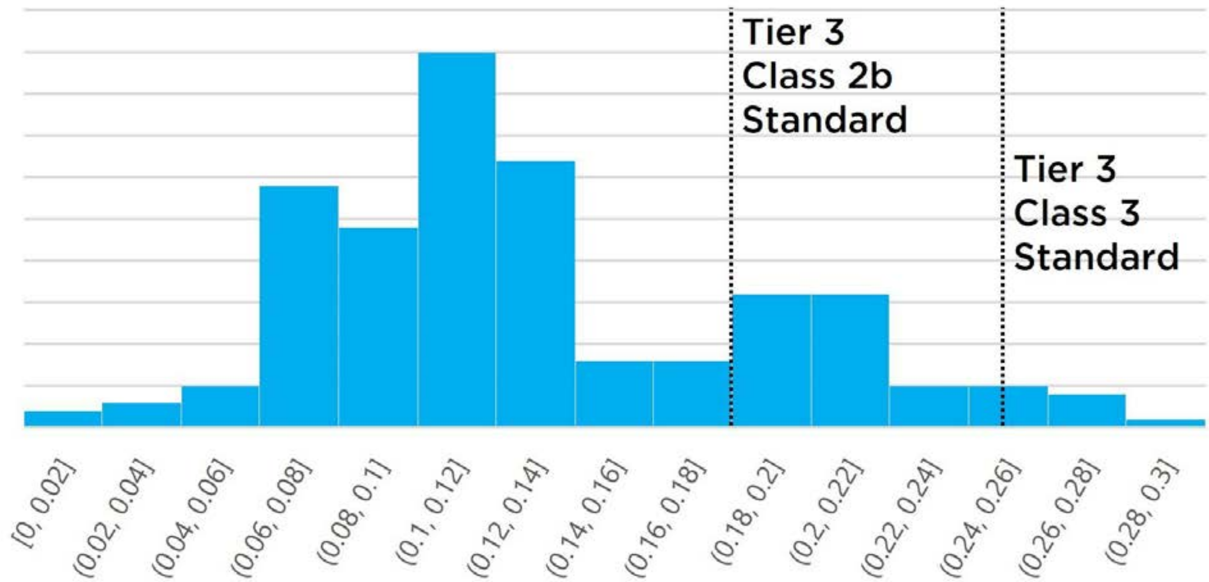
B. EPA should strengthen the Tier 4 $NMOG+NO_X$ standards, finalize the proposed PM requirements, and finalize the proposed change to criteria pollution requirements for MDVs with a GCWR above 22,000 pounds, subject to appropriate monitoring.

Consistent with the recently finalized criteria pollutant emission standards for heavy-duty engines (Classes 2b-8) and those that have been proposed for LDVs (Classes 1-2a plus medium-duty passenger vehicles) in this rulemaking, the Agency is proposing standards regulating tailpipe emissions of criteria pollutants from medium-duty vehicles. Under Clean Air Act Section 202(a)(3)(A), these standards must "reflect the *greatest degree of emission reduction achievable* through the application of technology which the Administrator determines will be available for the model year to which such standards apply, giving appropriate consideration to cost, energy, and safety factors associated with the application of such technology." 42 U.S.C. § 7521(a)(3)(A) (emphasis added). As described below, EPA should strengthen the Tier 4 $NMOG+NO_x$ standards and enact guardrails to ensure that windfall credits earned during a period of required lead time do not undercut the emissions gains possible in the 2027-2032 timeframe. We support the proposed $PM_{2.5}$ requirements and the proposed change to criteria pollution requirements for MDVs with a gross combined weight rating (GCWR) of more than 22,000 pounds, subject to appropriate monitoring to prevent manipulation.

1. EPA must improve the stringency of the Tier 4 $NMOG+NO_x$ standards for MDVs.

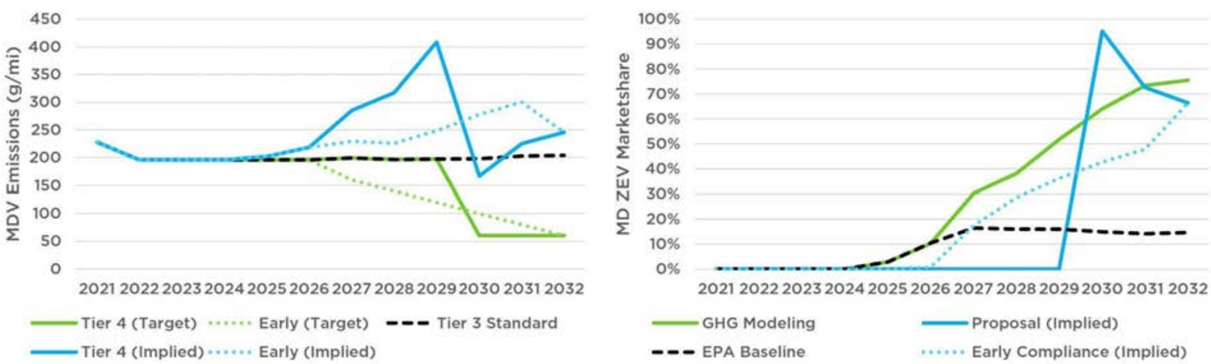
Because additional reductions in emissions of $NMOG+NO_x$ from MDVs are readily achievable, EPA must strengthen the Proposed Standards to meet its statutory mandate. Figure VIII.B-1 shows the distribution of certification data for MY 2022-2023 gasoline pickups, affirming EPA's observation that the MDV fleet is already capable of achieving levels of $NMOG+NO_x$ emissions far below the current standards. In fact, because these data are not sales-weighted and include some share of gasoline pickups that would now be required to certify to the heavy-duty engine standard under the Proposal, this table likely understates the capability of manufacturers to readily achieve reductions of $NMOG+NO_x$ emissions from their MDV combustion fleet.

Figure VIII.B-1. Distribution of $NMOG+NO_x$ certification values for Class 2b-3 gasoline pickups and vans



As in the case of the proposed light-duty $NMOG+NO_x$ standards (Section VI.F, *supra*), EPA's Proposed Standards for MDVs are in tension with its modeling of GHG compliance (Figure VIII.B-2). Here too, the Proposed Standards are well above the average emissions value expected under the conditions that: (1) manufacturers' combustion vehicles achieve Tier 3 standards; and (2) ZEV sales consistent with EPA's GHG modeling are achieved. If EPA's compliance modeling of ZEV sales is accurate and materializes in real-world sales, the remaining combustion fleet would be able to backslide to as much as double the average $NMOG+NO_x$ emissions allowed under Tier 3 (Figure VIII.B-2 (left)). Given the danger that these pollutants cause to public health and welfare, including through localized effects, such backsliding would be wholly inappropriate under Section 202. If instead the combustion fleet achieves Tier 3 standards as expected, far fewer ZEVs would be needed to comply with the proposed Tier 4 program or the early compliance pathway.

Figure VIII.B-2. Emissions performance and ZEV market share implied by the combination of achieving the proposed MDV GHG standards and MDV Tier 3 / Proposed Tier 4 NMOG+NOx standards



If manufacturers deploy MD ZEVs consistent with EPA's projection of compliance with the GHG standards, tailpipe NMOG+NOx emissions performance from the remaining combustion vehicles will greatly exceed Tier 3 standards (left). If combustion vehicles instead achieve Tier 3 emissions standards, far fewer ZEVs will be required to meet the proposed Tier 4 fleet average standards than are modeled to comply with the GHG standards (right).[210]

The relationship between the GHG Proposal and the Tier 4 proposal means that a significant amount of NMOG+NO_x reductions are left on the table, in conflict with EPA's statutory mandate to achieve the "greatest degree of emission reduction achievable." 42 U.S.C. § 7521(a)(3)(A). As mentioned previously, combustion vehicles can readily reduce emissions below Tier 3 levels, but at a bare minimum, EPA's final standards should reflect the emissions levels that would be achieved by the combustion fleet achieving Tier 3 NMOG+NO_x standards with ZEVs deployed to the extent modeled to meet GHG standards. Under this more stringent standard, manufacturers would retain flexibility to invest in greater ZEV deployment or to instead apply existing, feasible, and cost-effective technologies within their combustion fleet. These modifications would better ensure that the Tier 4 MDV standards are consistent with the greatest degree of emissions reduction achievable.

EPA should also take action to prevent the problems caused by a growing bank of emissions credits. Even in the absence of a GHG rule, the expected market-driven deployment of ZEVs would result in a significant bank of credits prior to 2030 under the proposed Tier 4 standard for MDVs (Figure VIII.B-2, right). Those windfall credits would either be used to delay the achievement of Tier 3 standards or to offset required reductions in the MY 2030-2032 period. In an effort to mitigate the impact of the deployment of technology (electrification) that is not

[210] The ZEV market share here appears significantly higher than in the GHG modeling because it excludes combustion vehicles with a gross combined weight rating (GCWR) of more than 22,000 pounds. However, ZEVs with a GCWR greater than 22,000 pounds are included in the MDV fleet in our analysis. This proposed change is further discussed in Section VIII.B.3.

required to meet the current standards, EPA should limit the use of credits generated through overcompliance with Tier 3 standards. To encourage manufacturers to adopt the more stringent early compliance pathway, the Agency could (for example) restrict the use of Tier 3 credits in the 2027+ timeframe to only those manufacturers that have elected the early credit pathway. This would be appropriate, since the Tier 3 standards fixed under the proposal through MY 2029 were predicated on the deployment of a reduced suite of emissions reduction technologies.

2. The proposed $PM_{2.5}$ requirements are appropriate.

As discussed in Section VI.F.2, proven and cost-effective technology exists to reduce tailpipe $PM_{2.5}$ levels to the levels required by EPA's proposed standards. MDVs with GCWR over 22,000 pounds (see the section immediately below) will already be required to achieve similar levels of reductions under EPA's proposal to certify these vehicles under the heavy-duty engine requirements, and the data supporting the finalization of those standards include an assessment of technology improvements for both compression-ignition and spark-ignition engines supporting a technology neutral achievement of $PM_{2.5}$ reductions.[211] The test protocols and targets for EPA's proposed $PM_{2.5}$ standards are achievable, as discussed in Section VI.F.2, and will provide significant health benefits.

3. EPA's proposed change to criteria pollution requirements for MDVs with a gross combined weight rating of more than 22,000 pounds is likely appropriate, but should be monitored for manipulation and efficacy.

EPA is proposing to require that vehicles with a GCWR greater than 22,000 pounds be certified to the heavy-duty engine standards, rather than to the proposed MDV standards.[212] EPA's logic here is sound: these vehicles' powertrains are often more powerful than the Class 4 and Class 5 vehicles in which related engines may be deployed, and they have a GCWR comparable to vehicles currently covered by the heavy-duty engine rules.

Table VIII.B-1. Market share of MDVs above and below the 22,000-pound gross combined weight rating[213]

Vehicle type	Fuel	GCWR <= 22k lbs.	GCWR > 22k lbs.
2b-3 Pickups	Gasoline	12.5%	15.6%
	Diesel	0.0%	37.5%
2b-3 Vans	Gasoline	30.7%	0.0%
	Diesel	3.7%	0.0%

[211] U.S. EPA, Control of Air Pollution from New Motor Vehicles: Heavy-Duty Engine and Vehicle Standards: Regulatory Impact Analysis, Sections 3.1 & 3.2, EPA-420-R-22-035 (Dec. 2022).
[212] 88 Fed. Reg. at 29257.
[213] Taken from EPA OMEGA2 modeling inputs: vehicles_mdv_20230208.csv (MY 2020 MDV fleet).

MY 2020 data indicates that this change could require more than half of the MDV fleet to certify to the heavy-duty engine standards (Table VIII.B-1).[214] Based on the emissions and warranty requirements for such engines, certifying the engines in these MDVs to such standards will likely yield emissions reductions at least as strong as if they were instead required to meet the proposed MDV standards. However, these standards apply solely to combustion engines and are not influenced by the share of deployed ZEVs.

In contrast, ZEV deployment affects the required emissions reductions for medium-duty combustion vehicles with a GCWR less than or equal to 22,000 pounds, as illustrated above in Section VIII.B.1. It is possible that manufacturers could try to shift more of their sales to vehicles with a GCWR over 22,000 pounds in order to reduce the required improvements to their remaining combustion fleet. If this change is finalized, the Agency should monitor future data from the MDV and heavy-duty engine in-use testing program to assess the nature of any difference between the emissions performance of MDVs above and below the 22,000-pound GCWR, and should commit to releasing a report on its findings.

IX. EPA Should Finalize the Proposed Changes to the Credit Program, but Should Not Renew Off-Cycle Menu Credits.

Below, we address EPA's proposal to renew the existing credit program with the following changes: (1) exclude all BEVs from eligibility for any off-cycle credits; (2) allow off-cycle credit eligibility for PHEVs based only on a ratio called the "utility factor"; (3) eliminate two of the three ways to obtain off-cycle menu credits (undergoing a 5-cycle testing procedure and documenting the efficacy of new technology via public notice and comment), while retaining only the third way (menu credits); and (4) renew but phase out the off-cycle menu credits for the remainder of the light- and medium-duty fleets over four years, in 10/8/6/3/0 gram/mile annual steps between MY 2028-2031. We support most of EPA's proposals but strongly urge EPA not to renew any off-cycle menu credits in this rulemaking.

We support EPA's continued use of an averaging, banking, and trading (ABT) compliance credit program for light- and medium-duty vehicle emissions, as it has for decades. We agree with EPA's determination that there is no reason to reopen those program provisions in this rulemaking.

We also note that the current compliance credit program includes multipliers for vehicles equipped with batteries, creating negative grams per mile values, and that EPA does not propose

[214] In the Proposal, EPA notes: "Based on an analysis of the MY 2022 and MY 2023 emissions certification data, most MDV complete and incomplete diesel pickup trucks would be required to switch to engine dynamometer certification; MY 2022 vans would not be required to use engine dynamometer certification; and only a small number of gasoline pickup trucks would be required to switch to engine certification." 88 Fed. Reg. at 29270. However, the data are not provided.

to renew those multipliers. We strongly support the sunsetting of all PEV multipliers and any other measures that create fictitious emission reductions.

A. Air conditioning credits

For light-duty vehicles,[215] EPA proposes to renew credits for manufacturers that install technology that improves the efficiency of air conditioning (“AC”) systems, but to exclude BEVs from eligibility, while retaining current 5-cycle testing protocols that confirm the systems actually reduce emissions as anticipated. 88 Fed. Reg. at 29246. EPA also proposes not to renew light-duty vehicles’ hydrofluorocarbon (“HFC”) refrigerant leakage control credits and to sunset current refrigerant standards for medium-duty vehicles, because another rulemaking under a different statute is addressing HFCs. *Id.* We generally support EPA’s proposals.

1. Background

AC systems create tailpipe emissions by using additional power generated through the combustion of gasoline. 88 Fed. Reg. at 29246. Since 2012 EPA has granted credits for AC systems that reduce this extra fuel usage by means of installing more efficient components and air recirculation settings, both measures that reduce engine loads. EPA states it has consistently increased the stringency of the light-duty CO_2 footprint curves in the amount of the anticipated AC credits by shifting the footprint curves downwards. Thus, according to EPA, manufacturers who opt not to install the more efficient systems must meet the increased stringency by means of other technology. AC efficiency credits are capped at 5.0 g/mile for passenger cars and 7.2 g/mile for light trucks, and all vehicles in these classes have been eligible for the credits. EPA deems the credits to be effective in reducing emissions and reports increased usage. In MY 2021, 17 of 20 manufacturers reported efficiency credits resulting in an average credit of 5.7 g/mile. 88 Fed. Reg. at 29246.

2. Proposal to renew AC efficiency credits for vehicles with combustion engines only

EPA now proposes to renew AC efficiency credit eligibility only for vehicles equipped with internal combustion engines. EPA reasons that such credits for BEVs are no longer required because BEVs running AC systems do not combust gasoline; AC efficiency credits are not representative of their emission reductions; and BEVs are already counted as 0 g/mile, so that adding AC efficiency credits to the calculation has led to reporting of BEV emissions at less than zero (in the case of Tesla, a fleet average of negative 126 g/mile, including 18.8 g/mile of AC credits). 88 Fed. Reg. at 29247. The credits, EPA explains, were adopted when BEV sales were low and incentivized BEVs, but are no longer needed. EPA next proposes to renew AC

[215] The medium-duty vehicle fleet does not include air conditioning efficiency-related credits or requirements, and EPA is not taking comments on that matter. 88 Fed. Reg. at 29246; 81 Fed. Reg. at 73742; 76 Fed. Reg. at 57196.

efficiency credits for combustion vehicles while increasing the standards' stringency to reflect use of those credits. EPA states it will continue to condition credit approval on mandatory 5-cycle testing[216] of certain grouped vehicles to confirm that the projected emission reductions are occurring in the real world (the "AC17" test).

We fully support EPA's proposal not to grant any AC credits to vehicles without a combustion engine. BEVs should no longer be credited with fictitious tailpipe emission reductions, in this case or otherwise. BEVs do not combust gasoline, regardless of whether they use AC systems. We also agree that the current credits are not representative of BEV upstream emissions and are no longer justified to incentivize BEVs, and that BEVs should not be accounted for as if they produce less than zero grams per mile.

We generally support the proposal to retain AC efficiency credits for vehicles with internal combustion engines, with some caveats. Historically, credits have allowed manufacturers to significantly delay compliance with EPA's standards, leading to near-term emission *increases*, as EPA has often acknowledged. *E.g.,* 86 Fed. Reg. at 43756; 77 Fed. Reg. 62812. That problem is exacerbated when vehicles do not have to undergo testing to confirm the technologies for which credits are awarded do in fact reduce emissions by an equivalent amount, and where the stringency of the standards has not been increased to reflect the anticipated credit use. Here, the latter concern is addressed if EPA does in fact increase stringency by lowering the footprint curve to reflect the available credits, and the AC17 test is vigorous. We would, however, oppose these AC efficiency credits should EPA relax any of the current AC17 test procedures, as their real-world effectiveness could no longer be assured. We also ask EPA to fully explain exactly how it ensures that the standards' stringency is in fact increased by an amount equivalent to the credits it grants.

We also support renewed AC efficiency system credits (for combustion vehicles only) for an additional reason. In light of the astonishingly rapid and dangerous temperature increases all across the country produced by the climate crisis, more frequent and more energy-intensive use of air conditioning is inevitable. Assuring that these systems are as efficient as possible is therefore of great importance. For that reason, we urge EPA to adopt an AC efficiency *standard* rather than a voluntary credit, as it has done for the medium-duty fleet in the case of refrigerant credits or, at a minimum, in its post-MY 2023 rulemaking.

B. Proposal not to renew air conditioning leakage credits

[216] The test includes a highway cycle, a high temperature condition cycle, a preconditioning cycle, and a cycle at solar peak periods of four hours. Where test results do not support full menu credits, proportional credits may be allowed. Tests are performed on one vehicle model for each platform, starting with the highest sales volume vehicles, and moving to the next-highest sales volume vehicle annually thereafter, until all vehicle models have been tested or the platform undergoes redesign. EPA is not taking comments on the testing procedures. 88 Fed. Reg. at 29247.

1. Background

When EPA established the current refrigerant leakage credits in 2012, the most common HFC refrigerant used in mobile air conditioners was HFC-134a, carrying a global warming potential ("GWP") of 1430 times that of CO_2. 88 Fed. Reg. at 29246. The most emission-reducing alternative at that time was HFO-1234yf, with a GWP of 4. To encourage the shift from HFC-134a, the 2012 standards allowed manufacturers to earn refrigerant credits for light duty vehicles and trucks, respectively, that are capped at 13.8 and 17.2 g/mile when an alternative refrigerant is used, and at 6.3 and 7.8 g/mile for employing leak-tight components. For the medium-duty fleet, EPA adopted a refrigerant leakage standard rather than a voluntary credit. *Id.* EPA describes the program as successful and reports that as of MY 2021, 95% of new vehicles use the refrigerant HFO-1234yf, 88 Fed. Reg. at 29247, which has a GWP of 4. 88 Fed. Reg. at 29246.

2. Proposal to eliminate refrigerant credits

EPA now proposes not to renew refrigerant credits beginning in MY 2027 for the light-duty fleet, and to sunset the refrigerant standards for medium-duty vehicles, largely because of the passage of the American Innovation and Manufacturing ("AIM") Act, 42 U.S.C. § 7675, in December 2020. Two years later, EPA issued a Notice of Proposed Rulemaking under the AIM Act (the "AIM Proposal") to restrict the HFCs used in light- and medium-vehicles to those not exceeding a GWP of 150, with effective dates, respectively, of MY 2025 for the light-duty fleet and MY 2026 for the heavy-duty fleet.[217] EPA states that there is no reason to believe manufacturers would use higher GWP refrigerants in the absence of EPA vehicle-based credits, and that not renewing the credits would avoid duplicative programs, simplify this rule, and reduce manufacturer credit reporting burdens.

EPA requests comments on whether there is any value in retaining the refrigerant credits. In our view, the answer is no. The AIM Proposal is expected to be finalized this summer or early fall, before EPA completes this rulemaking. If the current refrigerant credits are eliminated, there is no reason to believe manufacturers would use refrigerants other than HFC-1234yf (with its GWP of 4). Two possible alternative refrigerants with GWP values under 150 exist (HFC-152a and carbon dioxide), but adopting either would require a significant redesign of mobile air conditioners. We are not aware of any manufacturers currently planning to use HFC-152a, and while a few companies that import vehicles have investigated CO_2-based systems in northern Europe, it is our understanding that those systems would not work well in the temperature ranges experienced in the U.S. market. Thus, we concur with EPA's judgment that neither the majority of manufacturers already using HFO-1234yf nor the minority of manufacturers still using

[217] Phasedown of Hydrofluorocarbons: Restrictions on the Use of Certain Hydrofluorocarbons Under Subsection (i) of the American Innovation and Manufacturing Act of 2020, 87 Fed. Reg. 76738 (Dec. 15, 2022).

HFC-134a are likely to switch to either of the other two alternatives with GWPs under 150. Thus, while the AIM Proposal could be tightened to bar refrigerants with GWP greater than 4, the potential for backsliding under that proposal appears minimal. Thus, we agree that if the AIM Proposal is finalized as proposed, and considering that HFO-1234yf is already used in 95% of vehicles, there is no reason to renew a refrigerant credit program dating from 2012.

As a backstop, however, any remaining concerns can be resolved if either the AIM Proposal or this rule, once finalized, adopts a standard requiring refrigerants with no more than GWP values of 4, effective for MY 2026 and 2027, respectively.

C. Off-cycle credits

We strongly urge EPA not to renew any part of the off-cycle credit program after MY 2026. As explained below, EPA concedes that the program will cause significant fleet emissions *increases* even though it no longer achieves any of its purposes. There is no reasonable basis for carrying any part of the program forward beyond 2026, and doing so would be arbitrary and capricious.

1. Excluding BEVs from off-cycle credit eligibility

We concur with EPA's determination that off-cycle credits are inappropriate for BEVs for each of the reasons EPA states. 88 Fed. Reg. at 29251-52. Because EPA does not adjust the footprint curves downward to compensate for off-cycle credits, fleet emissions increase. Awarding credits is particularly inappropriate for BEVs because they have no tailpipe emissions and are already counted as emitting zero grams per mile, meaning that any credit awards tip their emission values into fictional negative territory. This in turn creates phantom benefits that further reduce the rule's average stringency. Because off-cycle credits are intended to stimulate the development of new combustion vehicle technologies, awarding them to BEVs also cannot, by definition, incentivize the development or application of new technology. Off-cycle credit values are also not representative of upstream emissions. These reasons for not awarding any off-cycle credits to BEVs become even more pertinent as the number of BEVs increases. *Id.* We urge EPA to finalize its proposal to exclude BEVs from off-cycle credit eligibility.

2. Renewing PHEV off-cycle credits based on the utility factor only.

We also concur with EPA that off-cycle credits for PHEVs exceeding their utility factor is inappropriate. 88 Fed. Reg. at 29251. Granting credits for any portion of time when PHEVs do not run on electricity is inappropriate for the reasons discussed in connection with BEVs. We agree with EPA that the current utility factor is inaccurate, as PHEVs run on electricity far less often than estimated. 88 Fed. Reg. at 29252, and *see* detailed discussion in Section XII, *infra*.[218] That is an additional reason why, as discussed below, off-cycle credits should not be renewed for PHEVs at all, regardless of whether they run on electricity or gasoline.

3. Eliminating the 5-cycle test procedures and the public notice and comment pathway

EPA justifies not renewing these two pathways for claiming off-cycle credits mainly because manufacturers have little or no interest in them. EPA points out that since 2021, the 5-cycle process has led to no new credits, and only one manufacturer has used it since 2012. As to the notice-and-comment pathway, EPA states that it has resulted in the award of only a few small credits since 2021. 88 Fed. Reg. at 20251. We agree that these programs should not be renewed, but we note that under EPA's Proposal, aside from air conditioning credits, the only off-cycle credits remaining would be menu credits, which require *neither* testing *nor* public comment, and as such are the least reliable and least defensible credits of all. Yet, as EPA reports, the use of menu credits has only grown over the years, and now constitutes a whopping *95% of credit use*. 88 Fed. Reg. at 29249. Eliminating pathways that automakers eschew because they impose the burden of demonstrating their effectiveness thus does very little indeed to address the fundamental flaws.

Because EPA's prior rules limited medium-duty fleet off-cycle credits to those approved under the 5-cycle test procedures or the notice-and-comment pathway and contained no menu credits, 88 Fed. Reg. at 29249, EPA's proposal not to renew those two pathways effectively terminates the credit program for that fleet, a decision we fully support.

4. Phasing out menu credits through MY 2030

EPA proffers numerous reasons for "phasing out" the menu credits program—for vehicles with internal combustion engines only—through 2030. But those reasons all demonstrate that retaining the program in any form has no verifiable benefits even as it significantly increases the fleet's emissions. Renewal of menu credits thus would be arbitrary and capricious, and we strongly urge EPA to abandon the proposal and not to renew the program at the end of MY 2026.

First, the Agency states that menu credits were designed "to provide an incentive for new and innovative technologies that reduce real world CO_2 emissions primarily outside of the 2-cycle test procedures." 88 Fed. Reg. at 29249. But EPA now concedes the program no longer accomplishes this purpose. It notes that industry is rapidly shifting its research and development resources and vehicle mix away from combustion vehicles to electrification, and is not likely to

[218] *See* also the numerous studies EPA cites at 88 Fed. Reg. 29252 n.274-475.

continue to "invest resources on off-cycle technology in the future for their ICE vehicle fleet." 88 Fed. Reg. at 29250. Moreover, industry has fewer and fewer opportunities of "recouping" its investments as "ICE vehicle production declines." *Id.* In other words, chances of menu credits stimulating any new technologies at all are slim to none.

Since 2012, EPA has also assured the public in its rulemakings that the increased emissions driven by credits are intended to be short-term and of a temporary nature only.[219] But EPA proposes to renew the program once again, even as it acknowledges the voluminous record evidence demonstrating its shortcomings and failures.[220] Reinstating the program through 2030 (for a total of 20 years) is in no way temporary and cannot be supported, as it is not delivering the hope for technical innovations that initially may have justified it.

EPA also concedes that menu credits meet neither of the guardrails that justify continuation of air conditioning credits. Menu credits undergo no or at most minimal testing to ascertain what, if any, emission reductions they may yield, and EPA once again is not proposing to increase the standards' stringency to account for the increased emissions. In 2021, EPA calculated the impact of the off-cycle credits it allowed under the MY 2023-2026 rulemaking as the loss of 42 g/mile. 88 Fed. Reg. at 29249 n.453, citing *Revised 2023 and Later Model Year Light-Duty Vehicle GHG Emissions Standards: Regulatory Impact Analysis*," EPA-420-R-21-028 (Dec. 2021). For MY 2016-2025, the impact of all off-cycle credits amounted to a stringency loss of 4-6%. 88 Fed. Reg. at 29249. EPA also notes that for this Proposal, emission increases caused by *all off-cycle credits* (i.e., under a full renewal of the program) would be even larger by 2032, when they would "become an outsized portion (*e.g.,* up to 12 percent) of the program." 88 Fed. Reg. at 29250. We note, however, that under EPA's proposal to *retain menu credits* through the proposed phase-out schedule, these compliance giveaways would still amount to some 3% reduction in stringency and a 3% increase in MY 2027-2055 cumulative CO_2e emissions.[221]

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[219] *E.g.,* 88 Fed. Reg. at 29246, 29248; 86 Fed. Reg. at 74441; 75 Fed. Reg. at 25331.

[220] *See generally* EPA, *Revised 2023 and Later Model Year Light-Duty Vehicle Greenhouse Gas Emission Standards: Response to Comments*, EPA-420-R-21-027, at 6-51 (Dec. 2021).

[221] The fleet average-modeled sum of off-cycle and air conditioning menu credits for MYs 2027-2032 represents about 3% of the MYs 2027-2032 Proposed Standards. We calculated this number by first sales-weighted averaging the direct off-cycle credits (i.e. air-conditioning plus off-cycle credits) in the modeled Proposal output file. We then compared these values to the Proposed Standards for the combined fleet. 88 Fed. Reg. at 29202, Table 10. Eliminating menu credits for MYs 2027-2055 improves the cumulative CO_2 emissions reductions of the Proposal by 275 million metric tons (roughly 3% of the total 8,000MMT shown in DRIA table 9-21). We calculated this number by first assuming manufacturers would achieve the same combustion vehicle emissions levels as they do in the modeled Proposal output file with only on-cycle technologies. We used this file because the on-cycle emissions values in a no-off-cycle scenario are equal to the currently-modeled certified emissions values (used for compliance calculations). These on-cycle values are then converted to on-road (i.e. real-world) emissions using conversion factors calculated from the output file. Finally, total fleetwide lifetime emissions are estimated by multiplying on-road CO_2e by lifetime vehicle-miles traveled and annual sales. For the detailed calculations, see the Excel Workbook attachment to this comment letter titled "No Off-Cycle Credits 2027-2055."

Next, EPA discusses that the synergistic effects and overlap among menu technologies—which reduce effectiveness—become more pronounced as credits represent a larger portion of emissions reductions and the standards become more stringent. Further, "the menu credits are based on MY 2008 vintage engine and vehicle baseline technologies . . . and therefore the credit levels are potentially becoming less representative of the emissions reductions." *Id.* And crucially, the Agency frankly admits that there is "*not currently a mechanism to check that off-cycle technologies provide emissions reductions in use commensurate with the level of the credits the menu provides*." 88 Fed. Reg. at 29250 (emphasis added). That the program simply cannot be fixed is all by itself sufficient reason not to carry it on.

The single reason proffered to justify a step-wise phase-out through MY 2030 as a "reasonable way to bring the program to an end" is the creation of "a transition period to help manufacturers who have made substantial use of the program in their product planning." 88 Fed. Reg. at 29250. But nothing backs up the need for a lead time of six or seven years (from the expected rule finalization in 2023 or 2024 through MY 2030). To the contrary, no lead time beyond MY 2026 is warranted, particularly in an industry racing toward zero-emission technologies. In any event, the menu program does not have to be "brought to an end" through this new rulemaking: it expires on its own after MY 2026. In its 2023-2026 rule (as before), EPA characterized the program as "temporary" and gave no indication that it would be extended, 86 Fed. Reg. at 74441, and commenters have implored EPA to jettison it for more than a decade. If a manufacturer has nonetheless made menu credits part of its post-MY 2026 product planning, it did so at its own risk. There is no need for a "transition period" for a program that ends in MY 2026.

D. The averaging, banking, and trading program continues to be an important way for manufacturers to maintain flexibility in meeting EPA's vehicle emission standards.

Like its previous GHG emission standards for light- and heavy-duty vehicles, and standards for certain vehicle criteria pollutant emissions dating back to 1983, EPA's Proposed Standards rely on an averaging, banking, and trading (ABT) approach allowing manufacturers to meet the standards by averaging emissions across vehicles. Given its longstanding use of this approach under Section 202, EPA's Proposal emphasizes that EPA is "not proposing any revisions to the [light-duty or medium-duty] GHG program ABT provisions or reopening them." 88 Fed. Reg. at 29246; *id*. at 29245; *see also id*. at 29277 (similar statement regarding ABT provisions for the proposed criteria pollutant program for NMOG+NOx standards).

We agree with EPA's determination that there is no reason to reopen the question whether it is permissible to use an ABT approach under Section 202. EPA has not only repeatedly used ABT in Section 202 standards but also repeatedly explained that ABT is consistent with and gives full effect to the requirements of Section 202 as well as the Clean Air Act's compliance and enforcement provisions applicable to standards issued under Section 202. Under such circumstances, it is eminently reasonable for EPA not to reconsider a question that has been settled for decades. *See Growth Energy v. EPA*, 5 F.4th 1, 13 (D.C. Cir. 2021). In promulgating its final standards, EPA should refrain from "substantive reconsideration," *id*. at 21, of whether ABT is a permissible approach under Section 202, which might inadvertently suggest, notwithstanding the statements in the Proposal, that EPA has reopened the issue. EPA may, of course, express its continued adherence to its previously settled view that Section 202 permits standards using ABT without reopening the issue, and it may respond to any unsolicited comments it may receive on the issue. *See Banner Health v. Price*, 867 F.3d 1323, 1341 (D.C. Cir. 2017) (quoting *Kennecott Utah Copper Corp. v. U.S. Dep't of Interior*, 88 F.3d 1191, 1213 (D.C. Cir. 1996)). But reexamination and reconsideration of whether ABT is consistent with the Clean Air Act is unnecessary and uncalled-for.

EPA first promulgated a Section 202 standard that used averaging when it issued its particulate standards for light-duty diesel vehicles in 1983. *See* 43 Fed. Reg. 33456 (July 21, 1983). EPA explained at that time that standards employing averaging fell within its "broad authority" under Section 202 and were "consistent with the [Clean Air Act's] certification scheme." *Id*. at 33458. Specifically, the 1983 standard required EPA to certify the conformity of a manufacturer's vehicles with a standard that was established based on a combination of testing of the families of vehicles making up their fleets and planned production volumes. This process would yield a fleet whose average emissions complied with the standard; the certificate would be conditioned on the manufacturer actually "maintain[ing] family production volumes such that the production-weighted average of the manufacturer's family limits indeed meets the standards at year's end." *Id*. at 33459. As EPA explained, averaging thus accords with the Act's prohibition on the sale of vehicles not covered by a certificate of conformity and allows imposition of appropriate penalties for any violations.

EPA's 1985 standard for NOx emissions from light-duty trucks, as well as for NOx and particulates from HD engines, similarly employed an averaging approach. *See* 50 Fed. Reg. 10606 (Mar. 15, 1985). EPA's final rulemaking notice again explained that its averaging approach was consistent with the statutory requirement that compliance be certified before vehicles were sold, and that certification was subject to the condition that the certificate would be voided if the manufacturer's production-weighted average emissions did not meet the standard at the end of the model year. *See id*. at 10633, 10636-37. EPA found that "the averaging concept" was "fully consistent with the technology-forcing mandate of the Act," *id*. at 10634, while at the same time "eas[ing] the compliance burden" for manufacturers, *id*. at 10635.

The D.C. Circuit rejected arguments that the 1985 standard's averaging approach was unauthorized under the Clean Air Act in *NRDC v. Thomas*, 805 F.2d 410 (D.C. Cir. 1986). The court observed that "EPA's agreement that averaging will allow manufacturers more flexibility in cost allocation while ensuring that a manufacturer's overall fleet still meets the emissions reduction standards makes sense." *Id*. at 425.

Thomas noted that there were potential arguments against averaging that it did not address because they had not been raised before the Agency, including an argument that an averaging approach might not be consistent with the Act's testing and certification provision, Section 206. *Id*. at 425 n.24. The court suggested that EPA consider this question in future proceedings and provide a further explanation of how averaging conformed to statutory requirements. *Id*.

EPA took the court up on that invitation in its subsequent 1990 rulemaking proceeding establishing certification programs for banking and trading of NOx and particulate emission credits for HD engines. That rulemaking resulted in an expanded averaging regime, with the addition of provisions for banking and trading of credits generated if manufacturers' production-weighted average emissions were below the requirements of the NOx and particulate standards. *See* 55 Fed. Reg. 30584, 30584-86 (July 26, 1990). Both in the final rulemaking notice and the proposal for those standards, EPA addressed the issues flagged in *Thomas* and explained at length how the ABT program conformed with the Clean Air Act's certification requirements. *See id*. at 30593-94 (final rule); 54 Fed. Reg. 22652, 22665-67 (May 25, 1989) (proposed rule). EPA articulated in detail how its ABT approach entails presale certification of the conformity of each engine or vehicle with the applicable standards based on testing of emissions generated by engine families and projected production estimates, with certification conditioned on a final end-of-model-year determination that a manufacturer's actual production-weighted average emissions comply with the standard. *See* 55 Fed. Reg. at 30585, 30594, 30600-04. These features of the ABT program, EPA explained, facilitate application of the Act's enforcement and penalty provisions. *See id*. at 30594, 30603-04. EPA similarly used ABT in its Tier 2 light-duty NOx standards promulgated in 2000. *See* 65 Fed. Reg. at 6744.

Having determined in these earlier rules that ABT standards are consistent with Section 202, EPA employed the ABT approach pioneered in the 1990 HD standards when it first adopted GHG standards for LDVs in 2010 and HD engines and vehicles in 2011. *See* 75 Fed. Reg. 25324, 25405 (May 7, 2010); 76 Fed. Reg. 57106, 57127-28 (Sept. 15, 2011). In each case, EPA explained at length how, in implementing ABT standards, it fulfills its statutory obligations to certify conformity of vehicles or engines with the standards before they are introduced into commerce, to require warranties of compliance, and to test for in-use compliance. *See* 75 Fed. Reg. at 25468-77; 76 Fed. Reg. at 57254-92. EPA also explained how, under an ABT approach, it would give full effect to the statute's provision for calculation of penalties for each nonconforming vehicle in the event of a violation of the standards. *See* 75 Fed. Reg. at 25482; 76 Fed. Reg. at 57257.

Subsequent iterations of GHG and other motor-vehicle emission standards under Section 202 for both LD and HD vehicles and engines have likewise used an ABT approach consistent with that used in the 2010 and 2011 GHG standards. *See* 77 Fed. Reg. 62624, 62788 (Oct. 15, 2012) (LD GHG standards); U.S. EPA, Control of Air Pollution From Motor Vehicles: Tier 3 Motor Vehicle Emission and Fuel Standards; Final rule, 79 Fed. Reg. 23414, 23419 (LD and HD Tier 3 NOx standards); 81 Fed. Reg. 73478, 73495 (Oct. 25, 2016) (HD Phase 2 GHG standards); 85 Fed. Reg. 24174, 25103-04, 25114 (Apr. 30, 2020) (LD GHG standards); 86 Fed. Reg. 74434, 74441 (Dec. 30, 2021) (LD GHG standards). In none of those rulemaking proceedings did EPA reopen the issue whether Section 202 permits use of ABT in standard-setting; the Agency treated the option to use ABT under Section 202 as a settled matter.

The Agency's settled practice of using ABT in Section 202 standards from 1990 onward did not generate further legal challenges until the most recent set of light-duty GHG standards. As to the latter standards, however, petitioners challenging the standards have argued in review proceedings pending in the U.S. Court of Appeals for the D.C. Circuit that Section 202 permits only the use of standards that specify emissions limits on an individual-vehicle basis, and that standards employing averaging render the Clean Air Act's compliance and enforcement provisions meaningless. *See* Final Br. for Priv. Petitioners, Texas v. EPA, Case No. 22-1031 (D.C. Cir. Apr. 27, 2023), ECF No. 1996915, at 36-50. EPA rejected those arguments when it considered them in the 1990 rulemaking, and they run counter to the settled construction of the statute on the basis of which EPA has issued standards since that time. EPA's brief in the D.C. Circuit and the brief of the state and nongovernmental organizations supporting EPA explain that challenges to ABT are untimely attempts to challenge determinations made decades ago, but also detail the reasons ABT is consistent with the language and structure of Section 202 and the applicable enforcement and compliance provisions of the Act. *See* EPA Br. 34-39, 62-75; State & Pub. Int. Br. at 3-6, 9-17.

In sum, the Proposal's statements that "EPA has included ABT in many programs across a wide range of mobile sources," 88 Fed. Reg. at 29245, and that the "ABT provisions are an integral part of the vehicle GHG program," *id*. at 29246, are unquestionably accurate. Given that EPA long ago addressed and resolved the lawfulness of ABT under Section 202, that EPA's use of ABT is consistent with the D.C. Circuit's precedent in *Thomas*, that EPA has repeatedly explained how the statute's certification, warranty, testing, and enforcement provisions function effectively in the context of ABT, and that the arguments against the use of ABT are essentially the same as those discussed in *Thomas* and revisited in the round of rulemaking that followed, there is no reason for the Agency to reopen these settled questions by reexamining them substantively in this rulemaking (or appearing to do so). The Agency should adhere to its statement in the Proposal that it is not reopening these issues.

To foster understanding of how the Act's testing, certification, warranty, in-use compliance, and penalty provisions operate in the context of a standard using ABT, it may be useful to include in the final rule's preamble a clear description of how EPA uses testing and manufacturers' production plans to issue certificates of conformity before vehicles or engines are marketed; how manufacturers warrant compliance; how EPA determines in-use compliance; how EPA determines whether a manufacturer's vehicles and engines have met the conditions imposed on their initial certification by ultimately complying with the production-weighted emission standards to which they are subject; and, in the event of noncompliance, how EPA would identify noncompliant vehicles and impose penalties or other remedies. If it does so, EPA should make clear that it is describing the operation of the statute and the ABT rules, not reexamining EPA's settled view that its ABT standards and their implementation conform to the Act's requirements.

Although the Agency need not, and should not, reconsider the lawfulness of ABT standards under Section 202, EPA's analysis more than adequately explains the benefits of continuing to use the ABT approach for this latest set of emission standards. EPA's analysis of the benefits ABT provides in this context, *see* 88 Fed. Reg. at 29342-43, amply justifies the Agency's choice of retaining the ABT approach for this set of standards. As EPA has indicated, the ABT structure allows EPA to require the reductions in vehicle pollutant emissions that are essential to addressing the endangerment of public health and welfare attributable to those emissions in a manner that best balances the need for significant cuts in emissions with the requirement that standards be feasible and achievable within the time allowed for compliance. The ABT approach "recognize[s] that automakers typically have compliance opportunities and strategies that differ across their fleet, as well a multi-year redesign cycle, so not every vehicle will be redesigned every year to add emissions-reducing technology;" ABT allows manufacturers to keep pace with required improvements by overcomplying with newly designed or redesigned vehicles while other vehicles whose designs are already locked in undercomply. 88 Fed. Reg. at 29342. Thus, "performance-based standards with ABT provisions give manufacturers a degree of flexibility in the design of specific vehicles and their fleet offerings, while allowing industry overall to meet the standards and thus achieve the health and environmental benefits projected for this rulemaking at a lower cost." *Id*. at 29343. These benefits of the ABT approach are recognized by regulators, environmental advocates, and industry alike. *See* Final Answering Br. for Intervenor Alliance for Automotive Innovation, Texas v. EPA, Case No. 22-1031 (D.C. Cir. Apr. 27, 2023), ECF No. 1996757, at 8-9 (stating that ABT has "been essential to the auto industry's efforts to meet EPA's increasingly ambitious goals for greenhouse gas reduction" and that "the automotive industry has relied for more than a generation" on ABT "to enable cost-effective emissions reductions"). These considerations more than justify EPA's continued use of this approach for purposes of these standards.

X. EPA Should Adopt the Proposed Durability and Warranty Requirements, But Should Also Require State-of-Certified Range Monitors.

We urge EPA to adopt the proposed PEV durability and warranty requirements. 88 Fed. Reg. at 29283-87. As EPA explains, the calculation of emission credits for PEVs is based on attributed mileage over their useful life. 88 Fed. Reg. at 29283. In addition to helping ensure that PEVs will in fact achieve the projected emission reductions throughout their useful lives, the warranty and durability requirements will enhance consumer confidence in PEVs and promote their faster adoption among purchasers, leading to greater air quality benefits.

EPA's authority to adopt the proposed durability requirements is grounded in Section 206 of the Clean Air Act, which (read in conjunction with Section 203) provides that before introducing a new motor vehicle into commerce, a manufacturer must obtain an EPA "certificate of conformity" indicating that the vehicle complies with applicable emission standards promulgated under Section 202. 42 U.S.C. § 7525(a)(1); 42 U.S.C. § 7522(a)(1). Section 202(a)(1), in turn, requires vehicles to achieve compliance with standards throughout their "useful life," "whether such vehicles and engines are designed as complete systems or incorporate devices to prevent or control such pollution." 42 U.S.C. § 7521(a)(1). Section 206 also provides that EPA may condition the certificate of conformity "upon such terms…as [it] may prescribe." 42 U.S.C. § 7525(a)(1). The statute thus confers broad authority on EPA to ensure that PEVs (like any other motor vehicle) in fact achieve the level of emission reductions attributed to them for purposes of compliance calculations throughout their useful lives.

Durability is also important for PEVs to ensure that vehicles in their second or third use cases maintain their durability and strong benefits to drivers. EPA points to several studies that highlight the importance of battery durability for PEVs, and notes that auto manufacturers are already required to "account for potential battery degradation that could result in an increase in CO2 emissions." 88 Fed. Reg. at 29283. Extending these requirements to PEVs is logical and well within EPA's authority.

Manufacturers are well-equipped to meet durability requirements, which are already in place in other jurisdictions. The United Nations Global Technical Regulation No. 22 (GTR No. 22) recommends durability standards for batteries in vehicles.[222] EPA notes that Agency staff chaired the informal working group that developed these standards. 88 Fed. Reg. at 29284 n.536. In the United States, the California Air Resources Board has established battery durability and warranty standards in the Advanced Clean Cars II regulations. *Id.* at 29284 nn.537-38. Pending approval of the ACC II waiver from EPA, at least seven states (representing approximately 25% of the United States vehicle sales market) will have enforceable battery durability and warranty

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[222] *See* United Nations, *Addendum 22: United Nations Global Technical Regulation No. 22* § 1.A, April 14, 2022.. https://unece.org/sites/default/files/2022-04/ECE_TRANS_180a22e.pdf

requirements. Therefore, EPA's consideration of battery durability and warranty standards is aligned with global trends and policies, and we support the proposed incorporation of GTR No. 22 into EPA's final rule.

However, while EPA has chosen to incorporate many parts of GTR No. 22, the Agency has chosen not to require a monitor for the vehicles' state of certified range (SOCR), without providing a sufficient justification. EPA recognizes that the state of certified energy (SOCE) is important to track minimum performance requirements, which we support. However, EPA notes that "monitoring the state of a vehicle's full-charge driving range capability… as an indicator of battery durability performance may be an attractive option because driving range is a metric that is more directly experienced and understood by the customer." 88 Fed. Reg. at 29286. The GTR No. 22 includes a requirement for SOCR, but it is not customer-facing, while California's ACC II program requires a range metric *instead* of a SOCE metric. *Id.* As EPA notes, drivers are accustomed to think about the range of their vehicles, not the energy levels of the battery. *Id.* Therefore, we request that EPA require both a SOCE monitor for compliance purposes as well as a SOCR monitor within the vehicle to provide confidence and transparency to drivers about the state of health of their vehicle battery. This is especially important as the vehicles transition into the secondary market, as SOCR monitors will enhance consumer confidence in used PEVs. We also request that EPA require the SCOR be readable by the customer, in addition to regulatory authorities.

We also support the proposed warranty provisions, which fall well within EPA's authority under the Clean Air Act. Section 207(a)(1) provides that manufacturers of motor vehicles must warrant that the vehicle is "free from defects in materials and workmanship which cause such vehicle . . . to fail to conform with applicable regulations" for the warranty period specified by EPA through regulation. 42 U.S.C. § 7541(a)(1). And Section 207(i)(2), which applies specifically to light-duty vehicles and light-duty trucks, establishes a warranty period for "specified major emission control components," including catalytic converters, electronic emissions control units, onboard diagnostic devices, and "any other pollution control device or component" EPA designates under that section. 42 U.S.C. § 7541(i)(2). PEV batteries and associated electric powertrain components are no different from the enumerated emission control technologies—they are "pollution control device[s] or component[s]" because they enable the control (in fact, the complete elimination) of tailpipe emissions from motor vehicles. We agree with EPA's rationale for applying warranty requirements to PEV batteries and associated electric powertrain components, 88 Fed. Reg. at 29286-87, and we recommend that EPA finalize this aspect of the Proposal.

XI. Revisions to Elements of the Compliance and Enforcement Program Are Warranted.

We also urge EPA to revise certain elements of its compliance and enforcement program, as detailed below.

A. Clarifications of EPA's existing enforcement authority are appropriate.

As noted in the Proposal, EPA has the authority to remedy non-compliance with its GHG emissions regulations by correcting credit balances.[223] Such action is appropriate under the Clean Air Act, and EPA has utilized such remedies on occasion in the past, including when manufacturers were found to be improperly certifying vehicles to lower emissions.[224]

EPA's in-use testing program is a critical part of ensuring that the regulatory program yields the reductions anticipated in the real world. Should a manufacturer's in-use testing illustrate deviations from the fleet level certification, particularly those of a systematic nature resulting in higher real-world emissions, it is appropriate for EPA to adjust the manufacturer's regulatory credit balance to reflect this real-world increase. We support EPA's clarification and believe EPA should act swiftly should a need for such enforcement arise.

Unlike other emissions programs, GHG certification is granted at the precise certified test, rather than as a bin, where there is some inherent compliance margin. While EPA has some allowance for in-use values that fall within 10% of the certified value, as discussed in the section immediately below, EPA is proposing to allow manufacturers to voluntarily certify to a higher emissions level to better reflect the range of anticipated in-use emissions from the full configurations of the certified fleet. We support this voluntary approach.

These two actions are complementary to each other, and we support EPA finalizing both together in the final rule. EPA is proposing to allow manufacturers to create their own compliance margin to reflect the full range of plausible in-use emissions from vehicle configurations covered under a given certification level. If, after in-use testing is completed, EPA still determines that the in-use test values do not reflect the emissions levels certified by the manufacturer, EPA is making clear that it has the authority to remedy the manufacturer's balance after the fact. This provides adequate opportunity in advance of the sale of vehicles to preemptively address any concerns about systematic deviation without relinquishing EPA's ultimate authority to ensure that credits for the regulatory program reflect in-use performance.

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[223] 88 Fed. Reg. at 29288

[224] See "Correction of Greenhouse Gas Emission Credits" in Consent Decree, *United States & CARB v. Hyundai Motor Company et al.*, 14-cv-1837 (D.D.C. Jan. 9, 2015), ECF No. 8, at 9.

B. EPA should eliminate the 10-percent compliance factor adjustment.

While EPA's proposed clarifications will help ensure that its regulations better reflect in-use emissions performance, they also illustrate that the current in-use compliance margin is far too high. For EPA to detect systematic deviations in in-use emissions compared to certification, a manufacturer would have to be assured that variability is low enough that its vehicles would not emit above the 10% thresholds, despite certifying to an artificially low emissions level. This inherently means that the test-to-test variability and production variability within a subconfiguration or model type for which the 10% is supposed to account[225] is actually much less than 10%.

A 10% margin for error in in-use testing is quite high, particularly when considered in the context of the levels of improvement required under the standards: the average 2-cycle tailpipe certification value for a passenger car has decreased by just 19% from 2012-2021 and, for light trucks, just 18%. To put the 10% margin in perspective, take the example of the breadth of configurations of the Ford F-150: it is available in 3 body types, in rear- or four-wheel-drive, in trucks that vary in curb weight by 1600 pounds, with six different engines (including a hybrid), and additional high-payload and high-towing packages. And yet, the certified emissions levels from this vehicle span just 40%. The necessity of a 10% margin for a narrow slice of that spectrum (for one drivetrain, one engine, and one payload package) is implausibly high.

We support EPA eliminating the 10% in-use compliance allowance as part of this rule.[226] It is particularly relevant when considering EPA's clarifications around manufacturers' voluntary adjustments to certification, which would eliminate the need for such allowance. Shifting to a threshold for which additional testing is required supports the original intent of the allowance (to recognize testing variability) without undermining in-use emissions from vehicles regulated under the light-duty GHG program.

XII. EPA Should Improve Its Proposed Adjustment to the PHEV Fleet Utility Factor to More Accurately Capture the True Emissions from PHEVs.

Below, we offer comment on EPA's proposed adjustment to the PHEV Fleet Utility Factor (FUF). EPA is correct to adjust the FUF to reflect real-world driving and recharging behavior, but the modification proposed is not sufficient to reflect the true emissions from PHEVs. Prior to the availability of PHEV models (and therefore in the absence of data on their actual usage), it was rational to use the Fleet Utility Factor as formulated in SAE 2841 in 2010 as the basis for estimating the percentage of operation without internal combustion engine use occurring in charge-depleting (CD) mode. However, there is now a significant body of real-world data that can be used to develop utility factors that more accurately reflect the actual

[225] 88 Fed. Reg. at 29288-9.
[226] *Id.* at 29289.

tailpipe CO_2 emissions from PHEV operation.[227] Because EPA proposes to retain a zero gram per mile value for operation in CD mode, the choice of utility factor will play an important role in determining the compliance value for PHEVs.

EPA has obtained California Bureau of Automotive Repair (BAR) data from onboard diagnostics devices (OBD) that show the real-world utilization of PHEVs in CD mode. The data show that all PHEV models in the dataset have actual utility factors lower than the current (SAE 2841) FUF. In some cases, the BAR data show real-world utility factors that are nearly 50% lower than the current FUF values. For example, the BAR data show the Honda Clarity PHEV as having a real-world utility factor of 0.359 while the SAE 2841 method gives the Clarity a FUF of 0.676.[228] These results show that the SAE2841 method using travel survey data is a poor estimator of actual vehicle usage. The Agency proposes to reduce the FUF for compliance calculations by averaging the current FUF with a curve derived from the BAR real-world data. This averaging will lower the gap between actual emissions performance and the compliance value, but will still allow for compliance values for PHEVs that are higher than justified. Given that EPA now has clear real-world data showing that the current FUF is not reflective of actual emissions from PHEVs, it is inappropriate to use the original SAE J2841 FUF or to use it in an average with other data. EPA should instead use a FUF consistent with the actual in-use data from BAR and adopt the FUF labeled "ICCT-BAR" in the DRIA.

The decision to average real-world usage data with the SAE 2841 estimate is poorly justified. EPA states that "an overly low FUF curve could disincentivize manufacturers to apply this technology." 88 Fed. Reg. at 29254. However, both the current FUF curve and the proposed curve over-credit PHEVs. A curve that correctly credits PHEVs' reductions in emissions (such as the ICCT-BAR curve) will not disincentivize adoption of PHEVs, but instead will provide a lower incentive for the partial elimination of tailpipe emissions and a greater incentive for complete elimination via fully-electric powertrain options. Even with a lower FUF, the ability to reduce the compliance emissions values by use of zero grams per mile for the CD mode phase will provide a significant incentive for a manufacturer to choose a PHEV powertrain over a non-plug-in hybrid. Choice of a lower FUF curve will at the same time ensure that there is a sufficient incentive to encourage the continued development and deployment of zero-emission technologies.

EPA also cites future models with longer electric range and greater all-electric performance as leading to future real-world performance that meets the proposed FUF curve. This is not supported by the available data. The longest electric range PHEV currently available is the Toyota RAV4 Prime. The RAV4 Prime data from the BAR dataset show a real-world utility

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[227] Aaron Isenstadt et al., ICCT, *Real World Usage of Plug-in Hybrid Vehicles in the United States* (Dec. 2022), https://theicct.org/wp-content/uploads/2022/12/real-world-phev-us-dec22.pdf.

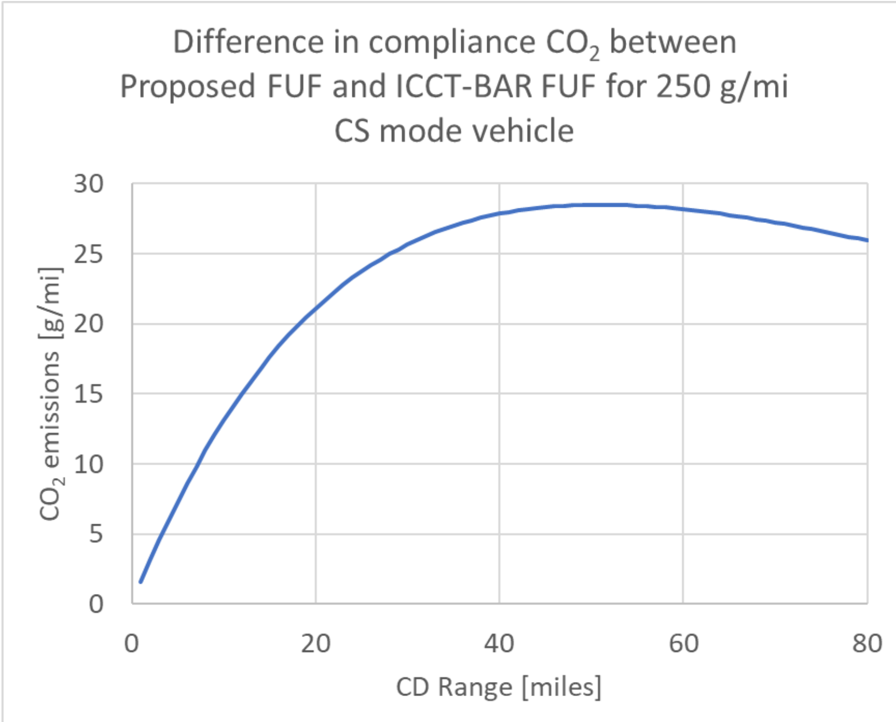
[228] The data is from EPA-HQ-OAR-2022-0829-0465_attachment_2.xlsx, and was processed using the method described in EPA-HQ-OAR-2022-0829-0465_attachment_1.pdf.

factor of 0.35, significantly lower than the proposed FUF for a 42-mile all-electric range (AER) vehicle (0.52) and even lower than the ICCT-BAR curve (0.41). EPA states that "increased consumer technology familiarity" will also make future PHEV usage approach the proposed FUF curve. 88 Fed. Reg. at 29254. Increased consumer knowledge may make purchasers able to shift more driving to electric-only mode. However, it is also possible that purchasers (especially in the secondary market) may buy a PHEV without the ability to plug in or may choose a PHEV because of incentives that make the purchase more attractive relative to a non-plug-in vehicle. Existing research on the use of PHEVs shows that the largest factor leading to lower real-world observed utility factors is lack of charging, with 20-30% of some PHEV models starting their travel day on a nearly empty battery.[229]

The proposed FUF could lead to PHEVs with a large difference between real-world emissions and the compliance values for CO_2 emissions. The use of PHEV powertrains in larger vehicles such as SUVs and pickups will cause this gap to grow, due to the gap between the zero grams per mile CD operation and the high gram per mile operation when the internal combustion engine is running. Over-crediting PHEVs' purported electric driving would create a new and unjustified loophole that would likely slow down the path to greater deployment of zero-emission technologies within the fleet. For example, for a PHEV that has compliance CO_2 charge sustaining (CS) mode emissions of 250 g/mile and an electric range of greater than 28 miles, the proposed FUF would artificially reduce the combined mode PHEV emissions by over 25 g/mile when compared to the ICCT-BAR FUF. (Figure XII.1). The gap between the proposed FUF and the real-world data (ICCT-BAR) is highest for vehicles with a CD range between 42 and 62 miles. California's ZEV regulations for model year 2029 and subsequent vehicles require a minimum certification electric range of 70 miles to be eligible for credit values, which is approximately a 50-mile label range. Therefore, PHEVs designed to meet the minimum range for ZEV credit value eligibility are likely to have the largest deviations between real-world emissions and the compliance emissions calculated using the proposed FUF.

[229] Seshadri Srinivasa Raghavan & Gil Tal, *Plug-in hybrid electric vehicle observed utility factor: Why the observed electrification performance differ from expectations*, 15 Int'l J. of Sustainable Transp. 105, 122 (2022), https://www.sciencedirect.com/org/science/article/pii/S1556831822004269.

Figure XII.1. Difference in Compliance CO_2 Between Proposed FUF and ICCT-BAR FUF for 250 g/mi CS Mode Vehicle



XIII. EPA Should Finalize the Proposed Test Fuel Change for GHG and Fuel Economy Certification But Not for Labeling Purposes, and It Should Require the Use of Adjustment Factors in Appropriate Circumstances.

We support EPA's proposal to require gasoline-powered vehicles to demonstrate compliance with the MY 2027-2032 GHG standards using Tier 3 test fuel, as well as its proposal to require the use of adjustment factors in certain situations. *See* 88 Fed. Reg. at 29240-42 & Tbl. 30. In addition to the points made below, we urge EPA to consider the comment letter that many of the undersigned organizations submitted to EPA in August 2020 regarding its related proposal on Tier 3 test fuel (which was never finalized).[230]

In the 2014 Tier 3 Rule, EPA appropriately decided to transition away from Indolene (also known as "Tier 2") test fuel, which no consumer can purchase, to a test fuel ("Tier 3," which contains 10% ethanol) that represents what consumers can actually purchase at the pump. 79 Fed. Reg. at 23525-26. As part of the Tier 3 rulemaking, EPA committed to assessing the impact of the test fuel change on the GHG emissions and fuel usage of the new vehicle fleet. *Id.* at 23531-32. The results of the Agency's subsequent research study were conclusive: switching from Indolene to Tier 3 test fuel reduces fuel economy and tailpipe emissions of carbon

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[230] Comment Letter re: EPA-HQ-OAR-2016-0604, Vehicle Test Procedure Adjustments for Tier 3 Certification Test Fuel (Aug. 14, 2020), at https://www.regulations.gov/comment/EPA-HQ-OAR-2016-0604-0081.

dioxide.[231] As EPA rightly concludes, the "difference in GHG emissions between the two fuels is significant in the context of measuring compliance" with GHG standards. 88 Fed. Reg. at 29241.

Because EPA has based the proposed MY 2027-2032 GHG standards on the use of Tier 3 test fuel instead of Indolene, *id.* at 29240-41, requiring manufacturers to use Tier 3 test fuel to demonstrate compliance in MY 2027 and beyond is appropriate. We agree that compliance testing using Tier 3 fuel in MY 2027-2032 does not require an adjustment factor.

We also agree with EPA's proposal that any manufacturers that use Tier 3 test fuel to certify compliance with pre-MY 2027 GHG standards must apply an adjustment factor of 1.0166. 88 Fed. Reg. at 29241 & Tbl. 30. Since the existing (pre-MY 2027) GHG standards are based on Indolene test fuel, using this adjustment factor is necessary to avoid arbitrarily crediting vehicles tested with Indolene with artificial reductions in GHG emissions. As EPA has recognized, not applying an adjustment factor would effectively (and inappropriately) reduce the stringency of the existing GHG standards. U.S. EPA, Vehicle Test Procedure Adjustments for Tier 3 Certification Test Fuel, 85 Fed. Reg. 28564, 28566 (May 13, 2020) (proposed, never-finalized rule regarding Tier 3 test fuel change). Failing to require an adjustment factor would also impose unwarranted additional costs on consumers at the gas pump. To avoid unnecessary and harmful delays in manufacturers applying the adjustment factor to pre-MY 2027 vehicles tested on Indolene, EPA should also clarify that this provision takes effect 60 days after the rule becomes final.

EPA's approach to adjusting the fuel economy and GHG certification values based on the certified fuel as outlined in Table 30 of the Proposal is appropriate. However, the Agency should begin requiring Tier 3 fuel used for certification for all non-carryover vehicles beginning with the first complete model year following finalization of the rule, in order to avoid manufacturers trying to exploit relative Indolene vs. Tier 3 performance different than the average adjustment factor. Manufacturers already certify vehicles on Tier 3 fuel and are aware of any potential discrepancies that could be used to their advantage, so the Agency should eliminate any opportunity for manipulation of certification results as soon as possible, with no phase in period. Allowing carryover is a sufficient compromise to minimize testing burden.

We do not support EPA's proposal to adjust certification test fuel requirements for purposes of fuel economy and emissions labels. The use of Tier 3 fuel for certification was justified because this fuel more closely aligns with the fuel available to consumers at the pump.[232] Thus, Tier 3 fuel is more representative of the fuel a consumer would use to judge their own fuel economy. In contrast, the data collected to support the latest iteration of the fuel

[231] *See* U.S. EPA, Tier 3 Certification Fuel Impacts Test Program, EPA-420-R-18-004 (Jan. 2018), at 2, available at https://www.regulations.gov/document/EPA-HQ-OAR-2016-0604-0003.
[232] "E10 most appropriately reflects in-use gasoline around the country today and into the foreseeable future, and thus we are finalizing E10 for the test fuel." 79 Fed. Reg. at 23450.

economy label was collected in 2004-2005,[233] prior to the Renewable Fuel Standard (RFS2) taking effect. Ethanol content in fuel in 2004-2005 was just 2%, on average; MTBE was the more popular oxygenate; and gasoline's oxygen content averaged just over 1%, as opposed to 2014, when Tier 3 (E10) fuel was defined to reflect the 10% ethanol content of the reformulated gasoline available to consumers and oxygen content nearly doubled.[234] While Indolene has never been available at the gas pump, many of the average properties for 2004 pump fuel are directionally more similar to Indolene than to Tier 3 fuel: lower gravity, lower ethanol content, lower oxygen, and higher aromatics.[235] Thus, the fuel economy labeling tests were, to first order, based on the pump fuel at the time, and now such tests should reflect the updated fuel more representative of today's current pump fuel. Therefore, rather than applying the adjustment factor to Tier 3-certified vehicles, as EPA proposes, it would be more appropriate to apply the inverse adjustment factor to Indolene-certified vehicles. While we appreciate the point made by EPA that "a comprehensive assessment of real world fuel economy is the best process to ensure that all real-world effects are reflected," 85 Fed. Reg. at 28579, such an assessment is a resource-intensive undertaking that has not been attempted in nearly 20 years, and EPA has sufficient data based on its Tier 2/Tier 3 program to account for a shift in the available pump fuel.

XIV. EPA Should Finalize Its Proposed Changes for Small Volume Manufacturers.

We support EPA's proposal to transition small volume manufacturers ("SVMs") into the primary program standards by MY 2032.[236] As illustrated in Table 37, the emissions standards presently applicable to SVMs are significantly less protective than those that apply to other manufacturers.[237] For MY 2021, SVM standards ranged from 308-376 g/mile.[238] By comparison, the revised footprint curve in SAFE 2 for passenger cars for MY 2021 was 161.8 to 220.9 g/mile.[239]

As EPA explains, there has been a significant shift in the vehicle market since EPA established the SVM alternative standards.[240] For example, "[v]ehicle electrification technologies are currently being implemented across many vehicle types including both luxury and high-performance vehicles by larger manufacturers and EPA expects this trend to continue."[241] In

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[233] U.S. EPA, Final Technical Support Document–Fuel Economy Labeling of Motor Vehicles: Revisions to Improve Calculation of Fuel Economy Estimates, EPA-420-R-06-017 (Dec. 2006), at Appendix A, available at http://nepis.epa.gov/Exe/ZyPDF.cgi/P1004F41.PDF?Dockey=P1004F41.PDF.
[234] U.S. EPA, Fuel Trends Report: 2006-2016, EPA-420-R-17-005 (2017), at 27, Tbl. 6, available at https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P100T5J6.pdf.
[235] *Compare id.* Tbl. 6 *with* U.S. EPA, Tier 3 Certification Fuel Impacts Test Program, EPA-420-R-18-004 (Jan. 2018), at 5, Tbl. 3.1.
[236] 88 Fed. Reg. at 29197, 29255.
[237] *Id.* at 29256.
[238] *Id.*
[239] 84 Fed. Reg. 24174, 25268 (Apr. 30, 2020).
[240] 88 Fed. Reg. at 29256.
[241] *Id.*

addition, as EPA notes, the credit trading market has become more robust since the SVM alternative standards were initially developed, expanding compliance options for SVMs. EPA concluded that "meeting the CO_2 standards is becoming less a feasibility issue and more a lead time issue for SVMs."[242]

EPA's conclusions that a transition of SVMs to the primary program coheres with the recent announcements and developments in the business model of the SVMs who have previously pursued less stringent standards. There are only four SVMs currently subject to less stringent standards: Ferrari, Aston Martin, Lotus, and McLaren. All are moving toward greater hybridization and electrification, which will facilitate compliance with the primary LDV GHG standards.

Ferrari in 2022 announced plans to rapidly electrify its vehicle offerings, achieving 40% BEV sales by 2030 and 80% electrified (PHEV + BEV) vehicles.[243] Ferrari already sells two PHEVs, the SF90 Stradale[244] and the 296 GTB.[245] Likewise, Aston Martin has committed to electrification. It will offer its first BEV in 2025 and has committed to having every model available with an electrified powertrain by 2026.[246] It will begin delivering its first PHEV, the Valhalla, in 2024.[247] Lotus is offering the all-electric Evija[248] and Eletre SUV.[249] The Eletre will be available in the United States beginning in 2024.[250] And McLaren has recently developed its first hybrid vehicle, the Artura, and indicated that all its vehicles will eventually be gas-electric hybrids or electric-only.[251]

Based on the SVMs' active transition into hybrid and battery electric vehicles—with its attendant improvements in GHG emissions—the existence of a robust credit trading market, and the significant lead time proposed by EPA for transitioning the SVMs into the broader program, We support EPA's proposal.

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242 *Id.*
243 Michael Taylor, *Ferrari to Go Electric in 2025, with 40% EV Sales by 2030*, Forbes (June 16, 2022), https://www.forbes.com/sites/michaeltaylor/2022/06/16/ferrari-to-go-electric-in-2025-with-40-ev-sales-by-2030/?sh=7fd8646d66a2.
244 *SF90 Stradale*, Ferrari, https://www.ferrari.com/en-EN/auto/sf90-stradale (last visited June 29, 2023).
245 *296 GTB*, Ferrari, https://www.ferrari.com/en-US/auto/296-gtb (last visited June 29, 2023).
246 Eric Stafford, *Aston Martin Is Going Electric, Launching Its First EV in 2025*, Car and Driver (Apr. 22, 2022), https://www.caranddriver.com/news/a39798418/aston-martin-electric-lineup-reveal-first-ev-2025/.
247 *Id.*; *see also Aston Martin Valhalla*, Aston Martin, https://www.astonmartin.com/en-us/models/special-projects/valhalla (last visited June 29, 2023).
248 *Evija*, Lotus, https://www.lotuscars.com/en-US/evija (June 29, 2023).
249 *Eletre*, Lotus, https://www.lotuscars.com/en-US/eletre (last visited June 29, 2023).
250 Mike Duff, *Lotus Moves to Float Its EV Division*, Autoweek (Feb. 8, 2023), https://www.autoweek.com/news/green-cars/a42801104/lotus-moves-to-float-its-ev-division/.
251 Josh Max, *McLaren Rolls Out the Hybrid 2023 Artura Supercar*, Forbes (Jan. 5, 2023), https://www.forbes.com/sites/joshmax/2023/01/05/mclaren-throws-its-hat-into-the-electrichybrid-ring-with-the-2023-artura/?sh=42c0eb057746.

XV. ZEV Penetration in the Absence of the Proposed Standards is Likely to Exceed EPA's Estimates, Supporting the Feasibility of More Stringent Standards.

To support the feasibility of Alternative 1 with a steeper increase in stringency after 2030, we now turn to the market growth of ZEVs and anticipated baseline (or "no action") levels of ZEV penetration. EPA's No Action scenario projected that BEVs will comprise 39% of the LDV fleet in 2032. To assess the reasonableness of this projection, EPA reviewed literature and other analytical projections, which clearly supported ZEV penetration at least as high as EPA's projections. While EPA's approach is reasonable, real-world "no action" levels of BEVs are likely to be even higher than EPA's No Action scenario. This supports making the finalized standards more stringent than proposed.

A. Other analyses predict high levels of ZEVs in the period of the Proposed Standards.

In the Proposal, EPA cites several sources that model the global and United States ZEV outlook over the next few decades. 88 Fed. Reg. at 29189, 29192-3.[252] These models vary in their assumptions (including whether IRA funding is considered in the projections), but all point to upward momentum of the PEV market globally and in the United States. EPA appears to have considered a variety of analyses available – looking at both aggressive projections and conservative models – to understand the global transition to PEVs. The most relevant of the analyses that EPA considered are those that account for the impact of the IRA in baseline ZEV penetration levels, and each of those supports baseline ZEV sales greater than the baseline levels projected in EPA's proposed No Action scenario. For example, the 2022 Bloomberg New Energy Finance (BNEF) analysis incorporating the IRA projects baseline ZEV sales of 52% in 2030, compared to EPA's projection of 39% in 2032. *Id.* at 29189. And the analysis by ICCT and Energy Innovation, which also incorporated the impacts of the IRA, projects 2032 baseline ZEV sales between 17% and 28% higher than EPA's projections. *Id.* An additional analysis by Boston Consulting Group not cited by EPA projects similar baseline ZEV sales, anticipating 53% U.S. market share for light-duty ZEVs in 2030.[253] The only analysis EPA considered that projected a baseline close to EPA's projection was IHS Markit—predicting nearly 40% ZEV sales in the U.S. by 2030—but this analysis was pre-IRA and therefore should be considered an underestimate. *See* 88 Fed. Reg. at 29189. These analyses justify and support strong EPA emission standards, and auto executives have signaled that their sales expectations align with baseline ZEV sales at least as high as—and most likely higher than—EPA's projections, even prior to the passage of

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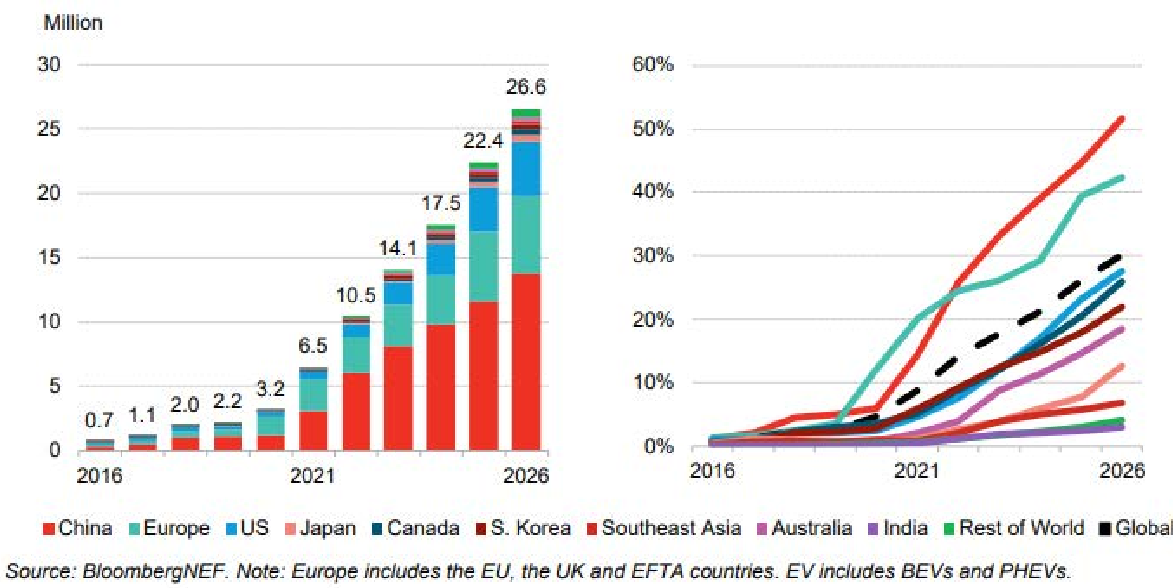
[252] IHS Markit (2021) predicted nearly 40% US PEV share by 2030 (pre-IRA); BNEF found the U.S. on pace to reach 40-50% PEVs by 2030, increasing to 52% when adjusted for IRA; ICCT/Energy Innovation found BEV share to be 56% to 67% by 2032 (including IRA); IEA found OEM announcements equal about 50% ZEVs in 2030.
[253] Nathan Niese et al., *Electric Cars Are Finding Their Next Gear*, BCG, Exhibit 1 (June 9, 2022), https://www.bcg.com/publications/2022/electric-cars-finding-next-gear. BCG's projections for 2030 include 47% market share for BEVs and 6% market share for PHEVs.

the IRA.[254] As discussed throughout these comments, we request that EPA adopt at least Alternative 1 based on strong projections of the growth of the PEV market, as well as consider additional new data that became available since the Proposal.

For example, in the Proposal, EPA cites 2022 BNEF data that states that global growth of EVs is projected to reach 21 million in 2025. However, the latest BNEF EV Outlook updates that modeling, and estimates that EV sales will reach approximately 22.4 million by 2025, growing to 26.6 million sales by 2026 and reaching 44% of global sales by 2030. In the United States, EVs are expected to reach 28% of sales by 2026, which equates to over 4 million new ZEV sales, a large growth from the 980,000 new ZEVs sold in 2022.[255]

Figure XV.A-1: **Global near-term passenger EV sales and share of new passenger vehicle sales by market**



B. State standards will lead to greater ZEV deployment.

In August 2022, CARB unanimously approved the ACC II standards, which, starting in model year 2026, require manufacturers to sell an increasing number of new ZEVs[256] annually,

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[254] KPMG, 22nd Annual Global Automotive Executive Survey 2021 8 (Nov. 2021), https://assets.kpmg.com/content/dam/kpmg/xx/pdf/2021/11/global-automotive-executive-summary-2021.pdf (finding that, even before the passage of the IRA, auto executives on average expected 52% of new vehicle sales to be all-electric by 2030). *See also,* Michael Wayland, Auto Executives Say More Than Half of U.S. Car Sales Will Be EVs By 2030, KPMG Survey Shows, CNBC (Nov. 30, 2021), https://www.cnbc.com/2021/11/30/auto-executives-say-more-than-half-of-us-car-sales-will-be-evs-by-2030-kpmg-survey-shows.html.

[255] BloombergNEF, *Electric Vehicle Outlook 2023: Executive Summary* (2023).

[256] Defined as Battery Electric, Plug-in Hybrid, and Fuel Cell Electric Vehicles.

culminating in 100% new ZEV sales by model year 2035. CARB submitted a waiver request for the ACC II standards in late May 2023.

While the ACC II standards cannot be enforced until the waiver is granted by EPA, six additional states[257] have adopted the standards in anticipation of waiver approval. These seven states (including California) approximately 25% of the United States vehicle market.[258] Further, at least five other states and the District of Columbia have announced their intention to adopt ACC II.[259] Should those jurisdictions also adopt ACC II, nearly one-third of the United States vehicle market would be on a trajectory to have 100% new zero-emission vehicle sales by 2035.[260]

EPA included ACC II in a sensitivity analysis but did not include it in the central analysis, as CARB had not yet submitted the waiver request for ACC II as of the date of the Proposal. However, now that CARB has submitted the waiver request, we ask that ACC II be included in the central analysis if the waiver is granted before the Proposal is finalized. And while ACC II clearly supports the feasibility of stronger federal standards, including through changes to business-as-usual (BAU) PEV penetration, it is also clear that stronger federal standards are feasible and justified even without it. As a result, we encourage EPA to model a scenario in the final rule that does not include ACC II, which will demonstrate that the record supports the final standards even in the absence of ACC II.

The addition of the ACC II sensitivity makes a significant difference in the No Action scenario, as the BAU for PEVs increases from 39% to 54% and the incremental average cost of the standards decreases from $1,164 to $164. It appears that this sensitivity does not include all of the states that have adopted ACC II or intend to adopt ACC II—specifically Virginia—implying that the BAU will increase, and the average incremental costs of the standards will decrease even further when the full range of states are included. The inclusion of the full portfolio of states that have adopted ACC II by the time of the final regulation in the

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[257] The states that have adopted ACCII as of the date of this comment letter are Oregon, Washington, Virginia, Massachusetts, New York, and Vermont.

[258] CARB, *States that Have Adopted California's Vehicle Standards under Section 177 of the Federal Clean Air Act,* May 13, 2022, https://ww2.arb.ca.gov/sites/default/files/2022-05/%C2%A7177_states_05132022_NADA_sales_r2_ac.pdf

[259] These states are: Rhode Island (https://dem.ri.gov/environmental-protection-bureau/air-resources/advanced-clean-cars-ii-advanced-clean-trucks), Delaware (https://news.delaware.gov/2022/03/03/delaware-to-adopt-zero-emission-vehicle-regulation/), Maryland (https://governor.maryland.gov/news/press/pages/Governor-Moore-Announces-Maryland-Adoption-of-the-Advanced-Clean-Cars-II-Rule-to-Combat-the-Effects-of-Climate-Change.aspx), New Jersey (https://nj.gov/governor/news/news/562023/approved/20230215b.shtml), and Colorado (https://cdphe.colorado.gov/coloradocleancars). Earlier this year, Washington D.C completed the public comment period on its proposal to adopt the ACC II regulations (https://doee.dc.gov/release/notice-comment-period-proposed-rulemaking-adoption-california-vehicle-emission-standards).

[260] CARB, *States that Have Adopted California's Vehicle Standards under Section 177 of the Federal Clean Air Act.*

central analysis will provide a more accurate picture of the state of the U.S. PEV market as well as presumed costs of the regulation.

The inclusion of ACC II in the central analysis is also aligned with assumptions EPA has included throughout the Proposal with respect to ACC II adoption, such as the assumption that "anticipated longer all-electric range and greater all-electric performance, *partially driven by CARB's ACC II program*… should result in performance more closely matching [the] proposed curve," 88 Fed. Reg. at 29254, and the alignment of the NMOG + NOx provisions with ACC II 88 Fed. Reg. at 29275.

C. Private investments and commitments will lead to greater ZEV deployment.

EPA should also consider private investments and commitments that have been announced or implemented throughout the United States thus far that will further facilitate rapid growth of ZEVs.

EPA states in the proposed rule that automakers, based on their public commitments, will achieve approximately 50% ZEV sales by 2030. 88 Fed. Reg. at 29296. EPA also considered additional automaker announcements to accelerate the EV market in the United States, *see, e.g.*, 88 Fed. Reg. at 29193-94. EPA should update these estimates in the final rule, including by recognizing the $210 billion of investments in the United States to accelerate the transition to ZEVs and build up a robust, domestic supply chain – a higher investment than any other country.[261] These investments will help increase the availability of ZEVs in the United States and further accelerate the transition to ZEVs that is already well underway in the market.

D. Congressional support will increase ZEV deployment and cost-competitiveness.

In addition to highlighting the investments from the BIL (explored in further detail later in these comments), EPA rightly points to the historic funding from the IRA as building on and supporting EPA's efforts to regulate tailpipe emissions from vehicles:

> Congress passed the Bipartisan Infrastructure Law (BIL) in 2021, and the Inflation Reduction Act (IRA) in 2022, which together provide further support for a government-wide approach to reducing emissions by providing significant funding and support for air pollution and GHG reductions across the economy, including specifically, for the component technology and infrastructure for the manufacture, sales, and use of electric vehicles.[262]

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[261] Noah Gabriel, *$210 Billion of Annouced Investments in Electric Vehicle Manufacturing Heading for the U.S.* (January 12, 2023), https://www.atlasevhub.com/data_story/210-billion-of-announced-investments-in-electric-vehicle-manufacturing-headed-for-the-u-s/.

[262] 88 Fed. Reg. at 29187.

Together, these legislative measures represent significant congressional support for accelerating the deployment of and market for ZEV technologies. First, the BIL and IRA provide an unprecedented level of investment (over $430 billion) in ZEV infrastructure, technology, and supply chains, through a variety of key tax provisions, manufacturing investments, grants, rebates, loans, and other investment mechanisms.[263] BIL and IRA programs will, among other things, provide both direct grants and tax credits to lower acquisition costs of vehicles and increase the range of cost-effective applications,[264] help entities conduct planning for fleet electrification,[265] enable deployment of charging and hydrogen fueling infrastructure,[266] and facilitate advances in technology that can lower future vehicle costs. These programs also invest in vehicle and battery manufacturing and recycling, driving cost reductions and increasing domestic supply. EPA should accordingly ensure that these important laws are reflected in its estimate of baseline LD ZEV market penetration.

These federal incentives are a key market enabler and will help drivers (and commercial L/MD fleets) adopt advanced clean transportation technologies (like ZEVs) that lower operating costs and reduce emissions. Manufacturers also stand to reap significant benefits, as several key tax credits are expected to add up to provide robust support of ZEV production. Passing those savings on to consumers could drive down the cost of new ZEVs and spur sales.[267] For example, Tesla alone could qualify for $1 billion in tax credits this year, while its Giga Nevada plant could gain up to $17.5 billion in credits for its projected annual production rate of 500 gigawatt hours.[268] Ford and General Motors also stated that they could reap significant benefits as a result of IRA investments. Ford expects $7 billion in tax credits over the next three years and GM could gain $300 million in 2023.[269]

Second, the congressional investments from the IRA and BIL further the public health goals of the Clean Air Act and of this rulemaking: the reduction of harmful pollution from light-

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[263] U.S. DOE Office of Policy, *The IRA Drives Significant Emission Reductions and Positions America to Reach Our Climate Goals*, DOE/OP-0018 (August 2022), https://www.energy.gov/sites/default/files/2022-08/8.18%20InflationReductionAct_Factsheet_Final.pdf.

[264] *See, e.g.*, 42 U.S.C. § 7432 (appropriating $1 billion to EPA to create a program that awards grants and rebates for the costs of replacing existing class 6 and 7 HDVs with ZEVs, purchasing, installing, operating, and maintaining infrastructure needed for ZEVs, associated workforce development and training, and planning and technical activities needed to support the deployment of ZEV); 26 U.S.C. § 45W (providing up to $40,000 in tax credits to assist with vehicle replacements and reduce the effective cost of commercial ZEVs).

[265] *See, e.g.*, 42 U.S.C. § 7432.

[266] *See, e.g.*, 26 U.S.C. § 30C (providing tax credits to qualified alternative fuel vehicle property); 42 U.S.C. § 16161a (providing $8 billion to DOE to fund regional hydrogen hubs across the country); 23 U.S.C. § 151 (appropriating $2.5 billion to support the build-out of clean charging and fueling infrastructure projects along designated alternative fuel corridors of the National Highway System).

[267] Tom Taylor & Noah Gabriel, The EV Transition: Key Market and Supply Chain Enablers, Atlas Public Policy (Nov. 2022), https://atlaspolicy.com/wp-content/uploads/2022/12/2022-EV-Transition-Key-Market-and-Supply-Chain-Enablers.pdf.

[268] Joann Muller, *Biden's EV Surprise*, Axios (Feb. 1, 2023) https://www.axios.com/2023/02/01/electric-car-ev-tax-incentives-biden.

[269] Muller, *Biden's EV Surprise*.

and medium-duty vehicles. A preliminary assessment conducted by the U.S. Department of Energy (DOE) found that the IRA, in combination with other enacted policies and past actions, will help drive 2030 economy-wide GHG emissions down to 40% below 2005 levels and move the United States towards its overall 2030 target of achieving a 50 to 52% reduction in GHG emissions below 2005 levels.[270] DOE also noted that the impacts of these congressional investments can be further amplified and accelerated when paired with ambitious and consistent executive branch, state, local, and private sector actions to reduce transportation sector emissions and to make large-scale investments in PEV manufacturing and battery supply chains.[271] These investments are key factors driving industry developments in ZEVs and reducing manufacturing costs, in turn helping make compliance (with the stringency levels in Alternative 1) through enhanced ZEV deployment even more feasible and cost-effective for manufacturers.

Third, congressional funding will prompt and support private sector investment. An analysis by Atlas Public Policy explains that the combination of a strong regulatory environment (like EPA's vehicle standards help provide) along with congressional investments has and will continue to encourage substantial private sector investment in ZEVs, and finds that the U.S. is on track to reach $210 billion in economic commitments by automakers and battery manufacturers by 2030.[272] Clear regulatory signals – like EPA's vehicle emissions regulations – can create further confidence in the private sector to accelerate and expand investments and help ensure companies follow through on their ZEV commitments. In the Proposal, EPA highlights several IRA clean vehicles provisions that will help bolster ZEV deployment, drive down costs, and facilitate compliance with strong standards. These include the clean vehicles tax credit (§ 30D), the previously owned clean vehicle tax credit (§ 25E), the commercial clean vehicle tax credit (§ 45W), and the advanced manufacturing production credit (§ 45X). The § 45X credit is anticipated to be the most lucrative program for automakers, offering a tax credit of $35 per kilowatt-hour for each domestically made battery cell, which could slice manufacturer production costs by a third.

Fourth, a number of other congressional investments can be leveraged to address timelines for deploying ZEVs, human capital issues, potential supply chain constraints, consumer demand, and workforce development issues. For example, the IRA provided $500 million for the enhanced use of the Defense Production Act (DPA) – which President Biden recently invoked to support critical minerals production – on top of the funds made available for the DPA through the normal appropriations process.[273] This provision will support domestic mineral supply chains for large-capacity batteries, including those used in PEVs, and is intended to help increase

[270] U.S. DOE Office of Policy, *The IRA Drives Significant Emission Reductions*.
[271] U.S. DOE Office of Policy, *The IRA Drives Significant Emission Reductions*.
[272] Gabriel, *$210 Billion of Annouced Investments*.
[273] The White House, *Building a Clean Energy Economy: A Guidebook to the Inflation Reduction Act's Investments in Clean Energy and Climate Action*. (2023).
https://www.whitehouse.gov/wp-content/uploads/2022/12/Inflation-Reduction-Act-Guidebook.pdf

productivity, workforce safety, and sustainability in the various steps of the critical minerals lifecycle.

Additionally, the CHIPS and Science Act will strengthen American manufacturing, supply chains, and national security, and will invest in research and development, science and technology, and the workforce of the future to position the U.S. as a leader in clean transportation.[274] This law is further complemented by other congressional investments like the IRA's Advanced Energy Project Credit (§ 48C), which provides a $10 billion investment to expand clean manufacturing and recycling (including critical minerals refining, processing and recycling) and to address technology supply chain gaps. Manufacturers and other private parties are more likely to fully leverage these and other congressional investments if strong regulatory signals are in place, as would be the case under any policy scenarios that are at least as stringent as Alternative 1. This too helps bolster EPA's conclusion of feasibility for the standards outlined in Alternative 1 and in EPA's main Proposal.

Lastly, EPA's Proposal references a number of studies that look at the effect congressional investments (especially the IRA) have on ZEV penetration levels. These studies include reports from ICCT, BloombergNEF,[275] IHS Markit,[276] and others that suggest that even before the IRA, the U.S. was on track to reach as much as 50% new ZEV sales by 2030 due to a range of preexisting policies and market forces. When adjusted for the effects of the IRA, ZEV penetration levels are expected to increase to as much as 61% of sales in 2030, increasing to as much as 67% of new sales by 2032, per ICCT's analysis.[277] These studies further support the feasibility of a final rule at least as stringent as Alternative 1.

XVI. EPA Should Not Repeat Its Past Pattern of Underestimating ZEV Technology Advancements and ZEV Deployment Within the Fleet.

The regulatory history shows that EPA's projections of ZEV technology advancements and overall ZEV deployment within the fleet routinely prove too conservative. EPA should not repeat those same mistakes in this rulemaking. For example, EPA's light-duty GHG rule finalized in 2012 set standards for MYs 2017–2025 and projected "very small" numbers of electric

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[274] The White House. "CHIPS and Science Act Will Lower Costs, Create Jobs, Strengthen Supply Chains, and Counter China." press release, August 9, 2021. https://www.whitehouse.gov/briefing-room/statements-releases/2022/08/09/fact-sheet-chips-and-science-act-will-lower-costs-create-jobs-strengthen-supply-chains-and-counter-china/.

[275] Bloomberg New Energy Finance (BNEF), Electric Vehicle Outlook 2022: Long term outlook economic transition scenario.

[276] IHS Markit, *US EPA Proposed Greenhouse Gas Emissions Standards for Model Years 2023-2026; What to Expect* (Aug. 9, 2021), https://www.spglobal.com/mobility/en/research-analysis/us-epa-proposed-greenhouse-gas-emissions-standards-my2023-26.html. The table indicates 32.3% BEVs and combined 39.7% BEV, PHEV, and range-extended electric vehicle (REX) in 2030.

[277] Peter Slowik et. al., Analyzing the Impact of the Inflation Reduction Act on Electric Vehicle Uptake in the U.S., ICCT (Jan. 2023), https://theicct.org/wp-content/uploads/2023/01/ira-impact-evs-us-jan23.pdf

vehicles in the light-duty fleet through MY 2025. 77 Fed. Reg. at 62917. In the 2012 rule, EPA projected combined PHEV and BEV penetration of only 1% for the MY 2021 car fleet. *Id.* at 62872. Yet BEV sales alone accounted for at least 3.2% of all vehicle sales in MY 2021.[278] In the 2012 rule, EPA did not even project combined BEV and PHEV sales that high *by MY 2025*. For the combined car and truck fleet, EPA projected BEV and PHEV penetration of only 2% by MY 2025, and for the car fleet alone, BEV and PHEV penetration of only 3% by MY 2025. *Id.* at 62874, 62875 Tbl. III-52. EPA re-evaluated those projections in 2016 and 2017, again projecting MY 2025 technology penetrations of around 3% or less for BEVs.[279] And EPA's 2020 rule still projected only 3.4% BEVs by MY 2025. 85 Fed. Reg. at 24936 Tbl. VII-29.

In the 2012 rulemaking, EPA also considered a more stringent alternative projecting a 5% combined BEV and PHEV penetration for MY 2025 for the car fleet, but it rejected this alternative based on "serious concerns about the ability and likelihood manufacturers can smoothly implement [that level of] increased technology penetration." 77 Fed. Reg. at 62877. Yet automakers ultimately surpassed that "serious[ly] concern[ing]" electrification penetration level in MY 2022 with BEVs alone. In MY 2022, BEV sales reached at least 5.8% of total light-duty vehicle sales,[280] and this growth has continued, with the United States on track to vastly outpace EPA's previous projections of MY 2025 light-duty vehicle electrification. In Q1 of 2023, for example, U.S. light-duty BEV sales alone reached 7.2% of total vehicle sales.[281]

EPA's projections of ZEV technology advancements and deployment have also proven too conservative in the heavy-duty sector. In the 2016 Phase 2 Final Rule, for example, EPA projected very small levels of HD ZEV penetration through MY 2027. In that rule, EPA projected "limited adoption of all-electric vehicles into the market," and stated that the Agency "do[es] not project fully electric vocational vehicles to be widely commercially available in the time frame of the final rules." 81 Fed. Reg. at 73500, 73704.[282] By the time EPA proposed a new rule in 2022, however, the Agency recognized that its 2016 projections were underestimates. *See,*

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[278] Cox Automotive, *In a Down Market, EV Sales Soar to New Record* (Jan. 13, 2023), https://www.coxautoinc.com/market-insights/in-a-down-market-ev-sales-soar-to-new-record/; EPA, *The 2022 Automotive Trends Report*, at 74. *See also* Ilma Fadhil et al., ICCT, *Electric Vehicles Market Monitor for Light-Duty Vehicles: China, Europe, United States, and India, 2020 and 2021*, at 6 (2023), https://theicct.org/publication/ev-ldv-major-markets-monitor-jan23/ (estimating nearly 5% total U.S. BEV and PHEV sales in MY 2021).

[279] *See* EPA, *Draft Technical Assessment Report: Midterm Evaluation of Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards for Model Years 2022–2025*, at ES-10 (2016) https://www.nhtsa.gov/sites/nhtsa.gov/files/draft-tar-final.pdf; EPA, *Final Determination on the Appropriateness of the Model Year 2022–2025 Light-Duty Vehicle Greenhouse Gas Emissions Standards under the Midterm Evaluation*, at 4-5, 21 (2017), https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P100QQ91.pdf.

[280] Cox Automotive, *In a Down Market, EV Sales Soar to New Record. See also* EPA, *The 2022 Automotive Trends Report*, at 74 (preliminary report that electric vehicle sales, including both BEVs and PHEVs, were 7.2% of total sales in 2022).

[281] Cox Automotive, *Another Record Broken: Q1 Electric Vehicle Sales Surpass 250,000, as EV Market Share in the U.S. Jumps to 7.2% of Total Sales* (Apr. 12, 2023), https://www.coxautoinc.com/market-insights/q1-2023-ev-sales/.

[282] *See also* 81 Fed. Reg. at 73818 ("As we look to the future, we are not projecting the adoption of electric HD pickups and vans into the heavy duty market…we believe there is no need to a cap for HD pickups and vans because of the infrequent projected use of EV technologies in the Phase 2 timeframe.").

e.g., 87 Fed. Reg. at 17595 ("Several factors have changed our outlook for heavy-duty electric vehicles since 2016. First, the heavy-duty market has evolved such that in 2021, there are a number of manufacturers producing fully electric heavy-duty vehicles in several applications."). Despite having predicted very limited HD ZEV penetration *through MY 2027* in 2016, EPA noted that by 2019, there were already approximately 60 makes and models of HD BEVs available for purchase, "with additional product lines in prototype or other early development stages." *Id.* EPA explained that "manufacturers and U.S. states have announced plans to shift the heavy-duty fleet toward zero-emissions technology beyond levels we accounted for in setting the existing HD GHG Phase 2 standards in 2016," and recognized the need "[t]o update the MY 2027 vehicle CO_2 standards from the HD GHG Phase 2 rulemaking to reflect the recent and projected trends in the electrification of the HD market." *Id.* at 17598. EPA acknowledged its 2016 under-projections again in the Phase 3 proposal, stating that the Agency has "considered new data and recent policy changes," and is "now projecting that ZEV technologies will be readily available and technologically feasible much sooner than we had projected." 88 Fed. Reg. at 25939. In both the light- and heavy-duty sectors, then, EPA's previous projections of ZEV deployment have proven far too conservative, and automakers have repeatedly shown they can deploy zero-emission technologies on a scale and at a pace far greater than EPA originally predicted.

XVII. Ongoing Investments in Charging Infrastructure and Efforts to Ready the Grid for Widespread EV Charging Justify Stronger Standards.

In this section, we explain in detail how charging infrastructure and the electric grid are well-positioned to support strong final standards—and in particular, Alternative 1 with a steeper increase in stringency after 2030.

A. Economic theory and historical precedent show that infrastructure buildout will occur at the pace and scale needed to support vehicle electrification.

EPA should reject arguments that the buildout of charging and grid infrastructure cannot occur at the pace and scale needed to support expanded vehicle electrification, which are unreasonably pessimistic and inconsistent with both economic theory and historical precedent. These arguments rely on the classic "chicken-and-egg" scenario said to be presented by ZEV sales and charging infrastructure, where each side of the market waits for the other. But EPA need not and should not wait for infrastructure to fully mature before finalizing strong standards. EPA's standards themselves will send a strong signal to the market to undertake the infrastructure investments needed to accommodate a gradual rise in vehicle electrification,[283] such that

[283] Environmental regulation itself, of course, can lead to technology innovation and market development. *See generally* Jaegul Lee et al., *Forcing Technological Change: A Case of Automobile Emissions Control Technology Development in the US*, 30 Technovation 249 (2010); Margaret R. Taylor, Edward S. Rubin, & David A. Hounshell, *Regulation as the Mother of Innovation: The Case of SO2 Control*, 27 Law & Policy 348 (2005); James Lents et al., *Chapter II: The regulation of automobile emission: A case study*, in *Environmental Regulation and Technology*

increased ZEV sales and infrastructure buildout will occur in relative tandem and reinforce each other. As one analyst sums it up: "The chicken-and-egg conundrum is being solved. Investments in the space and the adoption of EVs [a]re happening much faster than many analysts expected, and this is also accelerating the build-out of the charging network."[284]

The economic literature on indirect network effects and two-sided markets shows that an increase in BEV sales can be expected to stimulate associated infrastructure development. In a study on flex-fuel vehicles fueled by E85 (85% ethanol), Corts (2010) found that growth in sales of flex-fuel vehicles due to government fleet acquisition programs led to an increase in the number of retail E85 stations.[285] That relationship held true across all six Midwestern states analyzed, despite differences in those states' E85 subsidies and tax credits.[286] The author concluded that the results "confirm the basic validity" of the theory underlying government fleet purchase requirements: that increasing the "base of alternative fuel vehicles can spur the development of a retail alternative fuel distribution infrastructure."[287]

Recent economic research has confirmed this relationship in the context of ZEVs and charging infrastructure specifically. An influential study by Li et al. (2017) found that "EV demand and charging station deployment give rise to feedback loops" and that "subsidizing either side of the market will result in an increase in both EV sales and charging stations."[288] Similarly, Springel (2021) found "evidence of positive feedback effects on both sides of the market, suggesting that cumulative EV sales affect charging station entry and that public charging availability has an impact on consumers' vehicle choice."[289] The BIL and IRA subsidize *both* sides of the market, offering significant incentives for both ZEV purchases and the construction of charging infrastructure. Economic theory therefore supports the proposition that strong final standards, particularly in combination with the BIL and IRA's large financial incentives, will facilitate expansion of charging and grid infrastructure.[290]

Economic theory has in fact played out in Norway, where ZEV sales and infrastructure both expanded rapidly over the span of about a decade. There, the "path to charging point

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Innovation: Controlling Mercury Emissions from Coal-Fired Boilers (Marika Tatsutani & Praveen Amar eds., 2000) https://www.nescaum.org/documents/rpt000906mercury_innovative-technology.pdf.

[284] Gabriela Herculano, *Chicken-and-Egg Problem: EV Adoption and Buildout of Charging Networks*, Nasdaq (Apr. 18, 2022), https://www.nasdaq.com/articles/chicken-and-egg-problem%3A-ev-adoption-and-buildout-of-charging-networks.

[285] Kenneth S. Corts, *Building out alternative fuel retail infrastructure: Government fleet spillovers in E85*, 59 J. Env't Econ. & Mgmt. 219, 219-20 (2009).

[286] *Id.*

[287] *Id.* at 231.

[288] Shanjun Li et al., *The market for electric vehicles: indirect network effects and policy design*, 4 J. Ass'n Env't. & Resources Econ. 89, 128 (2017).

[289] Katalin Springel, *Network Externality and Subsidy Structure in Two-Sided Markets: Evidence from Electric Vehicle Incentives*, 13 Am. Econ. J.: Econ. Pol'y 393, 426 (2021).

[290] *See id.* at 394 (noting that "the presence of positive feedback amplifies the impact of both types of subsidies"), 415 ("positive feedback loops between the charging station network and total all-electric vehicle sales amplify the impact of both types of subsidy").

saturation *started by stimulating more demand for EVs*."[291] In other words, Norway did not wait for infrastructure to fully mature before beginning its transition to cleaner cars. Rather, rising ZEV sales themselves "helped trigger a spike in demand for charging stations."[292]

The concept that charging infrastructure will adequately scale up over time also finds support in an analogous historical example: the buildout of roads and gasoline refueling infrastructure in the early 20th century to serve the United States' growing fleet of automobiles. The country's exponential growth in automobile sales—first exceeding 1,000 in 1899 and growing to 1 million by 1916[293]—preceded the establishment of an extensive network of both suitable roads[294] and filling stations.[295] The buildout of road and refueling infrastructure unfolded over long time horizons and in a variety of ways, adapting to the needs of the automobile fleet as it changed and grew. Paving and other road improvement efforts began on a small scale in cities, where automobiles were initially concentrated; efforts to improve rural roads and construct highways happened a decade or more later, as motorists began to expand their driving beyond cities.[296] Similarly, in the case of refueling infrastructure, a network of modern filling stations did not spring up until well after automobiles had grown in popularity.[297] Before that, refueling needs were met through varied and dispersed "non-station" methods such as cans of gasoline sold at general stores, barrels at repair garages, mobile fuel carts, curb pumps, and home refueling pumps, which emerged at various times as the demand for gasoline increased.[298] Road and refueling infrastructure therefore exhibited a "long-term, adaptive and portfolio approach"[299] that, over the span of several decades, satisfied the shifting needs of the growing ranks of automobile owners.

That approach holds important lessons for this rulemaking. As detailed elsewhere in this comment letter, the introduction of ZEVs into the total on-road fleet will occur gradually. *See* Figure V.C-1 & Figure V.D-1, *supra*; Table XVII.G-1 (L/MD PEVs as a Share of Total On-Road

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[291] Whitney Bauck, *How Norway Became the World's Electric Car Capital*, Nexus Media News (Mar. 7, 2023), https://nexusmedianews.com/how-norway-became-the-worlds-electric-car-capital/.
[292] McKinsey & Co, *What Norway's Experience Reveals About the EV Charging Market* 3 (2023), https://www.mckinsey.com/industries/automotive-and-assembly/our-insights/what-norways-experience-reveals-about-the-ev-charging-market#/.
[293] *Roads*, Encyclopedia.com (May 29, 2018), https://www.encyclopedia.com/science-and-technology/technology/technology-terms-and-concepts/roads.
[294] *See id.* (noting that around 1904, "[o]nly a few hundred miles of roads in the entire country were suitable for motor vehicles"); *see also* F.W. Geels, *The Dynamics of Transitions in Socio-technical Systems: A Multi-level Analysis of the Transition Pathway from Horse-drawn Carriages to Automobiles (1860–1930)*, 17 Tech. Analysis & Strategic Mgmt. 445, 460, 467-68 (2005) (discussing the gradual expansion and improvement of road infrastructure in the 1910s and 1920s to accommodate growth in and changes to automobile travel).
[295] Marc W. Melaina, *Turn of the century refueling: A review of innovations in early gasoline refueling methods and analogies for hydrogen*, 35 Energy Pol'y 4919, 4922 (2007) (noting that "the takeoff period for gasoline stations occurred between 1915 and 1925, but exponential growth in vehicles began around 1910, so the rise of gasoline filling stations followed rather than preceded the rise of gasoline vehicles").
[296] Geels, at 467-68.
[297] Melaina, at 4922.
[298] *Id.* at 4924-27.
[299] *Id.* at 4932 (discussing refueling infrastructure).

L/MD Fleet, 2026-2040), *infra.* Economic theory and historical precedent show that growth in ZEV sales and infrastructure buildout will occur in relative tandem, with infrastructure responding over time commensurate with the evolving needs of the ZEV fleet. And in finalizing these standards, EPA will send a strong market signal that will facilitate infrastructure development at the pace and scale needed to support compliance with the standards. EPA must reject unfounded chicken-and-egg arguments questioning whether infrastructure will respond to rising demand.

B. EPA neglects to account for other significant sources of federal funding for ZEVs and charging infrastructure.

The Proposed Rule states: "The Bipartisan Infrastructure Law (BIL) provides up to $7.5 billion over five years to build out a national PEV charging network."[300] However, as also noted in the Proposed Rule, there are many other programs funded by the BIL that could provide significant additional funding: "Other programs with funding authorizations under the BIL that could be used in part to support charging infrastructure installations include the Congestion Mitigation & Air Quality Improvement Program, National Highway Performance Program, and Surface Transportation Block Grant Program among others."[301] To illustrate the point, consider the two largest programs funded by the BIL, the National Highway Performance Program ($148 billion over five years) and the Surface Transportation Block Grant program ($72 billion over five years). A portion of those funds could be invested in EV charging infrastructure and other investments that reduce emissions by reducing the need to drive. The block grant program is explicitly designed to be versatile and is available for a wide range of uses. In fact, it was originally created in the 1991 transportation law to encourage states to move beyond the interstate highway-building era into investments in other improvements to our transportation system,[302] and Congress has added more uses since then. If, say, 20% of the funding provided by just those two programs were directed to EV charging infrastructure, it would provide $44 billion in additional federal funding.[303]

And even without accounting for a portion of the National Highway Performance Program and Surface Transportation Block Grant (the two largest funding allocations made by the BIL), Atlas Public Policy's inventory reveals there is a total of over $50 billion in BIL funding for which ZEVs and charging infrastructure are eligible expenses (see Figure XVII.B-1 below).

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[300] 88 Fed. Reg. at 29307.
[301] *Id.* at 29308.
[302] Ellen Schweppe, Legacy of A Landmark: ISTEA After 10 Years (2001), at https://highways.dot.gov/public-roads/novemberdecember-2001/legacy-landmark-istea-after-10-years (last accessed June 30, 2023).
[303] *See* Deron Lovaas & Max Baumhefner. What if States Turn Pavement Into Charging Stations? (May 16, 2022), at https://www.nrdc.org/bio/deron-lovaas/what-if-states-turn-pavement-charging-stations (last accessed June 30, 2023).

Figure XVII.B-1: ZEV Funding in the Bipartisan Infrastructure Law[304]

C. The Alternative Fuel Refueling Property Tax Credit extended by the IRA is not restricted to rural areas, but instead to areas that are not urban.

The Proposed Rule states that under the IRA, "residents in low-income or rural areas would be eligible for a 30% credit for the cost of installing residential charging equipment up to a $1,000 cap."[305] However, the word "rural" does not appear in IRA § 30C, which defines "eligible census tracts" for the Alternative Fuel Vehicle Refueling Property credit "as any census tract which (I) is described in § 45D(e), or (II) is not an urban area."[306] The distinction is important because there are many areas that have not been classified as rural that cannot rightly be classified as urban. For example, if the U.S. Department of the Treasury classifies a census tract as not urban if more than 10% of the blocks within the census tract are designated as rural census blocks (to ensure those who live in rural blocks are not unduly denied access just because they happen to live next to urban blocks), tens of millions more Americans and businesses would have access to these important tax credits. This approach has been recommended to Treasury by a diverse coalition of industry associations, individual companies, environmental, consumer, and environmental justice groups, and other stakeholders.[307] EPA should correct its characterization of § 30C and should convey to Treasury that adopting the broadly-supported approach described above would support strong vehicle standards.

[304]Atlas Public Policy, Infrastructure Investment and Jobs Act (H.R. 3684), at https://www.atlasevhub.com/materials/invest-in-america-act-h-r-3684/ (last accessed June 30, 2023).
[305] 88 Fed. Reg. at 29308.
[306] 26 U.S.C. § 30C(c)(3)(B).
[307] Ltr. from Max Baumhefner et al. to U.S. Dep't of the Treasury, June 2023 (attached to this comment letter; signatories include Natural Resources Defense Council, Alliance for Automotive Innovation, American Council on Renewable Energy, Ample, CALSTART, ChargePoint, Clean Energy Works, Earthjustice, Elders Climate Action, Electrification Coalition, Environmental Defense Fund, EV Charging for All, EVBox, Forth Mobility, Green Latinos, International Brotherhood of Electrical Workers, International Parking & Mobility Institute, Itselectric, League of Conservation Voters, National Association of Convenience Stores, National Consumer Law Center, NATSO, Navistar, Plug in America, Representing America's Travel Plazas and Truck Stops, Rivian, Sierra Club, SIGMA: America's Leading Fuel Marketers, TeraWatt, Transportation for America, Union of Concerned Scientists, and Volvo Group North America).

D. A more complete inventory reveals $67 billion in announced investments in charging infrastructure, including $33 billion dedicated to light-duty vehicles and $4 billion that could support light-duty vehicles.

EPA also correctly identifies that there has been "rapid growth in the broader market for charging infrastructure serving cars or other electric vehicles."[308] New charging infrastructure announcements are occurring every week, showing the public and private sectors' commitment to building out infrastructure to support vehicle electrification. The Proposed Rule's description of recently announced investments in charging infrastructure underscores the fact that significant progress is being made.[309] However, this narrative should be supplemented by a more comprehensive inventory of the public, private, and utility sectors. As of March 31, 2023, Atlas Public Policy (Atlas) estimates $67 billion dollars in charging infrastructure investments that have been announced by the public, private, and utility sectors but not yet installed as charging ports in the ground.[310] Table XVII.D-1 provides a summary of tallied investment amounts, which include:

- $33 billion in announced, unspent investments for LDV charging;
- $30 billion in announced, unspent investments for medium- and heavy-duty vehicle charging; and
- $4 billion in announced, unspent investments for use across any vehicle class.

Table XVII.D-1: Estimated U.S. Charging Infrastructure Investments Announced but Not Yet In the Ground, as of March 31, 2023

Investments Announced ($ millions)				
Funding Sector	**Funding available only for light-duty vehicle charging**	**Funding available for light-duty, medium-duty or heavy-duty vehicle charging**	**Funding available only for medium- and heavy-duty vehicle charging**	**Total**
Public	$22,263	$4,360	$20,562	$47,186

308 U.S. EPA, Greenhouse Gas Emissions Standards for Heavy-Duty Vehicles—Phase 3, 88 Fed. Reg. 25926, 25934 (Apr. 27, 2023).
309 88 Fed. Reg. at 29308-09.
310 Atlas Pub. Pol'y, *Announced EV Infrastructure Funding* (June 15, 2023).

Private (Non-Utility) [incomplete tally]	$6,254		$4,292	$10,546
Low Carbon Fuel Standard [2023 – 2032]	$2,941		$3,278	$6,219
Utility	$1,886		$1,402	$3,288
Grand Total	**$33,344**	**$4,360**	**$29,534**	**$67,239**

These totals include public sector (e.g., Charging and Fueling Infrastructure Discretionary Grant funding, state funding commitments, and modeled estimates of 26 U.S. Code § 30C tax credit payments), private sector (e.g., automaker and charging service provider), and utility program investments.[311]

Even Atlas's tally of private sector commitments is likely incomplete. Private sector actors often do not announce their investment plans, and are especially unlikely to do so if they are investing in home, depot, or workplace charging. Tallied private sector commitments *exclude* an estimated $3.0 billion in capital raised by charging companies (including ChargePoint, EVgo, Blink, and Volta), some percentage of which is expected still to be invested in charging hardware and installation.

The scale of these announced investments reflects a strong and growing deployment of public and private charging infrastructure that, even in advance of the finalization of the Proposed Standards, has begun to set the stage for a robust charging network. Additional analyses have emphasized the growing momentum in infrastructure deployment; for example, an International Energy Agency report noted that "there has been a substantial upswing in investment in EV charging infrastructure, which has doubled in 2022 compared to the previous year."[312]

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[311] Note that these figures do not include funding for hydrogen fuel cell vehicles. Regarding the § 30C tax credit, Atlas assumes that 1) all qualifying projects receive the tax credit, 2) on average, qualifying projects will receive tax credits worth 18% of covered costs, and 3) that Treasury will classify a census tract as not urban if more than 10% of the blocks within the census tract are designated as rural census blocks, as recommended by multiple stakeholders described in Section XVII.C. The estimated Low Carbon Fuel Standard value is based on modeling from Dean Taylor Consulting for California, Oregon, and Washington and does not include capacity credits. It uses a 2023 – 2032 EV adoption trajectory for those three states that meets President Biden's LDV goal of 50% ZEV sales share by 2030 (which is lower than the trajectory modeled in the EPA's proposed vehicle emission standards), an MDHD EV adoption curves modeled on the EPA's proposed emissions regulations for MD and HD vehicles, and modeling from Atlas's INSITE tool of MWh demanded by MDHD vehicles. Utility program investments include approved investor-owned utility programs with an EV charging element. Amounts are unspent program dollars as of the most recent program report available as of March 31, 2023. If no program report was available, Atlas used the percentage of time remaining in the approved program schedule to estimate the unspent proportion of program funding.

[312] IEA, *World Energy Investment 2023*, at 50 (2023), https://iea.blob.core.windows.net/assets/54a781e5-05ab-4d43-bb7f-752c27495680/WorldEnergyInvestment2023.pdf

E. Increased access to Tesla's large and growing supercharger network will accelerate PEV adoption.

Recent announcements from Tesla, Ford, GM, Rivian, and Volvo that will allow more drivers to access Tesla's SuperCharger network bolster the case for strong vehicle standards. As shown in Figure XVII.E-1 and Figure XVII.E-2, this effectively doubles the number of public fast charging locations and connectors available to a majority of the EV market.

Figure XVII.E-1: J1772Combo and Chademo DC Fast Charging Ports[313]

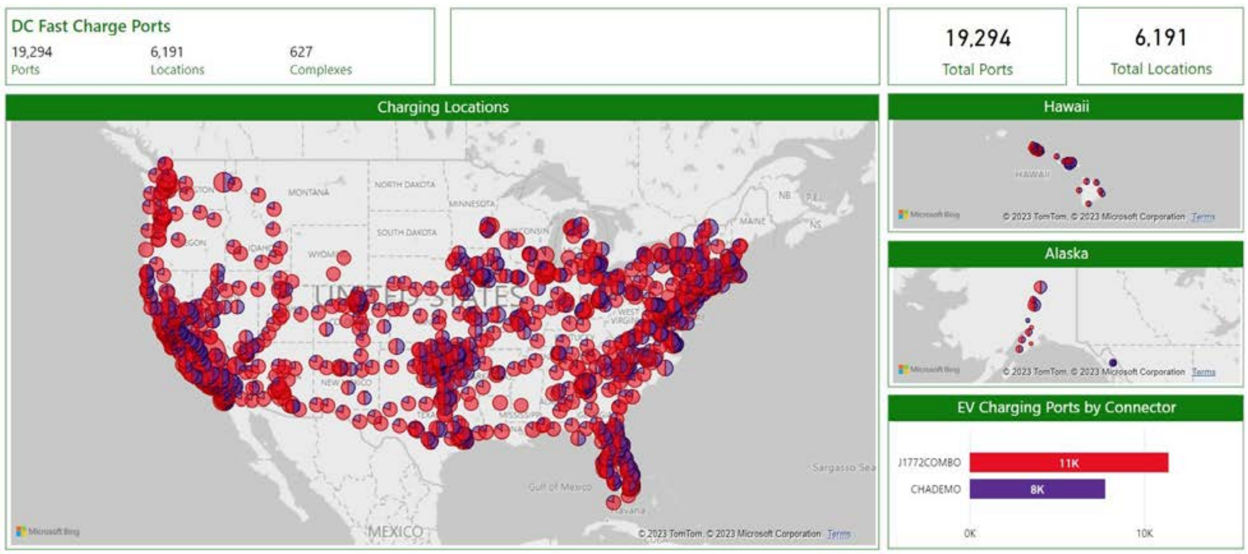
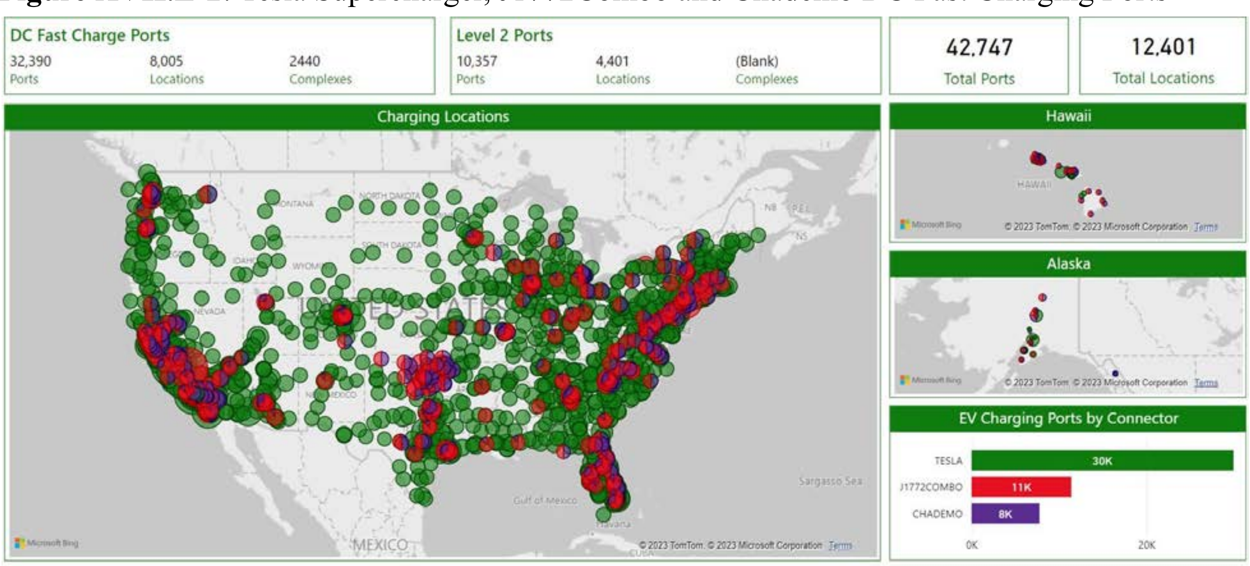


Figure XVII.E-2: Tesla Supercharger, J1772Combo and Chademo DC Fast Charging Ports[314]



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313 Atlas Public Policy, EV Hub (June 27, 2023) available at https://www.atlasevhub.com/materials/ev-charging-deployment/ (subscription required).

314 *Id.*

F. Barriers to the installation of charging infrastructure identified in the Proposal are being removed.

Barriers to the timely installation of charging infrastructure are being removed, which will allow investments at an even greater pace and scale.

Most of the challenges associated with energizing charging infrastructure in a timely manner are being faced in California, which has to date the highest percentage of electric LDVs on the road. Thankfully, a state law enacted in 2022 provides California's investor- and publicly-owned utilities with data necessary to inform grid planning to accommodate high levels of EV charging, requires those utilities to propose proactive grid investments in their General Rate Cases to comply with ZEV regulations (as well as a long list of other laws, standards, and requirements), and directs the California Public Utilities Commission (CPUC) and local utility governing boards to ensure the proposed investments are consistent with achieving the state's goals and regulations.[315] In May 2023, Southern California Edison (SCE) filed its General Rate Case, which includes such proactive investments.[316]

In addition, the California Senate recently voted 32-to-8 to advance new legislation (Senate Bill 410, "Powering Up Californians Act") that builds upon existing law to accelerate short-term energization timelines for EV charging and to ensure timely grid investments needed to electrify "light-duty, medium-duty, and heavy-duty vehicles and off-road vehicles, vessels, trains, and equipment" consistent with state law requiring economy-wide carbon neutrality by 2045, and "federal, state, regional, and local air quality and decarbonization standards, plans, and regulations."[317] The legislation also establishes a balancing account to recover associated costs, which would ensure that Pacific Gas & Electric (PG&E) and San Diego Gas & Electric (SDG&E) do not have to wait several years for their next General Rate Cases to propose investments like those recently proposed by SCE (and it would also allow SCE to propose subsequent investments before its next rate case that could not be predicted when its current rate case was filed).

Utilities across the country are also already planning for and deploying solutions to address increased vehicle electrification as their customers adopt PEVs to improve fleet economics and performance. Utilities and their customers will benefit from the ability to plan ahead for any significant infrastructure requirements. The regulatory certainty provided by this rulemaking can aid this planning.

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[315] California Assembly Bill 2700 Transportation electrification: electrical distribution grid upgrades. (2021-2022). https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=202120220AB2700.

[316] Southern California Edison, What you should know about SCE's general rate case (May 2023), at https://energized.edison.com/stories/sce-details-investments-to-advance-electric-grid-reliability-resilience-and-readiness (last accessed June 30, 2023).

[317] California Senate Bill 410. (2023). https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=202320240SB410.

Regulatory certainty can also help ensure that investments not only maintain strong electric service but improve it, while at the same time lowering costs. SCE President and CEO Steve Powell noted: "if we leverage the electric vehicle load and have that work for consumers as well, that whole idea of vehicle-to-grid, there can be real value in helping alleviate a lot of the infrastructure investments that need to happen," ultimately lowering overall energy bills for customers.[318] Similarly, Seattle City Light, in its Transportation Electrification Strategic Investment Plan, stated that "[w]hile there are system costs associated with increased transportation electrification (e.g., distribution and transmission infrastructure upgrades), with proactive utility planning and intervention, the system benefits (e.g., new revenue) are estimated to outweigh the costs, spreading the economic benefits of transportation electrification to all customers."[319] This will require action from regulators as well to help shape and approve these proactive and critical investments. As RMI recommended, "regulators can fulfil [sic] their responsibility for ensuring prudent and least-cost grid investments while proactively planning by using new information."[320]

In addition, the historic investments of the BIL and IRA are helping utilities build a stronger, cleaner grid and prepare for advanced electrification while minimizing customer costs. Duke Energy, for example, has stated that "[the BIL] provides an important down payment on the infrastructure and incentives that are needed to electrify transportation and secure the grid," and "[the IRA] can create significant cost savings for our customers."[321] New York utilities have indicated that they will be applying for $900 million in grants from the BIL and IRA to advance grid resilience.[322] National Grid in particular notes that "EV charging make-ready infrastructure is identical to electric infrastructure that serves other purposes, this is the kind of work electric utilities do every day,"[323] and that "areas of the [BIL] funding are enabling increased investment."[324]

Grid operators around the country are also beginning to incorporate EV planning into existing planning structures. For example, the Minnesota Public Utilities Commission has shifted investor-owned utility transportation electrification planning and reporting requirements to the integrated distribution planning process to account for increasing linkages between EV planning

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[318] Casey Wian, *Transportation Electrification Gains Momentum: Edison International and SCE outline plans to seize the "huge opportunity" of preparing the grid for exponential EV growth*, Energized, (Feb. 1, 2023), https://energized.edison.com/stories/transportation-electrification-gains-momentum.

[319] Seattle City Light, *Transportation Electrification Strategic Investment Plan* 6 (not dated), https://www.seattle.gov/documents/Departments/CityLight/TESIP.pdf.

[320] Ari Kahn et al., RMI, *Preventing Electric Truck Gridlock: Meeting the Urgent Need for a Stronger Grid* 16 (2023), https://rmi.org/insight/preventing-electric-truck-gridlock/.

[321] Jennifer Loraine, *Policy can have a crucial impact on our clean energy future*, Duke Energy News Center (Jan. 20, 2023), https://news.duke-energy.com/our-perspective/policy-can-have-a-crucial-impact-on-our-clean-energy-future.

[322] John Norris, *NY Utilities to Seek $900M from DOE*, RTO Insider, (Mar. 28, 2023), https://www.rtoinsider.com/articles/31898-ny-utilities-seek-900m-from-doe.

[323] Comments of National Grid to USDOT/FHWA on Docket No. FHWA-2021-0022, at 11 (Jan. 26, 2022), https://downloads.regulations.gov/FHWA-2021-0022-0150/attachment_1.pdf.

[324] *Id*. at 10.

and distribution system planning.[325] Incorporating robust EV planning in existing planning structures can help ensure those processes account for EV adoption, even where the utility business units responsible for those areas of planning may be distinct. Furthermore, combined planning processes can create administrative efficiencies that help expedite time-sensitive planning needs. On the transmission planning side, regional grid operators, such as the Midcontinent Independent System Operator, have already begun to think about how transportation electrification will affect total energy needs and the timing of annual peaks in electricity demand.[326] Strong vehicle standards give grid operators a reliable EV forecast against which to plan in processes that are already underway.

Finally, parties are working across sectors and industries to reduce barriers to charging deployment. Utilities, public utility commissions and other state regulators, grid operators, charging providers, and others can and have already begun to coordinate and plan for increased vehicle electrification. Examples include:

- The National Charging Experience Consortium (ChargeX) is a collaborative effort between Argonne National Laboratory, Idaho National Laboratory, NREL, BEV charging industry experts, consumer advocates, and other stakeholders whose mission is "to work together as BEV industry stakeholders to measure and significantly improve public charging reliability and usability by June 2025."[327]
- The National EV Charging Initiative brings together automakers, power providers, PEV and charging industry leaders, labor, and public interest groups to "develop a national charging network for light, medium, and heavy-duty vehicles and inspire deeper commitments from state leaders, the administration and each other."[328]
- The National Association of State Energy Officials and the American Association of State Highway and Transportation Officials partnered with the U.S. Joint Office of Energy and Transportation to hold a series of convenings to coordinate on a range of topics, including ZEV infrastructure and utility planning needs.[329]

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325 Minn. Public Utilities Comm'n, Order (Dec. 8, 2022). In the Matter of a Commission Inquiry into Electric Vehicle Charging and Infrastructure (Docket No. E999/CI-17-879), In the Matter of Minnesota Power's 2021 Integrated Distribution System Plan (Docket No. M-21-390), In the matter of Distribution System Planning for Otter Tail Power Company (Docket No. 21-612), In the matter of Xcel Energy's 2021 Integrated Distribution System Plan (Docket No. (21-694).
https://www.edockets.state.mn.us/edockets/searchDocuments.do?method=showPoup&documentId={30E7F284-0000-C433-8FFA-298183EBEB26}&documentTitle=202212-191192-02.

326 MISO Electrification Insights (April 2021), at 10, 14-15, available at https://cdn.misoenergy.org/Electrification%20Insights538860.pdf.

327 Idaho Nat'l Lab'y, *National Charging Experience Consortium*, https://inl.gov/chargex/ (last visited June 13, 2023).

328 EV Charging Initiative, https://www.evcharginginitiative.com/ (last visited June 13, 2023).

329 Nat'l Ass'n State Energy Officials (NASEO) & the Am. Ass'n State Highway & Transp. Officials (AASHTO), *Building a National Electric Vehicle Charging Infrastructure Network: Regional EV Meetings Key Themes, Takeaways, and Recommendations from the States* (not dated),

These convenings brought together State Departments of Transportation officials, State Energy Offices, and other key partners.

- PG&E and BMW of North America are testing a "vehicle-to-everything technology that will improve grid reliability and help EV customers lower their electric bills by exporting power back to the grid during peak demand periods." PG&E notes that "[t]he utility and automotive industries are creating a transformative clean energy future together."[330]
- NREL and Volvo collaborated on a research paper regarding challenges and opportunities of commercial ZEVs, noting:

> Coordination between disparate and historically unconnected stakeholders, including state agencies, local governments, automotive manufacturers, fleets, energy infrastructure and utility companies, and research and academia will be required to ensure a smooth and timely transition to ZEVs. This paper, a joint research and industry perspective, is one such example of cross-sectoral collaboration.[331]

These examples show that the relevant stakeholders are already stepping up to plan for and accommodate the charging and grid needs associated with greater vehicle electrification.

Fundamentally, charging infrastructure challenges are being addressed, as evidenced by the progress described above. We are not starting from scratch and do not need to replicate the gasoline and diesel refueling network to electrify vehicles. The electric grid is already nearly ubiquitous; it only needs to be extended at the fringes. These actions benefit utility shareholders and customers alike by removing barriers to investment in charging infrastructure. As explored in more detail below, America's utilities have a long history of accommodating significant growth.

In sum, the private and federal infrastructure investments EPA has identified justify strong standards, and barriers to additional investment are actively being removed. Furthermore, as noted above, EPA's inventory of federal, public, and private investments that already justifies increasingly stringent vehicle standards is incomplete; and a more complete inventory justifies stronger standards.

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https://www.naseo.org/data/sites/1/documents/publications/NASEO_AASHTO_Regional%20EV%20Meetings%20Summary_%20Final.pdf.

[330] BMW Group, *More Power To You: BMW of North America and PG&E Start V2X Testing in California* (May 16, 2023), https://www.press.bmwgroup.com/usa/article/detail/T0417218EN_US/more-power-to-you:-bmw-of-north-america-and-pg-e-start-v2x-testing-in-california.

[331] Matteo Muratori, et al., *Road to zero: Research and industry perspectives on zero-emission commercial vehicles*, iScience, May 19, 2023, https://www.cell.com/action/showPdf?pii=S2589-0042%2823%2900828-3, at 7.

G. EPA's conclusion that LDV charging will not compromise the reliability of the electric grid is supported by empirical data.

EPA observes that LDV charging is not anticipated to adversely impact electric grid reliability:

> U.S. electric power utilities routinely upgrade the nation's electric power system to improve grid reliability and to meet new electric power demands. For example, when confronted with rapid adoption of air conditioners in the 1960s and 1970s, U.S. electric power utilities successfully met the new demand for electricity by planning and building upgrades to the electric power distribution system. Likewise, U.S. electric power utilities planned and built distribution system upgrades required to service the rapid growth of power-intensive data centers and server farms over the past two decades. U.S. electric power utilities have already successfully designed and built the distribution system infrastructure required for 1.4 million battery electric vehicles. Utilities have also successfully integrated 46.1 GW of new utility-scale electric generating capacity into the grid.[332]

These conclusions are supported by empirical evidence from California, which already has more than 1.3 million PEVs on the road.[333] While some pundits have claimed EV charging is already straining the grid, triggering service disruptions, those claims have been debunked.[334] And root cause analysis from the California Independent System Operator (California ISO) showed that PEVs are not what has strained the grid.[335] Indeed, empirical evidence shows that PEV charging has been accommodated with minimal required grid upgrades and that EV charging can be shifted to hours of the day when there is plenty of spare grid capacity. Since 2011, CPUC has required the utilities it regulates to report annually on costs associated with accommodating PEV charging and on the charging patterns of PEVs on different utility rates.[336] As summarized by Synapse Energy Economics, utility grid upgrades required to accommodate PEV charging to this point in those service territories are essentially rounding errors compared to the costs of maintaining the electrical grid:

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[332] 88 Fed. Reg. at 29311 (citations omitted).

[333] Alliance for Automotive Innovation, *Electric Vehicle Sales Dashboard*, https://www.autosinnovate.org/resources/electric-vehicle-sales-dashboard.

[334] Dustin Gardiner, *No, Newsom's Push for Electric Cars Isn't the Cause of Potential Blackouts in California*, San Francisco Chronicle (Sept. 7, 2022), https://www.sfchronicle.com/politics/article/No-Newsom-s-push-for-electric-cars-isn-t-the-17426102.php.

[335] California ISO, *Root Cause Analysis: Mid-August 2020 Extreme Heat Waive* (Jan. 13, 2021), http://www.caiso.com/Documents/Final-Root-Cause-Analysis-Mid-August-2020-Extreme-Heat-Wave.pdf.

[336] S. Cal. Edison Co., San Diego Gas & Elec. Co. & Pac. Gas & Elec. Co., *Joint IOU Electric Vehicle Load Research and Charging Infrastructure Cost Report 10th Report* (Mar. 31, 2022), https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/energy-division/documents/transportation-electrification/10th-joint-iou-ev-load-report-mar-2022.pdf.

> Even in the service territories with the most EVs, the observed costs have been minor. For instance, in California where EV adoption has been markedly higher than other states, EV-related distribution upgrade costs appear minor compared to total distribution costs. Despite the fact EVs are often more concentrated in many neighborhoods and distribution circuits, California utilities collectively spent less than 0.03% of their total distribution-related expenses on distribution system upgrades associated with residential EV adoption.[337]

Furthermore, as detailed below, the projected growth in electricity demand over the coming years is well within the range of past historical load growth. Additionally, the industry is already responding to and preparing for increased electrification as more fleets and individuals adopt PEVs, and it has a wide range of tools, practices, and partnerships in place to continue to maintain a strong and reliable grid.

1. Electric system impacts will be gradual and within the range of historical growth.

When considering infrastructure buildout, it is important to remember that L/MD PEVs will enter the total on-road L/MD fleet gradually and in volumes that will remain below in-use L/MD combustion vehicles for the foreseeable future. EPA's data show that the Proposed Standards, if finalized, would likely result in PEVs comprising just 5% of the total on-road L/MD fleet by 2027, gradually reaching 20% in 2032 and 43% in 2040. Similarly, under the more stringent standards we recommend in this comment letter, the transition of the on-road L/MD fleet to PEVs would be gradual, reaching 22% in 2032 and 49% in 2040 (Table XVII.G-1). In other words, a relatively small portion of the L/MD fleet will be tapping into charging and grid infrastructure over the next decade, and even by 2040, L/MD PEVs would comprise less than half of the on-road fleet under this rulemaking. Infrastructure needs for L/MD PEVs will accordingly grow gradually over time.

Table XVII.G-1: L/MD PEVs as a Share of Total On-Road L/MD Fleet, 2026-2040

Year	EPA No Action	EPA Main Proposal	Alt 1+
2026	3.1%	3.1%	3.1%
2027	4.6%	5.2%	5.2%
2028	6.3%	7.6%	7.7%

[337] Melissa Whited, Tyler Fitch, Jason Frost, Eric Borden, Courtney Lane, Ben Havumaki, Sarah Shenstone-Harris & Elijah Sinclair, *Electric Vehicles Are Driving Rates Down* (June 2023), https://www.synapse-energy.com/sites/default/files/Electric%20Vehicles%20Are%20Driving%20Rates%20Down%20Factsheet.pdf (citations omitted).

2029	8.3%	10.5%	10.6%
2030	10.3%	13.7%	14.0%
2031	12.3%	17.0%	17.7%
2032	14.2%	20.4%	21.6%
2033	16.0%	23.7%	25.5%
2034	17.8%	26.9%	29.3%
2035	19.5%	30.0%	32.9%
2036	21.1%	33.0%	36.4%
2037	22.7%	35.9%	39.8%
2038	24.1%	38.6%	43.0%
2039	25.4%	41.1%	46.0%
2040	26.6%	43.4%	48.8%

Additionally, projected growth in electricity demand over the coming years, including demand related to PEV deployment in line with strengthened L/MD standards as well as additional economy-wide load growth, is well within the range of past historical load growth. EPA provides estimates of system-wide demand, including L/MD PEVs, under both No Action (i.e., baseline) and the Proposed Standards. DRIA at 5-14. These values show that system-wide increases in demand, including both increased demand from the Proposed Standards (assuming EPA finalizes the stringency levels it has proposed) and projected economy-wide load growth, is projected to average 1.6% per year between 2028 and 2040. Furthermore, based on analysis conducted by ERM (see Section V above), it is expected that incremental annual average electricity demand growth associated with PEV penetration in line with Alternative 1+, as compared to EPA's Proposed Standards, would be minimal—i.e., around or less than one tenth of a percentage point.

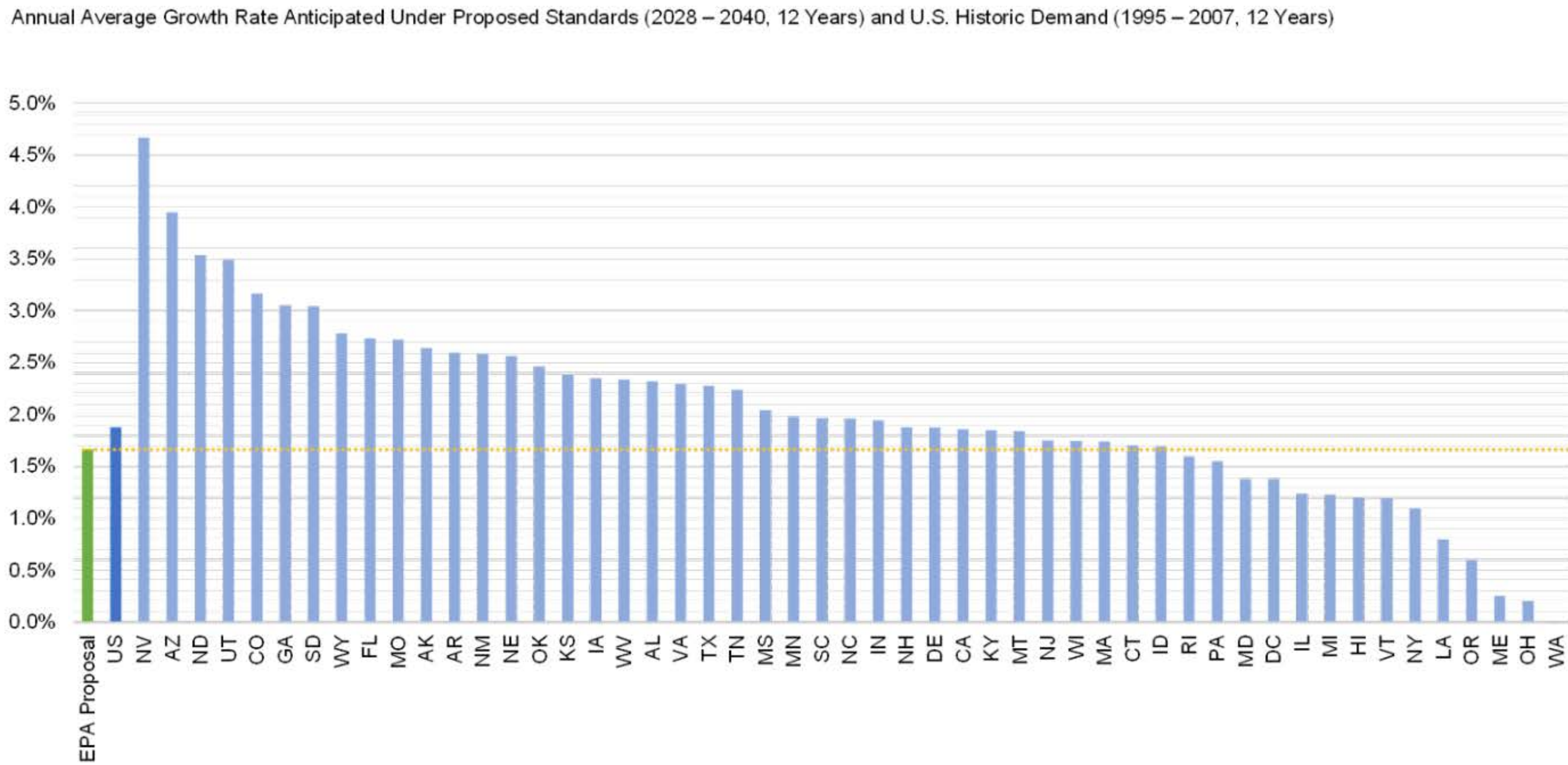
Maintaining reliable and safe electric power delivery through this level of demand growth, as well as higher levels of growth resulting from more stringent standards, is within electric utility standard practice as demonstrated through the electric power sector's strong track record of reliability and resiliency. These annual generation increases are well within the range of contemporary, normal operations for the U.S. electric sector (see Figure XVII.G-1 below). According to data reported to the Energy Information Administration in Form 861, in the 31 years from 1990 to 2021, average annual national growth in electricity sales was 1.1%. In 15 of those years, growth was 1.5% or higher, and in ten years it exceeded 2%. The U.S. has also seen previous periods of sustained high demand growth across most states; for example, 1995 to 2007 saw average nationwide growth of approximately 1.9% per year.

Many states saw much higher, sustained levels of growth. In the two decades from 1999 to 2018, North Dakota electric sales more than doubled. Year over year growth averaged nearly 5%, and in 2014 electric sales were 14% higher than the previous year alone. In Nevada between 1992 and 2007, annual electric sales growth averaged 4.9% and fell below 1.5% only once. More recently, Virginia has seen strong annual sales growth, with sales increasing 12.3% in the five years from 2016 to 2021, or 3% on average per year, even accounting for a pandemic dip.

This analysis draws similar conclusions to those of the researchers at the Electrification Futures Study, a multi-year research project to explore potential widespread electrification in the future energy system of the United States. In a report developing an integrated understanding of how the potential for electrification might impact the demand side in all major sectors of the U.S. energy system—transportation, residential and commercial buildings, and industry—this study concluded that "[e]lectrification has the potential to significantly increase overall demand for electricity, although even in the High scenario, compound annual electricity consumption growth rates are below long-term historical growth rates."[338] And costs associated with integrating PEV charging onto the grid can also be minimized with effective load management programs, as described immediately below.

[338] Trieu Mai et al., NREL, *Electrification Futures Study: Scenarios of Electric Technology Adoption and Power Consumption for the United States* (2018), https://www.nrel.gov/docs/fy18osti/71500.pdf.

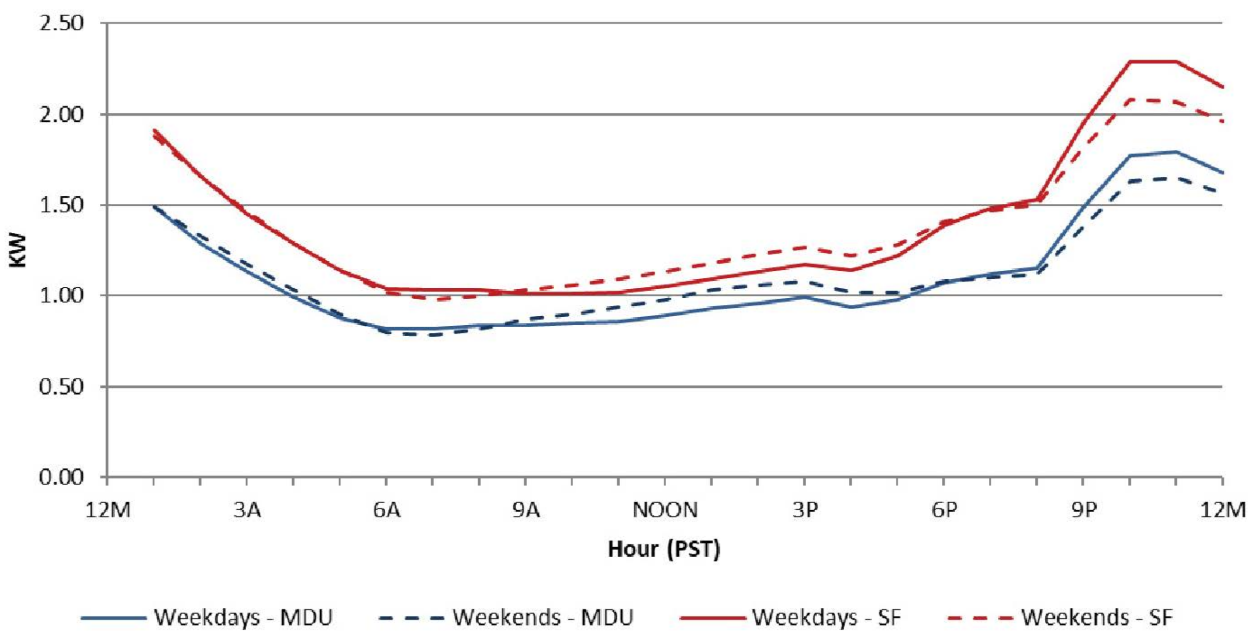
Figure XVII.G-1: Projected Demand Growth Rates Under Proposed Standards Compared to U.S. Historic Rates



2. Time-of-use electric rates are extremely effective at pushing PEV charging to hours of the day when there is plenty of spare grid capacity.

Real-world data from hundreds of thousands of PEVs reveals that time-of-use (TOU) electricity rates work. At the time the data described below was collected, SCE estimated there were 329,940 PEVs in its service territory (through December 31, 2021).[339] Figure XVII.G-2 shows the load profile of households in SCE territory with EVs, with a readily discernible uptick in electricity demand after 9PM (when the on-peak period ends on the time-of-use rates) as a result of PEV charging that increases until just before midnight and trails off in the early morning hours as those PEVs complete their charging.

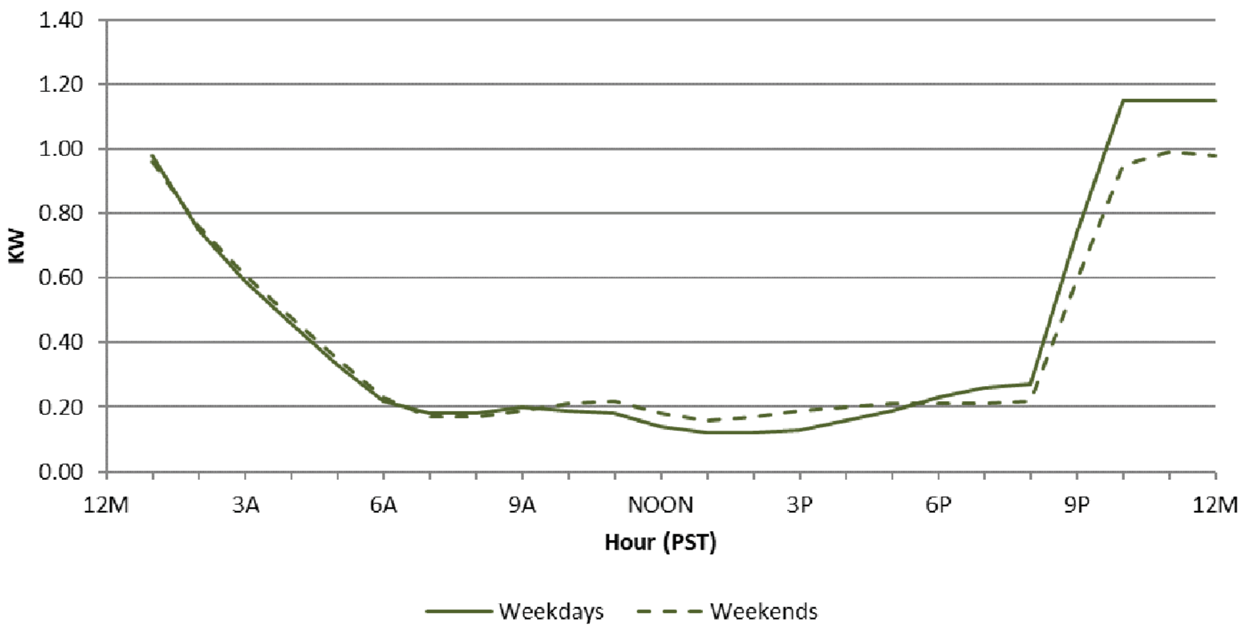
Figure XVII.G-2. Load Profile of Households with PEVs on a TOU Rate in SCE Territory[340]



The impact of TOU rates is even more self-evident in Figure XVII.G-3, which isolates PEVs on separate meters, demonstrating that PEVs charge almost exclusively after 9 PM on that TOU rate.

[339] S. Cal. Edison Co., San Diego Gas & Elec. Co. & Pac. Gas & Elec. Co., *Joint IOU Electric Vehicle Load Research and Charging Infrastructure Cost Report 10th Report* Sec. VI Att. 2 - SCE (Mar. 31, 2022), https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/energy-division/documents/transportation-electrification/10th-joint-iou-ev-load-report-mar-2022.pdf.
[340] *Id.* at 59.

Figure XVII.G-3: Load Profile of PEVs on a Separately Metered TOU Rate in SCE Territory[341]



The figures above represent real-world data collected from hundreds of thousands of households with PEVs. There is no need to test the proposition that simple TOU rates designed for PEVs work.

The combination of TOU rates and more active means of managing PEV charging can yield even greater benefits. Researchers from NRDC, Lawrence Berkeley National Laboratory, and Pacific Gas & Electric found that well-designed TOU rates could allow the utility's system to accommodate <u>universal</u> light-duty BEV adoption with minimal associated costs.[342] This peer-reviewed study used real-world data on the distribution grid and BEVs to simulate what would happen if every household in a major metro area had a BEV, and found that more comprehensive load management could essentially prevent all otherwise necessary grid upgrades.[343]

3. EVs can lower the cost of managing an increasingly dynamic electric grid.

Third-party analyses have found that PEVs, if deployed strategically, can improve grid operations. For example, PEVs can "contribute significantly to grid stability" and provide value to the grid through "deferred or avoided capital expenditure on additional stationary storage,

[341] *Id.* at 60.
[342] Jonathan Coignard et al, *Will Electric Vehicles Drive Distribution Grid Upgrades?: The Case of California*, 7 IEEE Electrification Mag. 2, 55-56 (June 5, 2019).
[343] *Id.*

power electronic infrastructure, transmission build-out, and more."[344] Additionally, utilities can deploy proven and emerging rate designs that ensure utilities recover costs, reliably serve PEV charging load, improve PEV owner experience, and take advantage of grid strengthening services from these vehicles.[345]

Researchers from Lawrence Berkeley National Laboratory estimate that using smart charging of light-duty PEVs as a means to comply with California's energy storage procurement mandate (designed to facilitate the integration of renewable energy) would save utility customers approximately $1.5 billion because it is cheaper to use batteries customers have already purchased on four wheels than to pay private companies to deploy standalone battery storage.[346] The same study also found that enabling "vehicle-to-grid" (V2G) technology, allowing PEVs to supply power back to the grid during times of stress, could save $13-15 billion in stationary battery costs.[347] "By displacing the need for construction of new stationary grid storage, EVs can provide the dual benefit of decarbonizing transportation while lowering the capital costs for widespread renewables integration," the researchers concluded.[348]

Focusing on the Midwest to underscore the point, researchers concluded that very high levels of renewable energy penetration in the Midcontinent Independent System Operator region could result in "negative valleys" (requiring excess renewable energy to be exported or curtailed), but that "[c]ontrolled (EV) charging [both smart charging and smart discharging back onto the grid] is able to reduce these negative valleys, and with sufficient numbers of EVs can eliminate them altogether, obviating the need for either export of excess renewable generation or curtailment."[349] This would provide both increased environmental benefits by facilitating the

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[344] Chengjian Xu et al., *Electric vehicle batteries alone could satisfy short-term grid storage demand by as early as 2030*, Nature Commc'n, Jan. 17, 2023, at 1, https://doi.org/10.1038/s41467-022-35393-0.

[345] *See e.g.,* Brittany Blair et al., Smart Electric Power Alliance, *Managed Charging Programs: Maximizing Customer Satisfaction and Grid Benefits* (2023), https://sepapower.org/resource/managed-charging-programs-maximizing-customer-satisfaction-and-grid-benefits/; Enel-X, *Understanding Smart EV Load Management* (Apr. 8, 2022), https://info.evcharging.enelx.com/whitepaper-download-ev-load-management-utility-dive; Zachary Needell, Wei Wei & Jessika E. Trancik, *Strategies for beneficial electric vehicle charging to reduce peak electricity demand and store solar energy*, Cell Reps. Physical Sci., Mar. 15, 2023, https://www.cell.com/cell-reports-physical-science/fulltext/S2666-3864(23)00046-2; Lily Paul & Maureen Marshall, CALSTART, *Not Just Smart: The Importance of Managed Charging* (2021), https://calstart.org/wp-content/uploads/2022/01/Managed-Charging-Paper-Final.pdf; Karen Kirk, *Yes, the grid can handle EV charging, even when demand spikes,* Yale Climate Connections (Mar. 23, 2023), https://yaleclimateconnections.org/2023/03/yes-the-grid-can-handle-ev-charging-even-when-demand-spikes/.

[346] Jonathan Coignard, et al., Clean Vehicles as an Enabler for a Clean Electricity Grid. Environmental Research Letters. v. 13, No. 5. (May 2018), at 4, 5, http://iopscience.iop.org/article/10.1088/1748-9326/aabe97 (last accessed June 30, 2023).

[347] *Id*. at 5, 6.

[348] *Id*. at 1.

[349] Jeffery Greenblatt, et al., Quantifying the Potential of Electric Vehicles to Provide Electric Grid Benefits in the MISO Area: Final report to the Midcontinent Independent System Operators. Lawrence Berkeley National Laboratory, at 6, 56, at https://cdn.misoenergy.org/Quantifying%20the%20Potential%20of%20Electric%20Vehicles%20to%20Provide%20Electric%20Grid%20Benefits%20in%20the%20MISO%20Area354192.pdf. (last accessed June 30, 2023).

integration of high levels of renewable generation and significant customer benefits. Put simply, it is cheaper to pay individual utility customers to use batteries on wheels they have already bought and paid for than it is to pay corporations to buy big batteries and park them on the grid.

4. PEV charging is already putting downward pressure on electric rates, to the benefit of all utility customers.

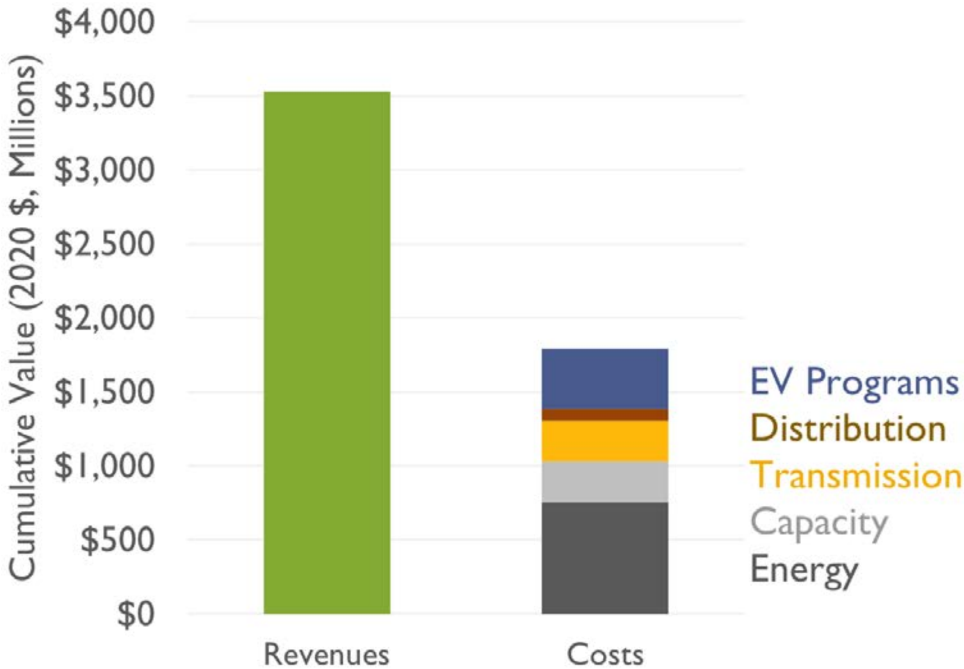
Because much PEV charging can be accomplished when there is spare capacity on the grid, charging can spread the costs of maintaining the system over a greater volume of electricity sales, reducing the per-kilowatt-hour price of electricity to the benefit of all customers. This has already been demonstrated in the real world.

In fact, empirical data compiled by Synapse Energy Economics shows that PEV drivers are not being subsidized by other utility customers and, in fact, they are putting downward pressure on rates. Between 2011 and 2020, PEV customers across the United States contributed more than $1.7 billion in net revenue to the body of utility customers.[350]

The results shown in Figure XVII.G-4 compare the new revenue the utilities collected from PEV drivers to the cost of the energy, capacity, transmission, and distribution system upgrades required to charge those vehicles, plus the costs of utility PEV infrastructure programs that are deploying charging stations for PEVs. In total, PEV drivers contributed an estimated $1.7 billion more than associated costs. That net revenue is returned to the body of utility customers in the form of electric bills that are lower than they would otherwise be.

[350] Melissa Whited, Tyler Fitch, Jason Frost, Eric Borden, Courtney Lane, Ben Havumaki, Sarah Shenstone-Harris & Elijah Sinclair, *Electric Vehicles Are Driving Rates Down* 1 (June 2023), https://www.synapse-energy.com/sites/default/files/Electric%20Vehicles%20Are%20Driving%20Rates%20Down%20Factsheet.pdf.

Figure XVII.G-4: Total Utility Revenues vs. Total Costs Associated with PEVs (2011-2020)[351]



5. New utility rates designed for PEV charging increase the fuel cost savings PEVs can provide.

Gasoline and electricity prices vary across the country, and electricity prices vary depending upon the particular characteristics of the utility rate on which a customer takes service. And many existing commercial and industrial utility rates have "demand charges" that can reduce fuel cost savings for high-powered/low-utilization PEV charging use cases, such as public charging along highways in remote areas. Thankfully, the challenge such demand charges can pose for PEV charging has long been recognized, and across the nation, many utilities and regulators have already implemented solutions or are in the process of doing so.

In fact, the BIL amended the Public Utility Regulatory Policies Act (PURPA) Section 111(d) to require regulators and non-regulated utilities to consider new rates that:

> promote affordable and equitable electric vehicle charging options for residential, commercial, and public electric vehicle charging infrastructure; improve the customer experience associated with electric vehicle charging; accelerate third-party investment in electric vehicle charging for light-, medium-, and

[351] *Id.* at 3.

heavy-duty vehicles; and appropriately recover the marginal costs of delivering electricity to electric vehicles and electric vehicle charging infrastructure.[352]

This has spurred new regulatory proceedings across the country. But many utilities, regulators, and state legislatures were already acting to address this issue before the BIL became law.

As detailed in a publication of the National Association of Regulatory Utility Commissioners (NARUC) entitled "Best Practices for Sustainable Commercial EV Rates and PURPA 111(d) Implementation," rates designed for EV charging can deliver significant fuel cost savings without relying on cross-subsidies from other utility customers.[353] For example, on a new Pacific Gas & Electric rate designed for commercial EV charging that still recovers all associated marginal costs, the San Joaquin Regional Transit District reduced its overall fuel cost per mile from $2.31 to $0.68 (in a utility service territory that has some of the higher underlying marginal costs in the nation).[354] The paper also details rates that take a similar approach that were approved for Southern California Edison, San Diego Gas & Electric, and Alabama Power.

Since the publication of that NARUC paper, many other utilities and regulators have either proposed or secured approval of new rates designed for EV charging. And by the time the standards in this rulemaking take effect in 2027, many more will have followed suit, increasing the fuel cost savings EVs can provide.

H. EPA should expect significant employment opportunities associated with the installation and maintenance of charging infrastructure and related grid infrastructure.

Research conducted on behalf of *EV Infrastructure Strike Force* suggests that, if the Biden Administration's goal of deploying 500,000 EV charging stations is met with public fast charging stations, it will support about 30,000 job-years.[355]

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[352] H.R.3684. Infrastructure Investment and Jobs Act. 117th Congress. (2021-2022). Section 40431 www.congress.gov/bill/117th-congress/house-bill/3684/text.

[353] Nancy Ryan, Alissa Burger, Jenifer Bosco, John Howat, and Miles Muller, Best Practices for Sustainable Commercial EV Rates and PURPA 111(d) Implementation (2022), https://pubs.naruc.org/pub/55C47758-1866-DAAC-99FB-FFA9E6574C2B.

[354] *Id.*

[355] Edward W. Carr, James J. Winebrake, and Samuel G. Winebrake, *Workforce Projections to Support Battery Electric Vehicle Charging Infrastructure Installation*, Energy and Environmental Research Associates, LLC (2021), https://etcommunity.org/assets/files/Workforce-ProjectionstoSupportBatteryElectricVehicleChargingInfrastructureInstallation-Final202106082.pdf.

XVIII. EPA Appropriately Concludes that Critical Minerals and the Battery Supply Chain Will Be Sufficient for the Levels of BEVs Projected in the Proposal, and More Reasonable Battery-Related Modeling Assumptions Would Demonstrate the Feasibility of Even Higher Levels of BEVs.

In this section, we explore how critical mineral and battery supply chain issues should not act as constraints on strong final standards, including Alternative 1 with a steeper increase in stringency after 2030. As EPA's analysis demonstrates, there will be sufficient materials and battery supply chain production to electrify light- and medium-duty vehicles consistent with the levels EPA projects for the Proposal, and for more stringent alternatives. In this section, we provide additional analysis that supports this conclusion.

In addition, alternative battery-related modeling inputs would increase the feasibility and benefits of PEVs. Below, we highlight modeling inputs that we believe led EPA to overestimate battery capacity requirements for electric vehicles. We provide support for alternative input values including new technologies, specific energy, and battery design, all of which will have direct implications for cost modeling and mineral demand (underscoring EPA's conclusion that there is sufficient mineral supply to meet electric vehicle demand).

As EPA notes, "with any emerging technology, a transition period must take place in which a robust supply chain develops to support production." 88 Fed. Reg. at 29313. Indeed, this is not the first time that the automotive industry has confronted critical mineral supply chain issues, and the industry has proven that it can rise to such challenges. For example, metal supply chain concerns arose during the move toward catalytic converters, and equipping all new vehicles with catalytic converters was seen at the time as a challenging "awesome prospect."[356] At the time, "[c]atalyst companies were concerned about their ability to obtain adequate supplies of noble metals if they would be used extensively in automotive catalytic converters."[357] Contemporaneous considerations of the "primary technical barriers" to catalytic converter adoption included "reducing the amount of precious metals used in each converter to a point where aggregate demand can be supplied without exhausting world reserves in the near future."[358] The only significant reserves of the necessary platinum group metals were located in the Republic of South Africa and the former USSR, "neither of which [could] be considered secure sources of supply."[359] Despite these concerns—which sound very similar to some of the rhetoric surrounding the battery minerals conversation—the automotive industry succeeded in

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[356] J.R. Mondt, *Cleaner Cars: The History and Technology of Emission Control Since the 1960s*, at 105 (2000). *See also* EPA, *Tier 2 Report to Congress*, at E-13 to E-15 (1998), https://nepis.epa.gov/Exe/ZyPDF.cgi/940054QY.PDF?Dockey=940054QY.PDF (noting that in the late 1990s there were concerns regarding increasing concentrations of palladium in automotive catalyst applications, and resulting future supply and price concerns).
[357] Mondt, at 99.
[358] Daniel Dexter, *Case Study of the Innovation Process Characterizing the Development of the Three-Way Catalytic Converter System*, at S-3 to S-4 (1979) https://rosap.ntl.bts.gov/view/dot/10766.
[359] *Id.* at S-4, 20.

incorporating catalytic converters in all U.S. vehicles. As detailed below, the industry can rise to the challenge again today.

A. There will be enough materials and battery supply chain production to electrify transportation.

We agree with EPA's conclusion that vehicle electrification, including the electrification of the heavy-, medium-, and light-duty fleets, will not lead to energy security risks but will instead provide the potential for a low-impact and domestic energy supply.[360] This section provides comments on the assessment of battery critical materials and battery production.

The lithium-ion batteries used to power PEVs include the following materials deemed critical by the United States Geological Survey: lithium, nickel, manganese, cobalt, graphite, and aluminum.[361] Of these materials, lithium is the only one that does not have a substitute currently on the market. Nickel and cobalt are in the cathodes nickel-manganese-cobalt (NMC) and nickel-cobalt-aluminum (NCA). These are not the constraining materials because they are now substituted in a growing portion of PEVs with the lithium-iron-phosphate (LFP) cathode.[362] Graphite can also be substituted; synthetic graphite is a direct substitution for mined graphite,[363] and research has also demonstrated the use of silicon mixed with or to replace graphite as the anode.[364]

Lithium is vital to manufacturing lithium-ion batteries, which are currently the only type of PEV battery used in all PEVs purchased in the U.S. Therefore, the analysis correctly points to lithium as the constraining material for lithium-ion batteries. Yet, this is a slightly conservative estimation for future constraints because alternative battery types are beginning to be marketed globally. For example, sodium-ion batteries have recently been recognized as a potential lithium-ion battery substitute[365] as Chinese automakers unveil their new technology.[366] This type of innovation is likely to reduce lithium demand globally and is further discussed in the next section.

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[360] 88 Fed. Reg. at 29313.
[361] U.S. Geological Survey, *United States Geological Survey Releases List of 2022 Critical Minerals* (2022), https://www.usgs.gov/news/national-news-release/us-geological-survey-releases-2022-list-critical-minerals.
[362] International Energy Agency, *Global EV Outlook 2023* at 11 (2023), https://www.iea.org/reports/global-ev-outlook-2023/trends-in-batteries.
[363] Jinrui Zhang, Chao Liang, and Jennifer B. Dunn, *Graphite Flows in the U.S.: Insights into a Key Ingredient of Energy Transition,* See 3402–3414, Environ. Sci. and Tech. (2023), https://pubs.acs.org/doi/10.1021/acs.est.2c08655.
[364] Xiuxia Zuo, Jin Zhu, Peter Müller-Buschbaum, Ya-Jun Cheng, *Silicon based lithium-ion battery anodes: A chronicle perspective review,* See 2211–2855, Nano Energy, (2017), http://dx.doi.org/10.1016/j.nanoen.2016.11.013.
[365] Petrova, *Here's why sodium-ion batteries are shaping up to be a big technology breakthrough* (2023), https://www.cnbc.com/2023/05/10/sodium-ion-batteries-shaping-up-to-be-big-technology-breakthrough.html.
[366] Jiri Opletal, *CATL's sodium-ion batteries will debut in Chery Auto EVs*, Car News China (2023), https://carnewschina.com/2023/04/16/catls-sodium-ion-batteries-will-debut-in-chery-auto-evs/.

Furthermore, we know that advocating for increased deployment of ZEVs within the light- and medium-duty fleet, which is an essential step to reducing fossil fuel emissions and addressing the climate crisis, will potentially include mining projects that impact environmental justice communities and, in particular, indigenous communities. PEVs also eliminate tailpipe emissions of harmful air pollutants that cause asthma and respiratory diseases, especially among Black, Indigenous, and other communities of color. However, without adequate protections for workers, communities, and environments near mining and processing sites, we risk replicating the harms of fossil fuel extraction. Besides the details below that discuss opportunities for PEV batteries that will not rely on lithium, there are measures that EPA can and should take to address the potential mining impacts. For example, EPA and the Administration can take action to build a robust circular economy to reduce the need for virgin material extraction and increase the supply of more responsibly sourced materials.

EPA points to findings by several sources that concur with its assessment that material and production will be sufficient to meet electric vehicle uptake in the LDV, MDV, and HDV sectors. *See* 88 Fed. Reg. at 29312-23; DRIA Chs. 3.1.3.2., 3.1.3.3. Increased demand for minerals, as well as government investments, will continue to spur these developments. The 2023 BNEF Electric Vehicle Outlook demonstrates these effects on the continued expansion of the supply chain.[367] In addition, academic sources have demonstrated that there are enough reserves and recycled content such that demand for lithium will barely exceed a quarter of the available reserve by 2050 and about half by 2100.[368]

1. Federal investments have spurred private investments in domestic supply.

Actions taken by the federal government have increased private investment in U.S. battery production. The impact of the BIL and the IRA on U.S.-based PEV manufacturing, repurposing, and recycling growth demonstrates the influence U.S. policy has on rapidly growing a domestically-produced supply. Within six months of the IRA's passage, automakers and battery manufacturers had announced a total of roughly $52 billion of planned investment in North America's PEV supply chain, with over 70% of those investments going toward battery supply chains and recycling.[369]

2. Recycled content can provide additional domestic mineral supply.

The current oil-dependent transportation system not only impacts the climate and the health of the U.S. population, it also requires continual drilling, production, and importing of

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[367] Bloomberg New Energy Finance, *Electric Vehicle Outlook 2023* (2023), https://about.bnef.com/electric-vehicle-outlook/#download.

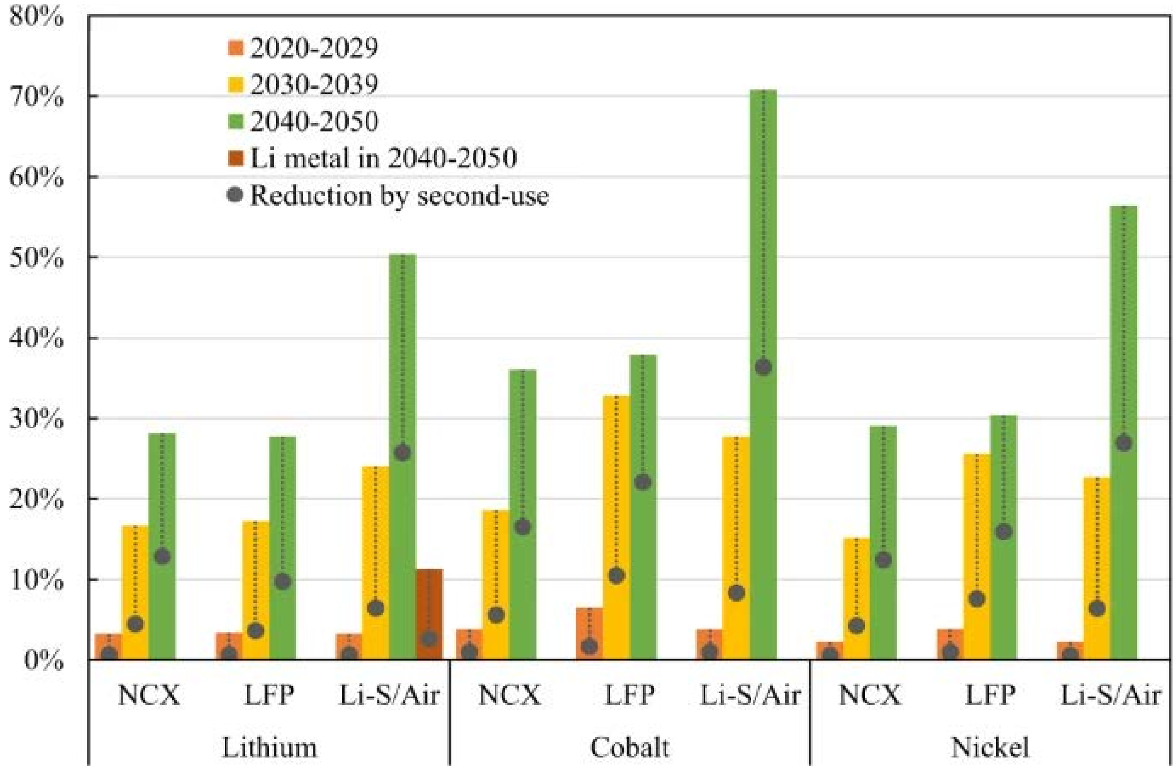
[368] Klimenko, Ratner, & Tereshin, *Constraints imposed by key-material resources on renewable energy development*, Renewable and Sustainable Energy Reviews, 2021, 144, 111011, 1364-0321. https://www.sciencedirect.com/science/article/pii/S1364032121003014.

[369] Cory Cantor, US Climate Law Fuels $52 Billion in New EV Investments, p 1, BloombergNEF, Mar. 13, 2023. Subscription required.

fuel. This is in stark contrast to the use of materials needed for electrified transportation, which can be continually recycled to produce the next generation of more efficient vehicles. This results in the continued growth of U.S. material stock even when initially relying on imported minerals. As the Proposal states, in 2050, 25 to 50% of lithium demand from electric vehicles can be met with recycled content. 88 Fed. Reg. at 29323-24.[370] Recycled content availability has been highly studied and documented in academic studies beyond the two listed in the Proposal (Sun et al., 2022; Ziemann et al., 2018), including in findings by Xu et al.[371] and Dunn et al.[372] Xu et al. demonstrates that the material demand that could be met by retiring and recycled supply is highly impacted by innovation and advancing energy density. As batteries become more advanced and energy-dense, either through innovation of chemistries used (e.g., the progress made in NMC) or through different chemistries (e.g., lithium-sulfur or lithium-air batteries), the mineral demand decreases to meet the same energy storage needs. This means that a high percentage of material demand can be met with the retiring supply of less material-efficient and lower density batteries. This is demonstrated in Figure XVIII.A-1 below; the more energy dense batteries (Li-S/Air) have higher recycled content for lithium, cobalt, and nickel in 2040-2050 (green bar).[373]

[370] The Proposal cites Sun et al., *Surging lithium price will not impede the electric vehicle boom*, Joule, doi:10.1016/j.joule.2022.06.028, https://dx.doi.org/10.1016/j.joule.2022.06.028, and. Ziemann et al., *Modeling the potential impact of lithium recycling from EV batteries on lithium demand: a dynamic MFA approach*, Resour. Conserv. Recycl. 133, 76–85. https://doi.org/10.1016/j.resconrec.
[371] Xu, C., Dai, Q., Gaines, L. et al. *Future material demand for automotive lithium-based batteries*, *Commun Materials,* 2020, 1, 99, 5–8, https://doi.org/10.1038/s43246-020-00095-x [hereinafter Xu, *Future material demand*].
[372]Jessica Dunn, Margaret Slattery, Alissa Kendall, Hanjiro Ambrose, and Shuhan Shen, *Circularity of Lithium-Ion Battery Materials in Electric Vehicles*, Environmental Science & Technology*,* 2021, 55, 5189–5198. DOI: 10.1021/acs.est.0c07030 [hereinafter Dunn, *Circulatity*].
[373] Xu, *Future material demand* at 6.

Figure XVIII.A-1: Closed-loop recycling potential of battery materials in a STEP scenario.

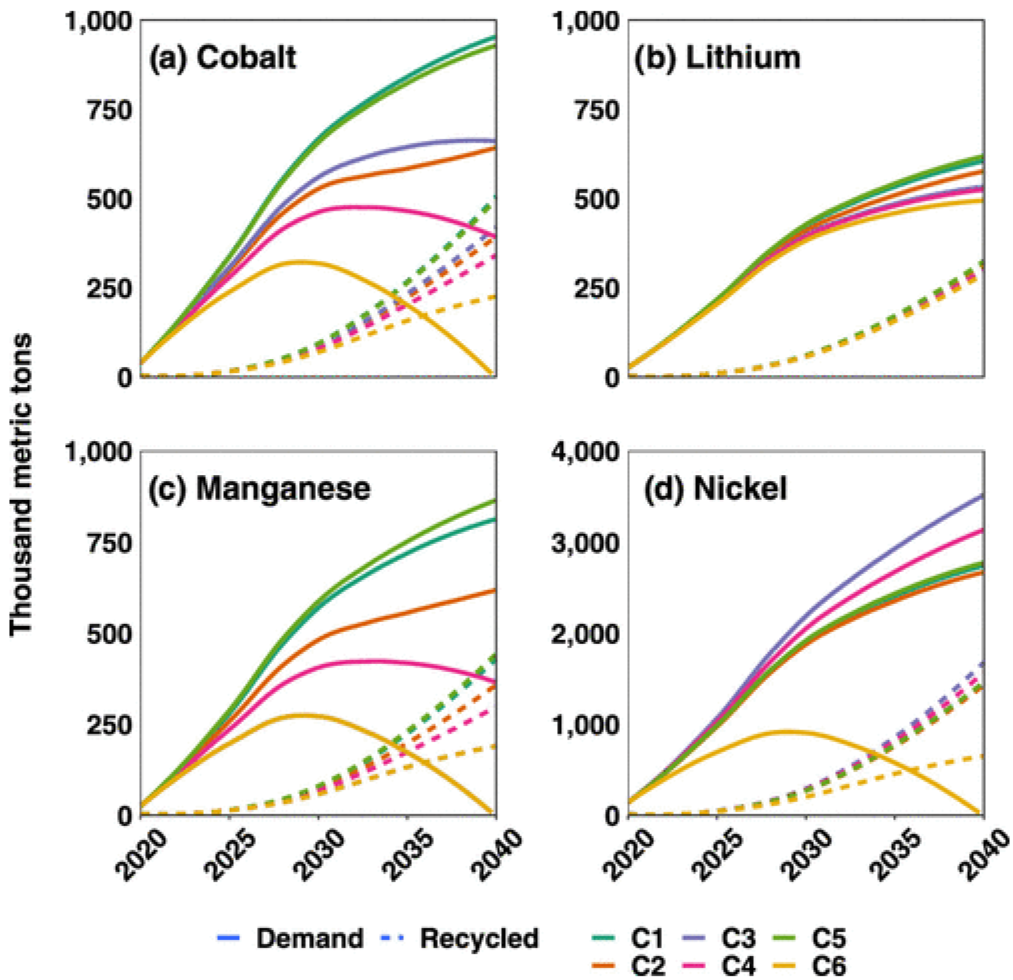


(Source: Xu et al.)

Dunn et al.[374] demonstrate that the choice of cathode materials can also highly increase potential circularity. Figure XVIII.A-2 below shows that a future with high lithium-iron-phosphate (LFP) market concentration, labeled as C6 in the legend, can significantly increase the amount of lithium, cobalt, manganese, and nickel demand met with recycled content, compared to a business-as-usual cathode market share, labeled as C1 in the legend.

[374]Dunn, *Circulatity* at 5194.

Figure XVIII.A-2: Circularity potential of materials as additional years are added to battery lifespan.



Source: Dunn et al.

The recycled content also varies based on the collection rate and the material recovery rate. There is potential for high material recovery due to the 95% recovery rate of lithium, nickel, cobalt, and manganese by commercial-scale hydrometallurgical recyclers in the U.S., such as Lithion, Redwood Materials, Licycle, and Cirba Solutions. In addition, direct cathode recycling, which can recover a cathode without breaking it down into separate materials, is under development by several startups as well as the National Lab research group, ReCell. As shown in Table XVIII.A-1 below, direct recycling currently has a recovery rate of 40% for lithium. But increasing the lithium recovery rate is a priority area for ongoing research.[375] The Argonne

[375] *See generally* Kendall, A., Slattery, M., Dunn, J., *Lithium-ion car battery recycling advisory group report*, (Mar. 16, 2022), https://calepa.ca.gov/lithium-ion-car-battery-recycling-advisory-group/.

National Laboratory model, BattPac, lists the following recovery rates shown in Table XVIII.A-1.[376]

Table XVIII.A-1: Recovery rates of battery materials from different recycling processes.

	Pyrometallurgical	Hydrometallurgical	Direct Physical
Copper	90%	90%	90%
Steel	90%	90%	90%
Aluminum		90%	90%
Graphite		90%	90%
Plastics		50%	50%
Li+ in product		90%	40%
LCO			90%
NMC(111)			90%
NMC(532)			90%
NMC(622)			90%
NMC(811)			90%
NCA			90%
LMO			90%
LFP			90%
Co2+ in product	98%	98%	
Ni2+ in product	98%	98%	
Mn2+ in product		98%	
Electrolyte Organics		50%	50%

Source: Argonne National Lab BatPac

Recycling facilities are also operational and under development in the United States. Table XVIII.A-2 from Atlas Public Policy attempts to capture all these developments.[377]

[376] Argonne National Laboratory, "BatPaC: battery manufacturing cost estimation," (2022). https://www.anl.gov/partnerships/batpac-battery-manufacturing-cost-estimation.
[377] Atlas Public Policy, *The EV Transition: Key Market and Supply Chain Enablers*, at 42 (Nov. 2022). https://atlaspolicy.com/the-ev-transition-key-market-and-supply-chain-enablers/.

XVIII.A-2: EV battery recycling facilities in the U.S.

Site Name	State	Target Capacity (tons/year)	Facility Product	Year Operational	Company
St Louis Facility	IL	24,000	Battery Grade Materials	Operational	Interco
Spoke Facility	NY	5,000	Black Mass	Operational	Li-Cycle
Worcester, Pilot Plant	MA	15	Cathode materials	Operational	Ascend Elements
Fairfield County Facility	OH	NA	NA	Operational	Cirba Solutions
Wistron Greentech facility	TX	500	Direct Recycling	Operational	Princeton NuEnergy
Spoke Facility	AL	10,000	Black Mass	Operational	Li-Cycle
Spoke Facility	AZ	10,000	Black Mass	Operational	Li-Cycle
Recycling Facility	GA	30,000	Cathode materials	2022	Ascend Elements
Spoke Facility	OH	15,000	Black Mass	2023	Li-Cycle
Hub Facility	NY	35,000	Battery Grade Materials	2023	Li-Cycle
Apex 1	KY	NA	Battery Grade Materials	2023	Ascend Elements
SungEel Recycling Park	GA	50,000	NA	2024	SungEel Materials
Carson City facility	NV	20,000	Battery Grade Materials	NA	Redwood Materials
Lithium-Ion Battery Recycling Pilot Plant	NV	20,000	Battery Grade Materials	NA	American Battery

Source: T. Taylor and N. Gabriel for Atlas Public Policy

3. EPA appropriately concludes that there will be sufficient lithium for the Proposed Standards, and supporting analysis also indicates likelihood of IRA-qualifying sources.

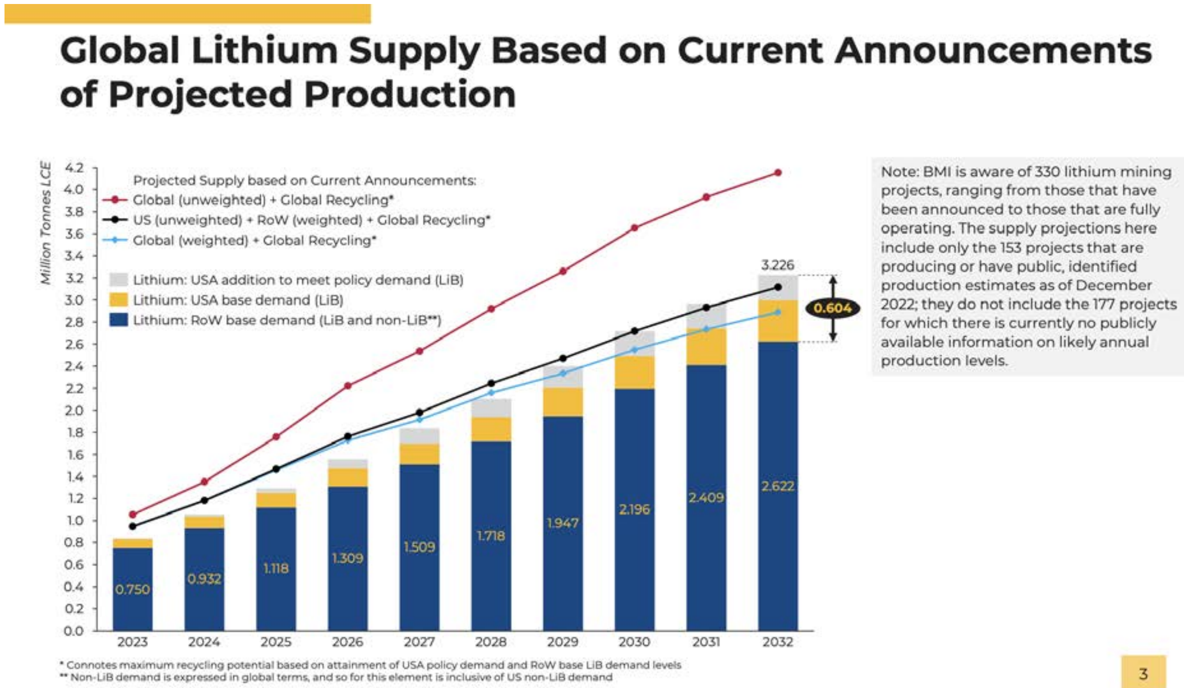
As discussed above, the current primary constraining material for PEVs is lithium. EPA points to a variety of sources to support its assumptions regarding lithium availability for U.S. PEV demand. *See* 88 Fed. Reg. at 29312-23; DRIA Chs. 3.1.3.2, 3.1.3.3.

Recent analysis by Benchmark Mineral Intelligence (BMI) on future lithium supply supports EPA's findings.[378] BMI compiled a list of all currently known lithium mining projects, including those already in operation as well as those in development, totaling 330 projects globally as of December 2022. Of those, 153 are already producing lithium or have public, identified supply projections. BMI took those supply projections and assigned them probabilities—e.g., currently producing mines were weighted at 100%, while projects that have secured a significant proportion of their funding and completed certain feasibility milestones necessary for production within the next 5 years were considered "probable" and weighted at 50%. Supply from the other 177 lithium mining projects (which do not yet have supply projections) were all counted as 0.

BMI then compared these projections to the projected lithium demand through 2032, using forecast global demand (including for non-battery applications), as well as demand based on EPA's proposed light-, medium-, and heavy-duty vehicle emission standards. Based just on the 153 included projects, BMI's weighted projections show sufficient lithium for the EPA's Proposed Standards (on top of forecast demand for the rest of the world) through 2028 as shown below in Figure XVIII.A-3. When the 18 U.S. projects with supply projections (out of 48 total U.S. projects) are weighted at 100%, lithium supply is sufficient for the Proposed Standards through 2030. And when the 153 included projects are weighted at 100%, global supply greatly exceeds demand through 2032.

[378] BMI, *Lithium Mining Projects – Supply Projections*, June 2023 (slide deck); BMI, *Lithium Mine Projects (06.30.2023)* (Excel spreadsheet), both attached to this comment letter.

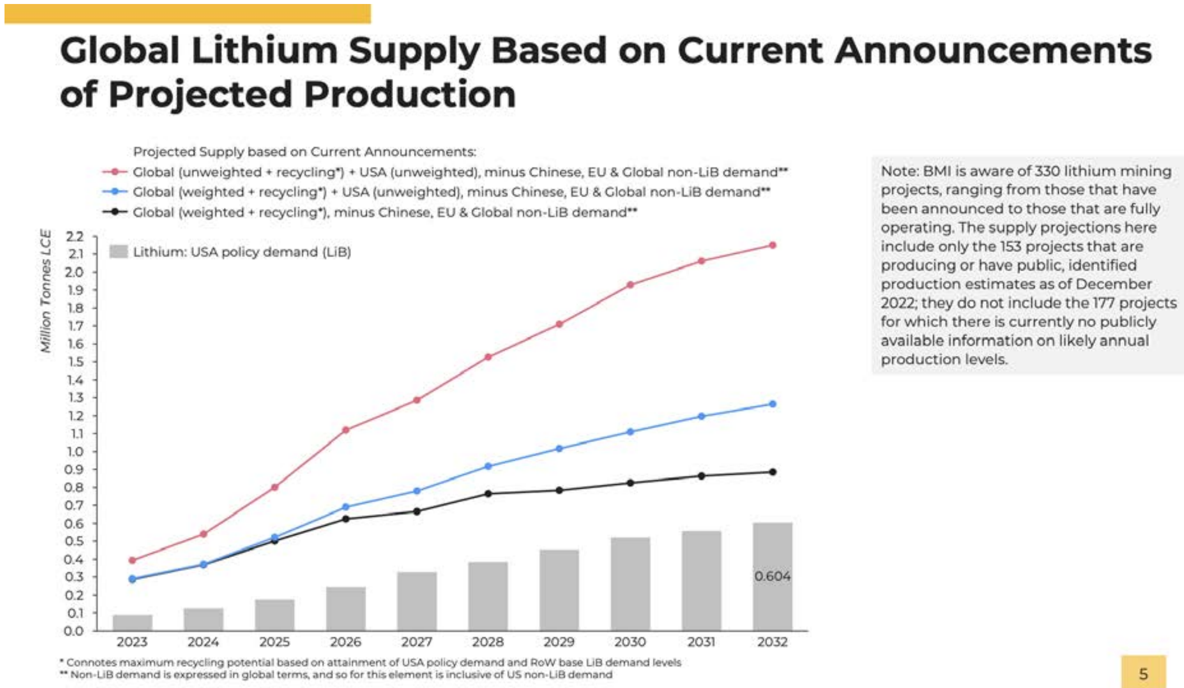
Figure XVIII.A-3: Global Lithium Supply Based with U.S. and Global Demand



Given that BMI's projections exclude 177 projects that have been announced but do not yet have supply projections, even a 100% weighting for the 153 projects that are operating or have supply projections is a conservative approach. It does not include any supply growth outside of the 153 projects identified as of December 2022, not even from the other 177 identified projects, despite increasing global demand and strong U.S. tax incentives. Moreover, it would be reasonable and expected that even BMI's supply projections would continue to increase as the identified projects get further along in the development process and market forces continue to act.

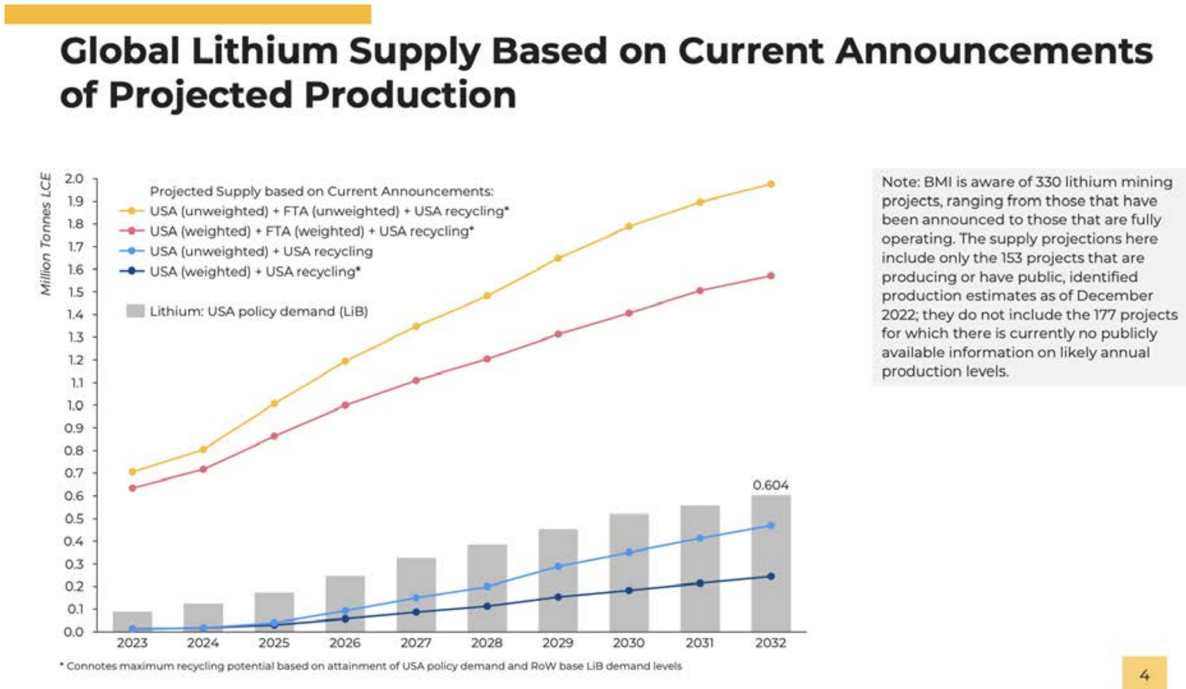
In addition, BMI's analysis indicates that there will be sufficient supply for U.S. demand even after considering competing lithium battery demand from China and Europe and global non-lithium battery demand as shown below in Figure XVIII.A-4.

Figure XVIII.A-4: Remaining Global Lithium Supply with U.S. Demand



BMI also broke down the supply from the 153 included projects by country, and then grouped those countries into categories based on U.S. trade-agreement status, consistent with the terms in the IRA. This projection shown in Figure XVIII.A-5 below makes clear that there is ample lithium supply from sources that satisfy the IRA § 30D Clean Vehicles Tax Credit requirements—specifically, domestic sources, as well as countries that have free trade agreements with the U.S. ("FTA countries"). This supports EPA's modeling assumption of an average tax credit of $6,000 per electric vehicle (out of a maximum allowable credit of $7,500), as lithium from these sources would qualify a vehicle for the tax credit, provided other conditions are met (e.g., vehicle assembly in North America, purchaser income limits).

Figure XVIII.A-5: U.S. Lithium Supply and Free Trade Agreement Country Supply with U.S. Demand



Slides of BMI's analysis, as well as their full list of lithium supply projects, are attached to these comments.

Finally, as has been noted elsewhere in these comments, there are alternative battery chemistries that do not use lithium (including sodium-ion batteries), and thus may end up lowering lithium demand in the future. In addition, in light of the points made in Section XVIII.B, below, we believe EPA's analysis of future lithium demand—and thus future lithium supply sufficiency—is conservative.

B. Alternative battery-related modeling inputs increase the feasibility and benefits of PEVs.

EPA's OMEGA modeling likely overestimates the battery cost and material demand per passenger PEV due to conservative technical assumptions made about advancements in lithium-ion batteries that would replace materials, increase specific energy, or allow for the longer use of batteries through refurbishment or reuse. Additionally, the variables discussed below can also cause mineral demand forecasts to be higher than actual future material demand.

1. Technological advancements resulting in decreased mineral demand can also further decrease battery costs.

In addition to the substitution of lithium discussed above, advanced lithium-ion batteries such as solid-state batteries could decrease the amount of lithium required to provide the same kWh and miles traveled. Innovation will increase battery specific energy and energy density, therefore reducing the amount of materials needed per kWh as well as battery cost.

Solid-state battery startups, such as QuantumScape,[379] are already partnering with automakers to ensure the technology is suitable for PEVs. Solid Power has partnered with Ford and BMW and has provided BMW with a research and development license to its all-solid-state cell design and manufacturing knowledge, and QuantumScape in December 2022 shipped its first lithium metal battery cells for trial.[380] Solid-state batteries have increased specific energy, with QuantumScape reporting their Li-Metal NMC batteries having up to 400 Wh/kg or 1,100 Wh/L depending on the anode. This increase is graphically represented in Figure XVIII.B-1 below, which was produced by QuantumScape.

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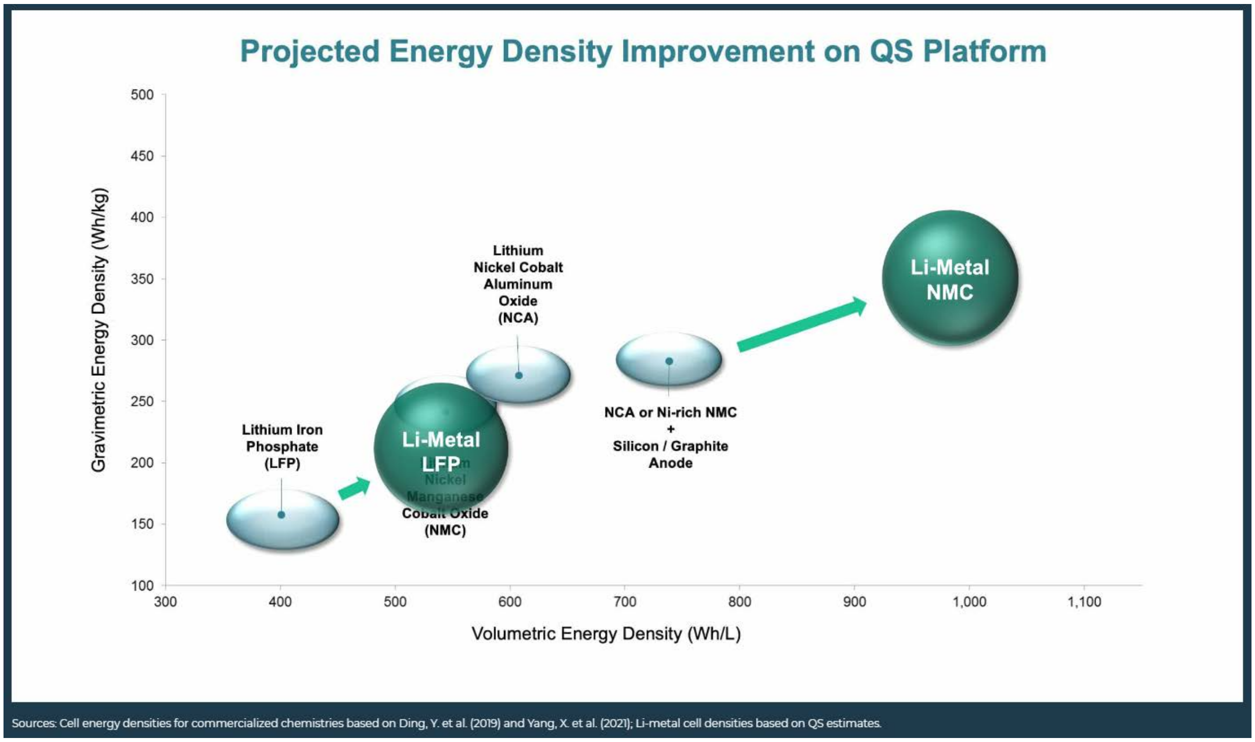
[379] QuantumScape, Delivering on the promise of solid-state technology, https://www.quantumscape.com/technology/ (last accessed, June 29, 2023).

[380] Steve Hanley, Solid Power & QuantumScape Begin Shipping Solid-State Batteries For Trials, CleanTechnica (Dec. 22, 2022), at https://cleantechnica.com/2022/12/22/solid-power-quantumscape-begin-shipping-solid-state-batteries-for-trials/ (last accessed June 29, 2023).

Figure XVIII.B-1: Energy Density Improvements as Projected by QuantumScape



Sources: Cell energy densities for commercialized chemistries based on Ding, et al.[381] *and Yang et al.*[382]*; Li-metal cell densities based on QuantumScape estimates*

Sodium-ion batteries are also making their way to the market, providing an alternative to lithium minerals and potentially reducing future lithium demand. CATL (the world's largest PEV battery maker) invested in the technology in 2021,[383] and the Chery iCar will be the first EV to use the technology.[384] There are already 20 sodium-ion battery factories under construction or planned around the world, demonstrating the uptake of this technology.[385]

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[381] Yuanli Ding, et al., Automotive Li-Ion Batteries: Current Status and Future Perspectives. Electrochem. Energy Rev. 2:1–28 (2019), available at https://doi.org/10.1007/s41918-018-0022-z (last accessed June 29, 2023).

[382] Xiaofei Yang, et al., Recent advances and perspectives on thin electrolytes for high-energy-density solid-state lithium batteries, Royal Society of Chem. (2020) DOI: 10.1039/d0ee02714f, available at https://www.eng.uwo.ca/nanoenergy/publications/2020/pdf/xiaofei-ees-thin-SSE-2020.pdf (last accessed June 29, 2023).

[383] Magdalena Petrova, Here's why sodium-ion batteries are shaping up to be a big technology breakthrough, CNBC (May 10, 2023), at https://www.cnbc.com/2023/05/10/sodium-ion-batteries-shaping-up-to-be-big-technology-breakthrough.html (last accessed June 29, 2023).

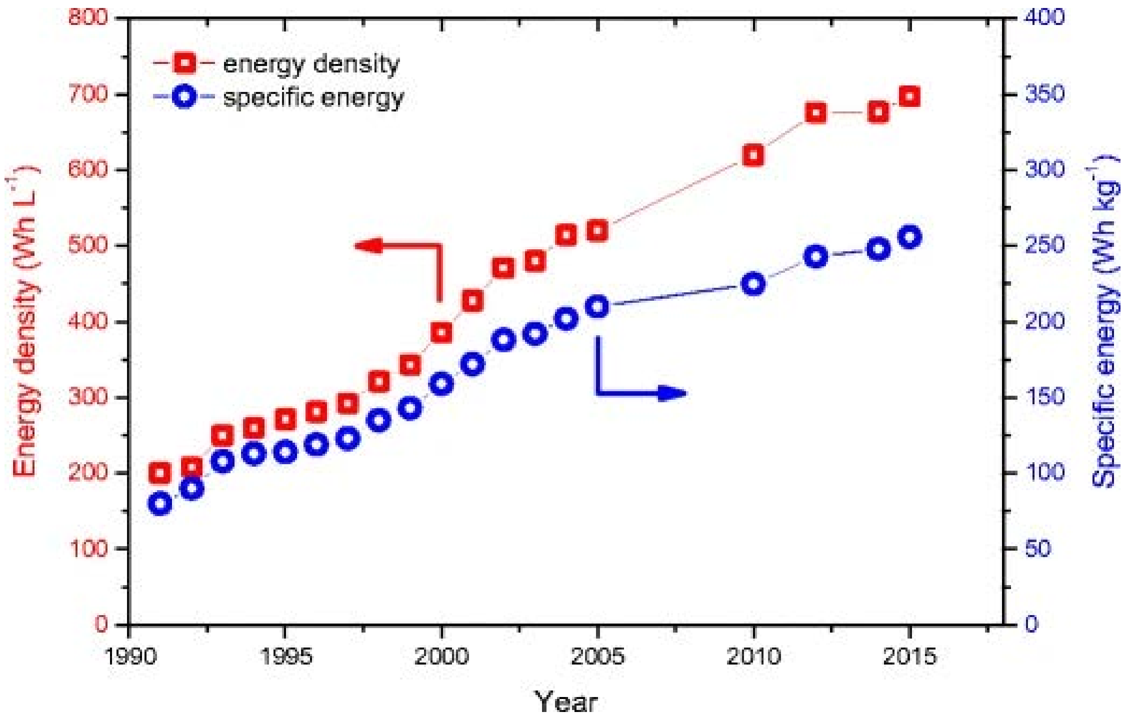
[384] Jiri Opletal, CATL's sodium-ion batteries will debut in Chery Auto EVs, Car News China (Apr. 16, 2023), at https://carnewschina.com/2023/04/16/catls-sodium-ion-batteries-will-debut-in-chery-auto-evs/ (last accessed June 29, 2023).

[385] Steve Hanley, The Sodium-Ion Battery Is Coming To Production Cars This Year, CleanTechnica (Apr. 22, 2023), at https://cleantechnica.com/2023/04/22/the-sodium-ion-battery-is-coming-to-production-cars-this-year/ (last accessed June 29, 2023).

2. Specific energy assumed in the model is lower than expected for LDVs.

"Specific energy" is the amount of energy a battery can store per unit of its weight, and "energy density" is the amount of energy a battery can store per unit of its volume. As shown in Figures XVIII.B-2 and XVIII.B-3 below, both of these metrics have increased dramatically over time for lithium-ion batteries. Improving battery specific energy and energy density increases the amount of energy that can be stored using the same amount of materials. This is important not only for reducing demand for battery minerals but also for improving the range of PEVs. These increases are the result of various factors, including battery chemistry and design improvements. Battery chemistries have different specific energies; nickel- and cobalt-containing chemistries have higher specific energy than LFP. For example, the Tesla Model Y uses an NCA battery with a reported 276-333 Wh/kg, while the Model S and Model X use a battery with slightly less at 250 Wh/kg.[386] While lower, this 250 Wh/kg is still a dramatic increase from Sony's commercialization in 1991 when it was 80 Wh/kg.[387]

Figure XVIII.B-2: Specific energy and energy density of nickel-based lithium-ion batteries continue to increase

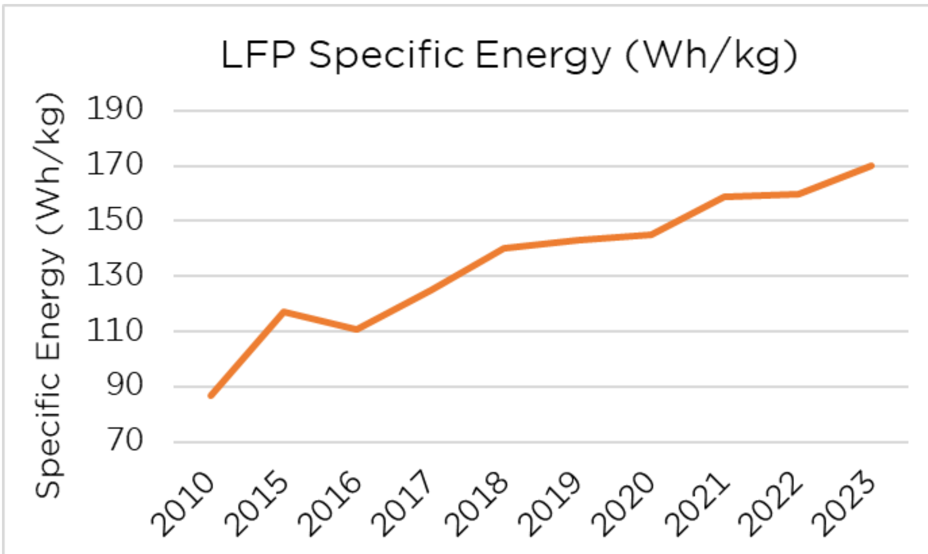


Source: Placke et al.

[386] Aditya Dhage, Cylindrical Cell Comparison 4680 vs 21700 vs 18650 (Jan. 8, 2023), at https://www.batterydesign.net/cylindrical-cell-comparison-4680-vs-21700-vs-18650/ (last accessed June 29, 2023).
[387] Tobias Placke, et al., Lithium ion, lithium metal, and alternative rechargeable battery technologies: the odyssey for high energy density, J Solid State Electrochem, 21:1939–1964 (2017) (hereinafter Placke et al. - Odyssey).

LFP batteries have similarly seen advancements in their specific energy, from below 90 Wh/kg in 2010[388] (shown in the figure below) to current reports from Proterra of 170 Wh/kg[389] and BYD of 166 Wh/kg.[390] BYD has recently announced the blade LFP battery, which is estimated to reach 180 Wh/kg[391] due to the use of "cell to pack" design, therefore not using the "cell to module to pack" design that has been historically seen.[392]

Figure XVIII.B-3: Specific energy of LFP lithium-ion batteries continues to increase



Data Source: BloombergNEF Electric Vehicle Outlook 2022 (subscription required)

a. Specific energy forecasts

U.S. PEV sales are currently dominated by nickel- and cobalt-containing cathode chemistries, representing 100% of sales in 2019.[393] The NCA cathode, used by Tesla, represents

[388] Dr. Andy Leach, Lithium-Ion Batteries: State of the Industry 2022, *Historic and estimated changes to battery-pack energy density*, BloombergNEF, Sept. 9, 2022. Subscription required
[389] Proterra, Proterra battery pack features and specifications (2020), at https://www.proterra.com/wp-content/uploads/2020/08/Proterra-EV-Battery-Pack-Specs-2020.pdf (last accessed June 29, 2023).
[390] Nigel, Battery Design from Chemistry to Pack: BYD Blade (July 4, 2022), at https://www.batterydesign.net/byd-blade/ (last accessed June 29, 2023).
[391] Yiwen Shi, Feasibility of BYD blade batteries in electric vehicles, Highlights in Sci., Engineering and Tech., Vol. 32 (2023), at https://drpress.org/ojs/index.php/HSET/article/view/5087/4928#:~:text=The%20ratio%20of%20energy%20density,to%2030%25%20%5B2%5D (last accessed June 29, 2023).
[392] International Energy Agency, Global EV Outlook 2022, at 140, available at https://iea.blob.core.windows.net/assets/ad8fb04c-4f75-42fc-973a-6e54c8a4449a/GlobalElectricVehicleOutlook2022.pdf (last accessed June 29, 2023).
[393] Jessica Dunn, et al., Circularity of Lithium-Ion Battery Materials in Electric Vehicles, Envtl. Sci. & Tech., 55 (8), 5189, 5192, Fig. 4 (2021), DOI: 10.1021/acs.est.0c07030 (hereinafter Dunn - Circularity).

the most sold PEV batteries in the United States over the last couple of years.[394] More recently, Tesla began selling PEVs in the United States that use LFP,[395] a trend that is being followed by Ford and Rivian.

If reviewed globally, NMC of different ratios (particularly 622 and 811) is the most prevalent chemistry today,[396] and LFP is more frequently used globally than in the U.S., with around 40% of global passenger PEV sales expected to contain LFP batteries in 2023.[397] While LFP batteries have lower specific energy, and therefore less range than nickel- and cobalt-based chemistries, they are cheaper to manufacture due to the lack of cobalt and nickel, and technological advances are closing the gap between LFP and nickel- and cobalt-based specific energies.[398]

Although the prevalence of different ratios of nickel- and cobalt-based chemistries (NMC and NCA) vary with time, those chemistries are currently predicted to hold nearly half the global passenger PEV market into the early 2030s, with NMC811 and NMC955 being the most popular chemistries in that category in 2027.[399] U.S.-based forecasts similarly assume nickel- and cobalt-based chemistries to be dominant over the next decade, despite the increasing use of LFP.[400]

The OMEGA model uses the NMC811 cathode for a base technology and 180-200 Wh/kg as the base specific energy. There are a few issues with these assumptions: 1) while NMC811 is representative of a technology sold today, NMC611 is currently more common, and NMC955 along with other chemistries like NCA and LFP are expected to be more common than NMC811 in 2027-2032; and 2) the specific energy used in OMEGA does not align with real-world NMC811 specific energy.[401] NMC811 has one of the highest specific energies, behind only NCA.[402] When paired with a graphite anode, the specific energy of the battery should be at least 250 Wh/kg, as shown in Figure XVIII.B-4 below, compared to the 180-200 Wh/kg used by EPA.[403]

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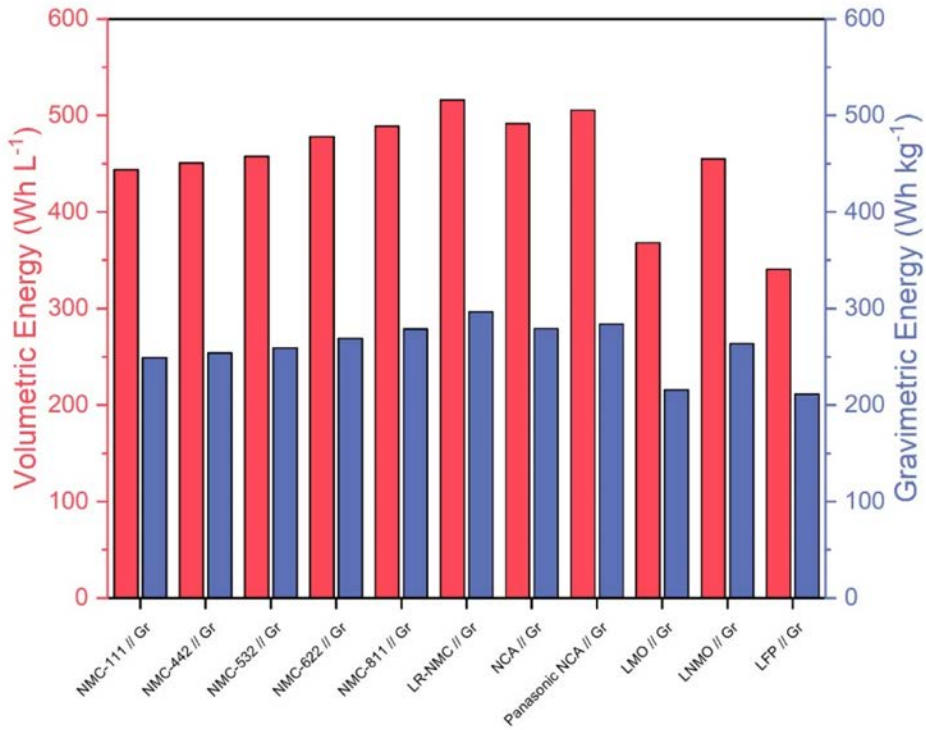
[394] *Id.* at 5192, Fig. 4.
[395] Michael Wayland, Tesla will change the type of battery cells it uses in all its standard-range cars, CNBC (Oct. 20, 2021), at https://www.cnbc.com/2021/10/20/tesla-switching-to-lfp-batteries-in-all-standard-range-cars.html (last accessed June 29, 2023).
[396] Colin McKerracher et al. Electric Vehicle Outlook 2023, Figure 202, BloombergNEF. June 8, 2023. Subscription required
[397] *Id.*
[398] *Id.* at 157-158
[399] *Id.* at Figure 202
[400] Dr. Andy Leach, Lithium-Ion Batteries: State of the Industry 2022, *US demand, chemistry mix, and recycling Capacity*, BloombergNEF, Sept. 9, 2022. Subscription required.
[401] *Id.*
[402] *Id.* at Historic and estimated changes to battery-pack energy density
[403] Marc Wentker, A Bottom-Up Approach to Lithium-Ion Battery Cost Modeling with a Focus on Cathode Active Materials, Energies 12(3):504, at 6, Fig. 2 (2019), available at https://doi.org/10.3390/en12030504

Figure XVIII.B-4: Specific energy of lithium-ion batteries with various cathodes and anodes



Source: Wentker et al., 2019

BloombergNEF's specific energy forecast used linear interpolation to demonstrate that in 2030, the 95% confidence lower limit of specific energy is 210 Wh/kg, with a higher limit of 275 Wh/kg, as shown in Figure XVIII.B-5 below.[404] This linear interpretation includes both LFP and NMC, but does not account for the high amount of nickel- and cobalt-containing cathodes used in the U.S. The forecast also does not account for material substitution and large specific energy gains expected from quickly-advancing technology. For example, the use of silicon in the anode can increase specific energy,[405] and while it is not yet used widely, startups are progressing this technology and constructing commercial-scale manufacturing facilities.[406]

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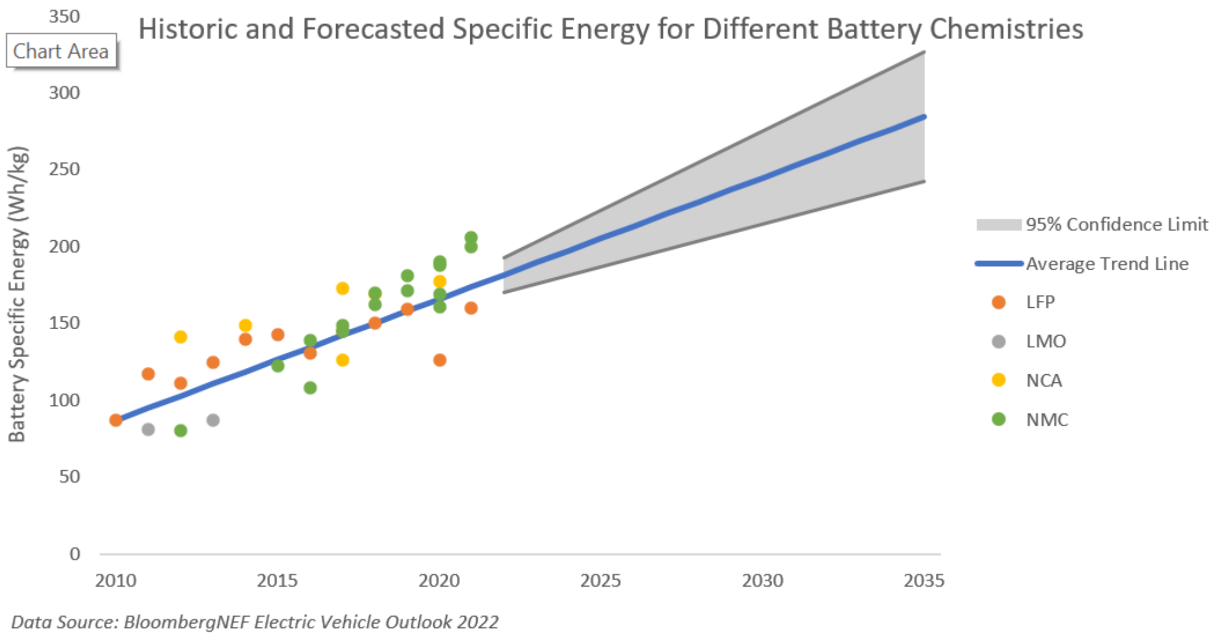
[404] Dr. Andy Leach, Lithium-Ion Batteries: State of the Industry 2022, *Historic and estimated changes to battery-pack energy density*, BloombergNEF, Sept. 9, 2022. Subscription required

[405] Placke et al. - Odyssey, *supra*.

[406] Matt Blois, Silicon anode battery companies get a major boost, Chemical and Engineering News (2022), at https://cen.acs.org/energy/energy-storage-/Silicon-anode-battery-companies-major/100/web/2022/12; *see also* Group14 Begins Construction of World's Largest Commercial Factory for Advanced Silicon Battery Materials (Apr. 4, 2023), at https://group14.technology/en/news/group14-technologies-begins-construction-of-the-worlds-largest-commercial-factory-for-advanced-silicon-battery-materials-.

Figure XVIII.B-5: Historic and forecasted battery-pack specific energy for different battery chemistries



Data Source: BloombergNEF Electric Vehicle Outlook 2022 (subscription required)

b. An updated specific energy forecast

The relatively low pack-level specific energy described in section 2.5.2.1.1 (Battery sizing) of the DRIA (180-200 Wh/kg) appears to only account for the use of LFP, even though the following section, 2.5.2.1.2 (Base year battery cost estimation), states that vehicles were assumed to contain batteries with the more efficient NMC811 chemistry in the cost analysis. Therefore, EPA's inputs for specific energy are conservative considering that nickel- and cobalt-containing cathodes are used in the vast majority of passenger PEVs sold in the US, and recent advancements, such as the Blade Battery (10 Wh/kg increase), demonstrate specific energy gains faster than historically seen. The EPA forecasts generally align with the lowest limit of specific energy forecasts by BloombergNEF in Figure XVIII.B-5 in the prior section, although it would be more accurate to align with a high forecast scenario considering the share of NMC chemistries in use.

Updating the specific energy forecast would likely lead to lower costs and mineral demand for passenger PEVs, and therefore increased feasibility and cost benefits of PEV technologies compared to EPA's current analytical approach. EPA's assumptions must be revised to reflect what is actually occurring in the market and what the currently predicted trends are for the future.

Table XVIII.B-1 Estimated Specific Energy for Passenger PEVs[407]

	Specific Energy (Wh/kg)	
Year	BNEF range	Our estimate (30% LFP & 70% NCX)
2024	180-212	214
2025	185-222	224
2026	190-233	234
2027	195-243	244
2028	200-254	254
2029	205-264	264
2030	210-275	274
2031	215-285	283
2032	220-296	293
2033	224-306	303
2034	229-317	313
2035	234-327	323

Table XVIII.B-1 is calculated based on historical energy densities for LFP and cobalt-containing cathodes (NCX) provided by BloombergNEF.[408] When specific energy for LFP and cobalt-containing cathodes are individually calculated based on linear interpolation, Table XVIII.B-2 shows the results. If the ratio of 30% LFP and 70% nickel-based is kept, we get the average specific energy in Table XVIII.B-1.

Table XVIII.B-2: Estimated Specific Energy for LFP and Nickel-Based Battery Chemistries

	Specific Energy (Wh/kg)	
Year	LFP	Nickel-based
2027	179	272
2028	184	284
2029	190	295
2030	195	307
2031	201	319
2032	206	331

Data Source: BloombergNEF Electric Vehicle Outlook 2023 (subscription required)

[407] Colin McKerracher et al. Electric Vehicle Outlook 2023, Figure 201, BloombergNEF. June 8, 2023. Subscription required

[408] *Id.*

Appropriately representing higher specific energies that align with today's technologies and forecasts also has implications for vehicle range, weight, and mineral demand. Batteries with higher specific energies can provide the same amount of power while using fewer minerals, therefore weighing less than batteries with lower specific energies. This means that vehicles with more efficient batteries can travel further with the same amount of energy because the battery significantly impacts the weight, and therefore, the efficiency of PEVs.

3. Design for disassembly holds promise for battery recycling.

The battery design parameters listed in the Proposal, which EPA used to develop battery cost estimates, *see* 88 Fed. Reg. at 29299, do not include design for disassembly (Dfd), also referred to as design for recycling or design for reuse. Dfd involves factoring end-of-life into the design of the vehicle, meaning that the battery is designed to be taken apart so that cells and modules can be refurbished, reused, or replaced, or so that the battery can be more efficiently and safely disassembled for recycling. This disassembly is typically a difficult, lengthy, and therefore expensive process because Dfd is not included in the design phase.[409]

As reuse and recycling becomes more prevalent and policies begin to require it, we expect that Dfd will also be more common. If Dfd occurs, more reuse, refurbishment and replacement will occur and batteries will have a longer lifespan, therefore reducing the amount of new batteries necessary for electrification.[410] The disassembly of a battery from a vehicle and down to the cell level currently represents approximately a third of light-duty vehicle recycling costs in the United States.[411] If Dfd occurs, this recycling cost will also decline, therefore leading to more prevalent recycling and greater availability of recycled supply.

XIX. Consumer Acceptance of PEVs Is Not a Barrier to Feasibility of EPA's Proposed Standards or More Stringent Standards.

In this section and in Sections XX and XXI, we explain how consumer acceptance considerations support strong final standards. As detailed below, PEVs offer significant economic and performance benefits to consumers, and consumer interest in PEVs continues to grow.

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[409] CalEPA, Lithium-ion car battery recycling advisory group report (2022), https://calepa.ca.gov/lithium-ion-car-battery-recycling-advisory-group/ (last accessed June 29, 2023).
[410] Michael S. Koroma, et al., Life cycle assessment of battery electric vehicles: Implications of future electricity mix and different battery end-of-life management, Sci Total Env. 20;831:154859 (2022), available at https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9171403/ (last accessed June 29, 2023).
[411] *See* Jessica Dunn, et al., Electric vehicle lithium-ion battery recycled content standards for the US – targets, costs, and environmental impacts, Resources, Conservation and Recycling, 185, 106488, 0921-3449 (2022), at 6, Fig. 3, available at https://doi.org/10.1016/j.resconrec.2022.106488

A. EPA has broad discretion in considering consumer preferences when promulgating emission standards but should not give undue weight to that factor.

As explained in EPA's Proposal and Section II of these comments, when promulgating new emissions standards under Clean Air Act § 202(a), EPA must consider the statutory criteria of technological feasibility, cost of compliance, and lead time.[412] EPA may consider other factors, and in the past has considered a rule's various impacts on vehicle purchasers.[413]

While EPA has often considered consumer acceptance in its Section 202 rulemakings, the Agency may not let the unique preferences of each and every consumer dictate its consideration of the appropriateness or feasibility of emission standards. In *International Harvester Company v. Ruckelshaus*, 478 F.2d 615, 640 (D.C. Cir. 1973), the D.C. Circuit Court of Appeals concluded:

> We are inclined to agree with the Administrator that as long as feasible technology permits the demand for new passenger automobiles to be generally met, the basic requirements of the Act would be satisfied, even though this might occasion fewer models and a more limited choice of engine types. The driver preferences of hot rodders are not to outweigh the goal of a clean environment.

While *International Harvester* involved emission requirements for light-duty vehicles under a provision of the 1970 Amendments, the principles the court expressed apply just as well to standards under Section 202(a)(1). As detailed in Section II, Congress intended EPA's standards to push the industry toward greater emission reductions and did not expect them to preserve the market dominance of any particular type of powertrain or power source. EPA should not give oversized weight to arguments questioning consumer preferences, which is not a factor Congress identified in Section 202(a)(1).

While EPA has discretion whether to consider and how much weight to give purchaser acceptance in setting emission standards, that discretion is limited by EPA's primary statutory duty to set standards that adequately protect public health and welfare. An understanding of consumers' willingness to purchase and drive PEVs could inform the feasibility and effectiveness of EPA's regulations. EPA's attention to consumer preferences, however, cannot compromise its overall Clean Air Act mandate to mitigate the automobile's "devastating impact on the American environment," *International Harvester*, 478 F.2d at 622, or the Agency's primary duty to protect public health and welfare by minimizing harmful air pollution. Most importantly here, however, is that consumer acceptance of PEVs is widespread and growing, and PEVs provide the vehicle features and characteristics that drivers want and need. Thus, as this

[412] 42 U.S.C. § 7521(a); 88 Fed. Reg. at 29186.
[413] 88 Fed. Reg. at 29186.

section will explain, consumer acceptance is not a barrier to PEV penetration at the levels projected by EPA's Proposal or at levels consistent with Alternative 1 with increasing stringency after 2030.

B. Consumer acceptance of PEVs is not a barrier to feasibility because consumer acceptance is widespread and growing.

Under EPA's Proposed Standards and under Alternative 1 with a faster ramp-up after 2030, consumer preferences generally align with the most economically advantageous and cost-effective compliance pathway (increasing the deployment of PEVs within the light-duty fleet) toward meeting strong emission standards that fulfill EPA's statutory mandate. American drivers have shifted and are continuing to shift toward acceptance of—and, increasingly, preference for—PEVs. As several original equipment manufacturers (OEMs) have themselves explained, "[r]educed interest in legacy products due to technology advancements and consumer preference shifts are an inevitable reality of the market and occur in all sectors of the economy." *See* Initial Brief for Industry Respondent-Intervenors at 13-14, *Ohio v. EPA*, No. 22-1081 (D.C. Cir. Feb. 13, 2023).[414] Here, as PEV technology advances and both the public health and driver-experienced benefits of PEVs become apparent, consumer's preferences are naturally shifting away from combustion vehicles and toward PEVs.

EPA's Proposal accurately highlights the already "greatly increased acceptance [of PEVs] by consumers," 88 Fed. Reg. at 29187, and that "consumer affinity for PEVs is strong." *Id.* at 29189. This market-based consumer acceptance is evidenced at least in part by recent rapid growth in PEV market share—growth that has outpaced historical estimates considered ambitious just a decade ago. EPA's 2012 Rule, for example, assumed electric vehicles would account for only 3% of the car market and 2% of the combined car and light-duty truck market by 2025. 77 Fed. Reg. at 62874, 62875 Tbl.III-52. By 2021, however, combined car BEV and PHEV market share had already outpaced that estimate for 2025, reaching about 4.2% of LDV sales and double the 2020 market share.[415] By 2022, electric vehicle market share had again reached a new high, with combined LDV BEV and PHEV market share totaling 7.6% for 2022[416]—already more than double EPA's 2012 Rule projection *for 2025*. As of the first quarter

[414] Automaker industry respondent-intervenors on this brief include Ford Motor Company, BMW of North America, LLC, Volkswagen Group of America, Volvo Car USA LLC, American Honda Motor Co., Inc., and the National Coalition for Advanced Transportation (whose members include Rivian and Tesla). The Initial Brief for Industry Respondent-Intervenors is available at https://blogs.edf.org/climate411/files/2023/02/Industry-Respondent-Intervenors-Initial-Brief-Feb.-13-2023_.pdf.

[415] Plug In America, *The Expanding EV Market: Observations in a Year of Growth* 4 (Feb. 2022), https://pluginamerica.org/wp-content/uploads/2022/03/2022-PIA-Survey-Report.pdf; David Gohlke et al., *Assessment of Light-Duty Plug-In Electric Vehicles in the United States, 2010–2021*, Argonne National Laboratory 4 (Nov. 2022), https://publications.anl.gov/anlpubs/2022/11/178584.pdf; Argonne National Laboratory, *Light Duty Electric Drive Vehicles Monthly Sales Updates*, https://www.anl.gov/esia/light-duty-electric-drive-vehicles-monthly-sales-updates); EPA, *The 2022 EPA Automotive Trends Report* 57 (Dec. 2022), https://www.epa.gov/system/files/documents/2022-12/420r22029.pdf.

[416] Colin McKerracher et al., *Electric Vehicle Outlook 2023*, BloombergNEF (June 8, 2023). Subscription required.

of 2023, U.S. light-duty PEV sales were up again, to 8.3%,[417] an increase of 60% compared to the same period in 2022.[418] As discussed in the Proposal, forecasts based on consumer demand now suggest U.S. passenger car PEV sales percentages of 40% to more than 50% by 2030, 88 Fed. Reg. at 29192, and public announcements by major automobile manufacturers support baseline PEV sales at this level or higher. *Id.* at 29190-2; DRIA at 3-16..

Data regarding PEV registrations and preorders also shows strong and growing consumer demand for these vehicles and signals widening consumer acceptance. In the first three months of 2022, registrations for new PEVs increased 60% in the United States, even though overall new car registrations were down 18%.[419] Looking at consumer sales shares, however, is likely an inadequate proxy for actual consumer interest in PEVs, given the fact that many consumers do not yet have access to these vehicles. A recent analysis by Sierra Club found that 66% of car dealerships nationwide did not yet have a single EV available for sale.[420] When new PEV models enter the market, consumers race to place orders. In late 2022, for example, GMC's new Sierra model electric pickup truck averaged more than 500 reservations per day and reached roughly 20,000 reservations after a little over a month, on top of over 170,000 reservations for GMC's Silverado EV pickup.[421] Similarly, the Dodge Ram 1500 REV pickup reached its maximum number of preorders in just 5 days earlier this year.[422]

This consumer purchase data shows Americans' increasing desire for PEVs, and is backed up by other data and research. Specifically, as this section will explain, peer-reviewed research and analyses, customer-based surveys, and comparisons with international sales trends provide further evidence of broad and expanding consumer preference for PEVs.

1. Recent peer-reviewed academic literature supports broad and growing consumer acceptance of PEVs.

Several recent peer-reviewed papers have shown that consumers are in fact ready and willing to adopt electric vehicles. EPA references some of these papers in the Proposal, and

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[417] Argonne National Laboratory, *Light Duty Electric Drive Vehicles Monthly Sales Updates*, https://www.anl.gov/esia/light-duty-electric-drive-vehicles-monthly-sales-updates (showing, as of May 2023, PEV car sales over 10% of total car sales, and combined PEV car and light-duty truck sales of 8.36% of total light-duty sales).
[418] International Energy Agency, *Global EV Outlook 2023*, at 22 (April 2023), https://iea.blob.core.windows.net/assets/dacf14d2-eabc-498a-8263-9f97fd5dc327/GEVO2023.pdf.
[419] Jayme Deerwester, *Registrations for Electric Vehicles Soar, Signaling Increasing Mainstream Acceptance*, USA Today (May 16, 2022), https://www.usatoday.com/story/money/cars/2022/05/16/electric-vehicle-registration-soars/9798645002/.
[420] Sierra Club, *Rev Up Electric Vehicles: A Nationwide Study of the Electric Vehicle Shopping Experience* (May 2023), https://www.sierraclub.org/sites/www.sierraclub.org/files/2023-05/SierraClubRevUpReport2023.pdf.
[421] Peter Holderith, *2024 GMC Sierra EV Waitlist Proves People Want All the Electric Pickups*, thedrive.com (Nov. 29, 2022), https://www.thedrive.com/news/2024-gmc-sierra-ev-waitlist-proves-people-want-all-the-electric-pickups.
[422] Peter Johnson, *Ram Closes Reservations for Its First Electric Truck, the 1500 REV, After 5 Days*, electrek (Feb. 17, 2023), https://electrek.co/2023/02/17/ram-closes-reservations-for-its-first-electric-truck-the-1500-rev/.

should also consider additional research on PEV consumer acceptance, including research that is recently published. For example, a recent study by leading academics in this field, and not discussed in EPA's Proposal, examined consumer choices of plug-in electric vehicles (including BEVs and PHEVs) relative to conventional gasoline vehicles.[423] The study, Forsythe et al. (2023), found that when consumers' basic demands for vehicle attributes are met, they accept or prefer BEVs to combustion vehicles.[424] The analysis was conducted through a nationwide survey-based consumer discrete choice experiment from December 2020 to September 2021, in which new vehicle consumers—weighted to be representative of the U.S. population—chose among potential vehicle options in a manner that mimicked the process of comparing vehicles on an automaker's website.[425] In order to examine how consumer preferences might be changing over time, the experiment was designed to be compared to an earlier discrete choice experiment conducted in 2012–2013.[426] The Forsythe et al. (2023) experiment was well-designed in that it (1) mitigated typical concerns of stated-preference experiments by "incorporat[ing] multiple features into the survey design that tend to improve the ability for survey responses to reveal comparable preferences as when making true purchase decisions";[427] (2) included a substantial number of participants (734 car-buyers and 862 SUV-buyers) recruited using both Amazon's Mechanical Turk (to mirror the earlier comparative study) and Dynata (which includes older and higher-income respondents), and weighted to ensure representativeness of the U.S. new vehicle buying population;[428] and (3) evaluated expected technology for a near-future hypothetical vehicle based on extensive research conducted by the National Academies of Sciences, Engineering, and Medicine, thus reflecting what PEV models could realistically be available to consumers in the short term.[429]

Forsythe et al. (2023) was the first to examine "the degree to which consumer willingness to trade off relevant vehicle attributes associated with electrification (e.g., range, operating cost, price, etc.) may have changed over time due to technology improvements or other factors and

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[423] Connor R. Forsythe, Kenneth T. Gillingham, Jeremy J. Michalek & Kate S. Whitefoot, *Technology Advancement is Driving Electric Vehicle Adoption*, PNAS (May 2023), https://www.pnas.org/doi/epdf/10.1073/pnas.2219396120.
[424] *Id.*
[425] *Id.* at 1, 3.
[426] *Id.* at 1*; see also* J.P. Helveston, et al., *Will Subsidies Drive Electric Vehicle Adoption? Measuring Consumer Preferences in the U.S. and China*, 73 Transp. Res. Part A: Policy Pract. 96-112 (2015), https://reader.elsevier.com/reader/sd/pii/S0965856415000038?token=029105616ECD043F67531E36FA6FBC42FD0801DE87C8B7FB2771B0B4E37E79E91CA7AE0CBC4CC7EFA61DCFC6A671DDFC&originRegion=us-east-1&originCreation=20230518185020.
[427] Forsythe et al. (2023) at 3 (listing features incorporated to mitigate any limitations of stated-preference surveys). *See also* C.A. Vossler, M. Doyon & D. Rondeau, *Truth in Consequentiality: Theory and Field Evidence on Discrete Choice Experiments*, 4 Am. Econ. Journal: Microeconomics 145-171 (2012), https://www.aeaweb.org/articles?id=10.1257/mic.4.4.145.
[428] Forsythe et al. (2023) at 3.
[429] *Id.* at 2–3; *see also* National Academies of Sciences, Engineering, and Medicine, *Assessment of Technologies for Improving Light-Duty Vehicle Fuel Economy—2025-2035* (2021), https://nap.nationalacademies.org/catalog/26092/assessment-of-technologies-for-improving-light-duty-vehicle-fuel-economy-2025-2035.

what this could imply for the sales of new vehicles in upcoming years."[430] The results indicated that "any perceived disadvantages of BEVs relative to gasoline vehicles are often compensated by the BEV's improved operating cost, acceleration, and fast-charging capabilities, particularly for BEVs with a longer range."[431]

In short, the study reveals that the attributes consumers look for in their vehicles have most likely stayed consistent between the 2012 stated-preference experiment and Forsythe et al. (2023)'s most recent. As BEVs are able to provide more of those attributes, consumers choose BEVs more often. The authors ultimately concluded that reasonable forecasted improvements of BEV range and price—based on extensive research on technology development by the National Academies of Sciences—show that "consumer valuation of many BEVs is expected to equal or exceed their gasoline counterparts by 2030," resulting in 40% to nearing 60% of consumers choosing BEV powertrain options over combustion powertrain options for the same vehicle.[432] Moreover, "[a] suggestive market-wide simulation extrapolation indicates that if every gasoline vehicle had a BEV option in 2030, the majority of new car and near-majority of new sport-utility vehicle choice shares could be electric in that year due to projected technology improvements alone."[433] Finally, Forsythe et al. (2023) suggested that, with the assumed technological projections, even if all BEV purchase incentives were entirely phased out, BEVs could still have a market share of about 50% relative to combustion vehicles by 2030, based on consumer choice alone.[434]

As discussed in EPA's Proposal and the Agency's January 2023 literature review of consumer acceptance research,[435] other recent studies show a similar trend of increasing consumer preference for PEVs. For example, Carley et al. (2019) found that American consumers were more intent on purchasing PEVs in 2017 than in 2011.[436] Gillingham et al. (2023), cited briefly in EPA's Proposal, is especially illustrative of the increasing consumer demand for PEVs. That study used data on all new light-duty vehicles sold in the United States between 2014 and 2020 (a dataset of over 106 million observations), and found that in the

[430] Forsythe et al. (2023) at 2.
[431] *Id.* at 2.
[432] *Id.* at 1, 5 Fig.3 (showing U.S. BEV car market shares in MY 2030 over 50% and U.S. BEV SUV market shares in MY 2030 over 40%).
[433] *Id.* at 1. These projected technology improvements follow the projections from National Academies of Sciences, Engineering, and Medicine, *Assessment of Technologies for Improving Light-Duty Vehicle Fuel Economy—2025-2035* (2021), https://nap.nationalacademies.org/catalog/26092/assessment-of-technologies-for-improving-light-duty-vehicle-fuel-economy-2025-2035.
[434] Forsythe et al. (2023) at 6.
[435] EPA & Lawrence Berkeley National Laboratory, *Literature Review of U.S. Consumer Acceptance of New Personally Owned Light Duty Plug-In Electric Vehicles* (Jan. 2023), https://cfpub.epa.gov/si/si_public_record_report.cfm?Lab=OTAQ&dirEntryId=353465.
[436] Sanya Carley, Saba Siddiki & Sean Nicholson-Crotty, *Evolution of Plug-In Electric Vehicle Demand: Assessing Consumer Perceptions and Intent to Purchase Over Time*, 70 Transp. Res. Part D: Transp. Environ. 94-111 (2019), https://www.sciencedirect.com/science/article/abs/pii/S1361920918311635.

vehicle segments and classes where EVs were available, they were competing very successfully with comparable combustion vehicles, with relative market shares "exceeding 30% in recent years."[437] The results of this investigation could imply that fleet-wide LDV PEV market share in 2020 was around 2% not because only 2% of buyers wanted PEVs, but at least in part due to "the (near-)absence of EV offerings in many segments of the vehicle market"[438] where purchasers are interested in purchasing vehicles. If consumers want to purchase a particular vehicle type and there are no PEVs available within that market segment, they will buy a combustion vehicle. Gillingham et al. (2023) shows that when PEVs are available in those market segments, consumers already often choose the PEV over the combustion vehicle.

A number of studies in addition to those cited in EPA's literature review of consumer acceptance have considered the impacts of various factors on consumer acceptance of PEVs, and these—coupled with the current rapid pace of technological development and vast investment in PEV infrastructure—provide additional evidence that consumer acceptance is not a barrier to PEV penetration at levels consistent with EPA's Proposal or with Alternative 1 with increasing stringency after 2030. One body of research, for example, reveals that consumer demand is responsive to the availability of public charging infrastructure. When this infrastructure is available—as it increasingly is and will be, *see* Section XVII—consumer acceptance of and demand for PEVs increases. Cole et al. (2023) concluded that for encouraging PEV sales, "[s]pending on charging stations is more effective than spending on rebates," with shifting spending from rebates to charging station programs increasing projected EV penetration share in 2030 from 48% to 68%.[439] Similarly, Li (2017) found that, between 2011 to 2013, the federal income tax credit of up to $7,500 for EV buyers contributed to about 40% of EV sales, but "[a] policy of equal-sized spending but subsidizing charging station deployment could have been more than twice as effective in promoting EV adoption."[440] Using data from Norway, Springel (2021) found that spending on charging station subsidies, at least initially, resulted in more EV purchases than spending on consumer price subsidies.[441] Given the extensive investments in PEV infrastructure, detailed in Section XVII, PEV demand would be expected to be responsive to these investments, and increasing. Additionally, Herberz et al. (2022) studied BEV adoption and found that "car owners systematically underestimate the compatibility of available battery ranges with their annual mobility needs and that this underestimation is associated with increased

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[437] Kenneth T. Gillingham, Arthur A. van Benthem, Stephanie Weber, Mohamed Ali Saafi & Xin He, *Has Consumer Acceptance of Electric Vehicles Been Increasing? Evidence from Microdata on Every New Vehicle Sale in the United States*, American Economic Association: Papers & Proceedings 333–334 (May 2023).
[438] *Id.* at 334.
[439] Cassandra Cole, Michael Droste, Christopher Knittel, Shanjun Li & James Stock, *Policies for Electrifying the Light-Duty Fleet in the United States*, American Economic Association: Papers & Proceedings 320 (May 2023).
[440] Shanjun Li, Lang Tong, Jianwei Xing & Yiyi Zhou, *The Market for Electric Vehicles: Indirect Network Effects and Policy Design*, 4 Journal of the Association of Environmental and Resource Economists 89 (Jan. 2017).
[441] Katalin Springel, *Network Externality and Subsidy Structure in Two-Sided Markets: Evidence from Electric Vehicle Incentives*, American Economic Journal: Economic Policy 393, 425–426 (Nov. 2021).

demand for long battery ranges and reduced willingness to adopt electric vehicles."[442] Researchers found that simply providing tailored compatibility information increased consumer willingness to pay for BEVs, even more than information about easy access to charging infrastructure.

2. Consumer surveys also support broad and growing consumer acceptance of PEVs.

Many well-designed, real-world consumer surveys also confirm significant and growing consumer interest in purchasing PEVs. A report on a recent, nationally representative survey of 8,027 Americans conducted by Consumer Reports with input from the Union of Concerned Scientists, GreenLatinos, and EVNoire, conducted between January 27 and February 18, 2022, found that "[o]verall interest in EVs is high" across all racial demographics.[443] Between 33% and 52% of respondents (depending on racial demographics) would "definitely" or "seriously consider" purchasing or leasing an EV as their next vehicle.[444] Only 28% of Americans would not consider getting an electric-only vehicle if they were to buy or lease a vehicle today.[445] Even in rural areas, the survey showed that current interest in EV purchases is high, with up to 29% of rural drivers at least seriously considering buying or leasing an EV.[446] Between 2020 and 2022, Consumer Reports surveys have shown a 350% increase in consumer demand for BEVs.[447]

Survey responses in the 2022 Capital One Car Buying Outlook also overwhelmingly show that Americans envision a future in which they will be driving PEVs. Over 60% of American car buyers and 84% of American car dealers surveyed agreed that electric vehicles are

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[442] Mario Herberz, Ulf J. J. Hahnel & Tobias Brosch, *Counteracting Electric Vehicle Range Concern with a Scalable Behavioural Intervention*, Nature Energy 503 (2022).
[443] Consumer Reports, et al., *Survey Says: Considerable Interest in Electric Vehicles Across Racial, Ethnic Demographics: Smarter Policies Can Help Overcome Barriers* 2 (Sept. 2022), https://www.ucsusa.org/sites/default/files/2022-09/ev-demographic-survey_0.pdf.
[444] *Id.*
[445] Consumer Reports, *Battery Electric Vehicles & Low Carbon Fuel Survey: A Nationally Representative Multi-Mode Survey* 3 (Apr. 2022), https://article.images.consumerreports.org/image/upload/v1657127210/prod/content/dam/CRO-Images-2022/Cars/07July/2022_Consumer_Reports_BEV_and_LCF_Survey_Report.pdf. *See also* Lydia Saad, *Gallup Vault: Misjudging Cellphone Adoption* (Feb. 16, 2018), https://news.gallup.com/vault/227810/gallup-vault-misjudging-cellphone-adoption.aspx (noting that Americans have not always accurately judged their acceptance of future behavior and have underestimated their acceptance of newer technologies, with almost a quarter of Americans saying in 2000 that they had no intention of ever having a mobile phone).
[446] Maria Cecilia Pinto de Moura, *Survey Shows Pathway to Speeding Up EV Adoption in Rural Areas*, Union of Concerned Scientists (March 14, 2023), https://blog.ucsusa.org/cecilia-moura/survey-shows-pathway-to-speeding-up-ev-adoption-in-rural-areas/.
[447] Chris Harto, *Excess Demand: The Looming EV Shortage*, Consumer Reports 2, 4 (Mar. 2023), https://advocacy.consumerreports.org/wp-content/uploads/2023/03/Excess-Demand-The-Looming-EV-Shortage.pdf.

the future.[448] Additionally, 46% of car buyers already believe they will be driving an electric vehicle within the next 10 years.[449] The annual global EY Mobility Consumer Index found a similar level of consumer demand for and interest in PEVs, and also emphasized that this is a global trend with which the United States must keep pace in order to remain globally competitive. The investigation, conducted in March 2022, surveyed approximately 13,000 respondents from 18 countries including the United States on themes including EVs, mobility and travel behavior, and car buying. It found that preference for fully electric cars for those surveyed tripled between 2020 and 2022,[450] and 52% of global car buyers currently prefer their next car purchase to be an EV, PHEV, or hybrid vehicle.[451]

Very recent surveys from this year also show strong consumer interest in PEVs. KPMG's Consumer Pulse Summer 2023 survey of 1,000 Americans showed that nearly half of U.S. combustion vehicle owners are considering switching to PEVs or hybrid electric vehicles, prompted in large part by increasing gas prices and environmental concerns.[452] A 2023 online poll of 4,410 Americans by Reuters/Ipsos found that already just over a third of Americans would consider buying an EV for their next car purchase.[453] J.D. Power's most recent U.S. Electric Vehicle Consideration Study, released in June 2023, also found high interest in EVs. The study found the number of car buyers "very likely" and "overall likely" to consider purchasing an EV increased over 2002, with 26% of shoppers "very likely" and 61% "overall likely" to consider purchasing an EV.[454]

3. A "tipping point" in PEV adoption can signify rapid mass consumer acceptance, and the United States has reached this milestone.

Analysis from other countries shows that once 5% of a country's new car sales are electric—a threshold the United States has crossed—the country has reached an "electric-car

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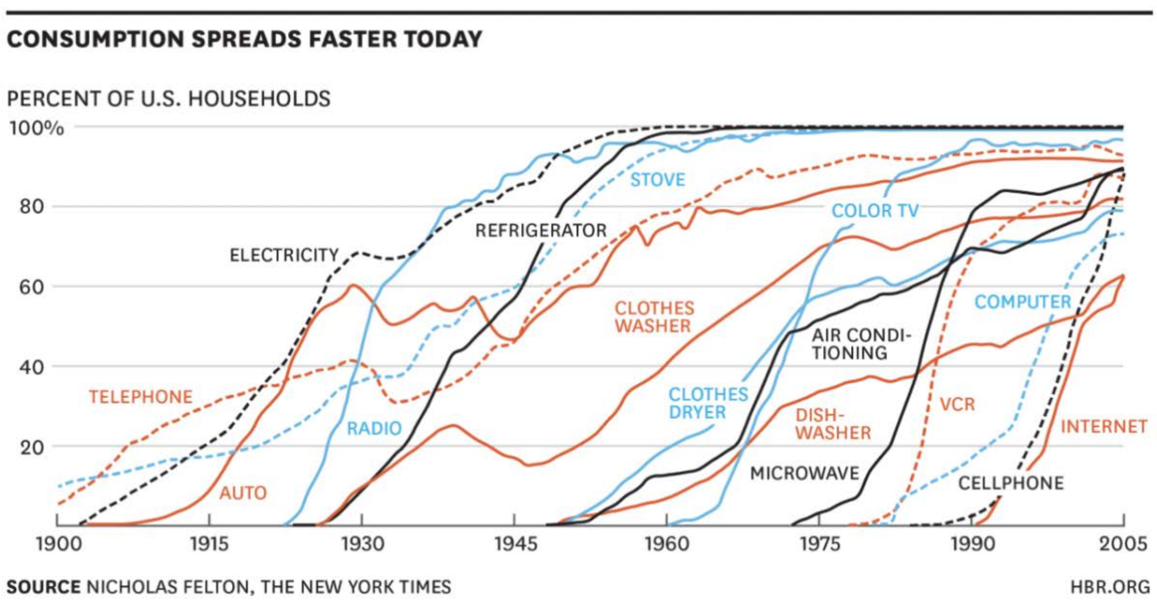
[448] Capital One, *19 Percent of Consumers Find Car Buying Process Transparent* (July 26, 2022), https://www.capitalone.com/about/newsroom/car-buying-outlook-deep-dive/ (summarizing findings of Capital One's 2022 Car Buying Outlook).
[449] *Id.*
[450] Gaurav Batra, Ankit Khatri, Akshi Goel & Menaka Samant, *EY Mobility Consumer Index 2022 Study* 4 (May 2022), https://assets.ey.com/content/dam/ey-sites/ey-com/en_gl/topics/automotive-and-transportation/automotive-transportation-pdfs/ey-mobility-consumer-index-2022-study.pdf.
[451] *Id.*
[452] KPMG, *Consumer Pulse Summer 2023 Report, Consumer & Retail* 3, 45–46 (Apr. 2023), https://advisory.kpmg.us/content/dam/advisory/en/pdfs/2023/consumer-pulse-summer-2023-report-april.pdf.
[453] David Shepardson, *One-Third of Americans Would Consider EV Purchase - Reuters/Ipsos Poll*, Reuters (Mar. 21, 2023), https://www.reuters.com/technology/one-third-americans-would-consider-ev-purchase-reutersipsos-poll-2023-03-21/; Ipsos, *Reuters/Ipsos Issues Survey March 2023* (March 24, 2023), https://www.ipsos.com/en-us/reutersipsos-issues-survey-march-2023.
[454] J.D. Power, *Action Needed to Keep Charging from Short Circuiting EV Purchase Consideration, J.D. Power Finds* (June 15, 2023), https://www.jdpower.com/business/press-releases/2023-us-electric-vehicle-consideration-evc-study.

tipping point" which "signals the start of mass EV adoption, the period when technological preferences rapidly flip."[455] So far, 18 countries have reached this "tipping point," and assuming the United States follows their trend, "a quarter of new car sales could be electric by the end of 2025. That would be a year or two ahead of most major forecasts."[456] This "tipping point" occurs because technologies generally follow an S-shaped adoption curve. "Sales move at a crawl in the early-adopter phase, then surprisingly quickly once things go mainstream….In the case of electric vehicles, 5% seems to be the point when early adopters are overtaken by mainstream demand. Before then, sales tend to be slow and unpredictable. Afterward, rapidly accelerating demand ensues."[457] This S-shaped pace of technology adoption has been observed for numerous emerging technologies since the early 1900s, including the telephone, the automobile, electricity, refrigeration, clothes washers and dryers, air conditioning, microwaves, computers, cellphones, and the internet, as Figure XIX.B-1 shows.[458]

Figure XIX.B-1. Consumption Spreads Faster Today[459]



[455] Tom Randall, *U.S. Crosses the Electric-Car Tipping Point for Mass Adoption* at 1, Bloomberg (July 9, 2022), https://www.bloomberg.com/news/articles/2022-07-09/us-electric-car-sales-reach-key-milestone; *See also* McKinsey & Company, *Why the Automotive Future is Electric* at 7 (Sept. 2021), https://www.mckinsey.com/~/media/mckinsey/industries/automotive%20and%20assembly/our%20insights/why%20the%20automotive%20future%20is%20electric/why-the-automotive-future-is-electric-f.pdf (noting that the global "tipping point in passenger EV adoption occurred in the second half of 2020, when EV sales and penetration accelerated in major markets despite the economic crisis caused by the COVID-19 pandemic").
[456] Tom Randall, *U.S. Crosses the Electric-Car Tipping Point for Mass Adoption* at 1, Bloomberg (July 9, 2022), https://www.bloomberg.com/news/articles/2022-07-09/us-electric-car-sales-reach-key-milestone.
[457] *Id.* at 3.
[458] Rita McGrath, *The Pace of Technology Adoption is Speeding Up*, Harvard Business Review (Nov. 25, 2013), https://hbr.org/2013/11/the-pace-of-technology-adoption-is-speeding-up.
[459] This figure is reproduced from *id.*

Moreover, the pace of adoption has been speeding up consistently across new technologies, as Figure XIX.B-1 also shows. For example, "[i]t took decades for the telephone to reach 50% of households, beginning before 1900. It took five years or less for cellphones to accomplish the same penetration in 1990."[460] The automotive industry has not been left out of this increasing speed of technological adoption, with automotive design cycles decreasing from 60 months to 24 or 36 months over a period of five years.[461]

Between 2021 and 2022, the United States reached this "tipping point" level of PEV penetration, jumping from 4% to over 7.6% PEV sales share.[462] As this tipping point is reached, it is likely that Americans' exposure to PEVs increases. Importantly, "studies show that increasing knowledge and exposure to these [electric] vehicles results in lasting, positive impressions."[463] A comprehensive literature review regarding consumer adoption of BEVs found that social interactions can influence BEV adoption.[464] Some consumers have no interest in purchasing a PEV simply because they lack information about the characteristics of PEVs, but when consumers learn about PEVs, they are more likely to be interested in purchasing one. For example, a study considering hybrid electric vehicle ("HEV") adoption—which "can be used as a proxy for future PEV adoption"—found that there is a strong "direct neighbor effect" by which each consumer's HEV-adoption decision can be influenced by the HEV-adoption decisions of geographic neighbors.[465] Another study, using a survey of vehicle customers in California and a spatial and statistical analysis, found that having more neighbors and work colleagues who have EVs increases EV adoption.[466] Yet another study using very rich data from Sweden found the same result: having more neighbors and work colleagues who drive EVs increases EV adoption. This study also explored reasons for the effect, finding that information transmission is likely very important.[467]

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[460] *Id.* See also Michael DeGusta, *Are Smart Phones Spreading Faster than Any Technology in Human History*, MIT Technology Review (May 9, 2012), https://www.technologyreview.com/2012/05/09/186160/are-smart-phones-spreading-faster-than-any-technology-in-human-history/ (showing that it took 25 years for telephones to reach a 10% adoption rate and an additional 39 years for telephones to reach a 40% penetration rate, but smart phones reached 40% penetration in just 10 years).

[461] Rita McGrath, *The Pace of Technology Adoption is Speeding Up*, Harvard Business Review (Nov. 25, 2013), https://hbr.org/2013/11/the-pace-of-technology-adoption-is-speeding-up.

[462] Colin McKerracher et al., *Electric Vehicle Outlook 2023*, BloombergNEF (June 8, 2023). Subscription required.

[463] CARB, *California's Advanced Clean Cars Midterm Review, Appendix B: Consumer Acceptance of Zero Emission Vehicles and Plug-In Hybrid Electric Vehicles* B-2 (Jan. 18, 2017), https://ww2.arb.ca.gov/sites/default/files/2020-01/appendix_b_consumer_acceptance_ac.pdf.

[464] M. Coffman et al., *Electric Vehicles Revisited: A Review of Factors that Affect Adoption*, Transp. Rev. 37, 79–93 (2017).

[465] X. Liu, M. Roberts & R. Sioshani, *Spatial Effects on Hybrid Electric Vehicle Adoption*, Transportation Research Part D: Transport and Environment 52A, at 86 (2017), https://www.osti.gov/pages/biblio/1346139.

[466] Debapriya Chakraborty, David S. Bunch, David Brownstone, Bingzheng Xu & Gil Tal, *Plug-In Electric Vehicle Diffusion in California: Role of Exposure to New Technology at Home and Work*, Transportation Research Part A: Policy and Practice 156, pp. 133-151 (2022).

[467] Sebastian Tebbe, *Peer Effects in (Hybrid) Electric Vehicle Adoption*, working paper, *see* https://sebastiantebbe.github.io/files/YST_Slides.pdf.

Survey data again corroborates this research. The 2022 Consumer Reports survey found that for all groups of consumers, "experience with EVs strongly correlated to interest in purchasing or leasing an EV."[468] The survey found, for example, that "Americans who are more likely to say that they will buy/lease an electric-only vehicle if they were to get a vehicle today have had more exposure to them. They see them where they live and have friends, relatives, or co-workers who own one."[469] In fact, 71% of those who said they would definitely buy or lease an EV if they were getting a vehicle today had seen EVs in their neighborhood, compared to 44% of all survey respondents.[470] "There is … a strong relationship between having some personal experience with an electric-only vehicle and the likelihood of buying or leasing one."[471] Seventeen percent of all survey respondents had been a passenger in an electric-only vehicle in the past 12 months, compared to 39% of people who said they would definitely buy or lease an electric-only vehicle if they were to buy or lease a vehicle today. Only 7% of survey respondents had driven an EV in the past 12 months, but 20% of those who would definitely buy or lease one have driven one.[472] Two surveys commissioned by the Consumer Federation of America to study consumer attitudes towards PEVs similarly found that "the more consumers know about PEVs, the more positive their attitudes towards them and the more likely they are to consider acquiring one."[473] And J.D. Power's 2023 U.S. Electric Vehicle Consideration Study found that the number of consumers reporting they are "very likely" to consider purchasing an EV was more than double for consumers who had ridden as a passenger in an EV compared to those with no personal experience with EVs.[474]

This exposure effect is also evident when reviewing the outcome of events specifically aimed at exposing potential buyers to PEVs. For example, research by CARB has found that "exposure to PEVs through ride and drive events or car-sharing programs seem to result in lasting, positive impressions and serve to be one of the most influential information sources for helping consumers decide on a PEV. Second to a vehicle test drive, another PEV driver is the

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[468] Consumer Reports, et al., *Survey Says: Considerable Interest in Electric Vehicles Across Racial, Ethnic Demographics: Smarter Policies Can Help Overcome Barriers* 2 (Sept. 2022), https://www.ucsusa.org/sites/default/files/2022-09/ev-demographic-survey_0.pdf.
[469] Consumer Reports, *Battery Electric Vehicles & Low Carbon Fuel Survey: A Nationally Representative Multi-Mode Survey* 7 (Apr. 2022), https://article.images.consumerreports.org/image/upload/v1657127210/prod/content/dam/CRO-Images-2022/Cars/07July/2022_Consumer_Reports_BEV_and_LCF_Survey_Report.pdf.
[470] *Id.*
[471] *Id.* at 8.
[472] *Id.*
[473] Consumer Federation of America, *New Data Shows Consumer Interest in Electric Vehicles Is Growing* (Sept. 19, 2016), https://consumerfed.org/press_release/new-data-shows-consumer-interest-electric-vehicles-growing/; Consumer Federation of America, *Knowledge Affects Consumer Interest in EVs, New EVs Guide to Address Info Gap* (Oct. 29, 2015), https://consumerfed.org/press_release/knowledge-affects-consumer-interest-in-evs-new-evs-guide-to-address-info-gap/.
[474] J.D. Power, *Action Needed to Keep Charging from Short Circuiting EV Purchase Consideration, J.D. Power Finds* (June 15, 2023), https://www.jdpower.com/business/press-releases/2023-us-electric-vehicle-consideration-evc-study.

other most influential information source for new buyers to choose a PHEV or BEV."[475] CARB explained that "[t]he impact of exposure to PEVs through participation in ride and drive events and carsharing programs has been shown to have a positive effect on attitudes towards PEVs and increase interest in PEV adoption."[476] Furthermore, "simply giving consumers more information on PEVs also increases their interest in acquiring one. A study analyzed the effect of providing information on fuel costs of different vehicle technologies for specific commuting patterns on attitudes regarding PEVs," and found that after utilizing an online tool that allowed users to compare fuel costs for different vehicles based on their own commuting patterns, local fuel prices, and charging opportunities, "[p]articipants reported a significantly greater intention to acquire a PEV."[477]

This "tipping point" concept, and the resulting wider PEV exposure when a location reaches the tipping point, is possibly already playing out in microcosms of high PEV sales within the nation. In California, for example—a state even further past this "tipping point" than the United States as a whole—sales of EVs reached more than 21% of all new vehicles sold in early 2023,[478] and at least one survey shows almost three-quarters of California vehicle shoppers say they are "overall likely" to consider an EV.[479] The phase of rapid PEV adoption also has already been underway in several individual cities. For example, 32.9% of monthly new vehicle registrations in the San Francisco metro area were EVs in January 2023, up from 26.7% in January 2022, and 17.2% of new vehicle registrations in Seattle were EVs in January 2023, up from 8.4% in January 2022.[480] Passenger EV sales shares for the first quarter of 2023 were 29.1% of sales in San Francisco and 20.7% of sales in Los Angeles.[481] In the New York City metro area in 2020, there were about three EVs per 1,000 people; today there are about seven EVs per 1,000 people—growth that has been "propelled by more varied models, more charging stations and lower prices."[482]

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[475] CARB, *California's Advanced Clean Cars Midterm Review, Appendix B: Consumer Acceptance of Zero Emission Vehicles and Plug-In Hybrid Electric Vehicles* B-39 (Jan. 18, 2017), https://ww2.arb.ca.gov/sites/default/files/2020-01/appendix_b_consumer_acceptance_ac.pdf.
[476] *Id*. at B-50 to B-51.
[477] *Id.* at B-52.
[478] Amy Chen, Yuri Avila & Dustin Gardiner, *EV Sales are Booming in California. Charts Show How Tesla is Quickly Losing Market Share*, San Francisco Chronicle (Apr. 26, 2023), https://www.sfchronicle.com/projects/2023/ev-tracker-california/.
[479] J.D. Power, *Action Needed to Keep Charging from Short Circuiting EV Purchase Consideration, J.D. Power Finds* (June 15, 2023), https://www.jdpower.com/business/press-releases/2023-us-electric-vehicle-consideration-evc-study.
[480] Emily Harris, *EVs Dominate San Francisco Market as Choices Expand*, Axios (Apr. 7, 2023), https://www.axios.com/local/san-francisco/2023/04/07/evs-tesla-dominate-san-francisco-market-brand-choices-expand; Melissa Santos & Joann Muller, *Electric Vehicle Adoption Doubles in Seattle*, Axios (Apr. 20, 2023), https://www.axios.com/local/seattle/2023/04/20/electric-vehicles-seattle-registrations.
[481] California Energy Commission, *New ZEV Sales in California*, https://www.energy.ca.gov/data-reports/energy-almanac/zero-emission-vehicle-and-infrastructure-statistics/new-zev-sales (filtered to show ZEV sales in San Francisco and Los Angeles counties).
[482] Robin Shulman Agueros, *Why the New York Area Is Seeing an Explosive Growth in Electric Cars*, New York Times (Mar. 7, 2023), https://www.nytimes.com/2023/03/05/nyregion/electric-vehicles-cars-nyc.html.

This concept could also shed light on one possible reason that PEV sales percentages have been unevenly distributed across the nation, with more sales in cities than rural areas, in a way that minimizes any concerns that rural consumers could have insufficient demand for PEVs. A 2023 survey conducted by the Union of Concerned Scientists and Consumer Reports "uncover[ed] that there isn't sufficient familiarity with EVs in rural areas. The overwhelming majority of respondents—96%—has never owned or leased an EV."[483] The survey found that only 6% of rural respondents said they were very familiar with the fundamentals of buying and owning an EV, while 30% said they were somewhat familiar, and concluded that "[o]ne of the reasons for this lack of familiarity could be the scarcity of EVs in rural areas: only 27% of rural dwellers have seen an EV in their neighborhood in the past month compared to more than half of urban dwellers, and even fewer have a friend, relative or co-worker who owns an EV. A whopping 90% of rural dwellers have never been a passenger in an EV, and almost nobody has ever driven one."[484] As efforts are made to increase familiarity with PEVs in rural areas, more Americans will learn about the very real benefits and advantages of PEVs, especially for rural drivers, *see* Section XIX.C.6 below, and this "neighbor effect" will begin to take hold in more places.

C. When considering the attributes consumers care about most, EVs are a great fit.

One of the reasons this "neighbor effect" may occur is because when consumers learn about PEVs, they often realize that PEVs offer a superior fit for the attributes they care about most in their driving and vehicle-owning experience. Forsythe et al. (2023) found that key factors Americans consider when purchasing vehicles and considering PEV options are operating cost, range, fast-charging capabilities, and performance characteristics such as acceleration.[485] Consumer surveys and other studies have found the same attributes, along with fuel economy, as key to purchase decisions.[486] As explained briefly in this section and in more detail in Sections

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[483] Maria Cecilia Pinto de Moura, *Survey Shows Pathway to Speeding Up EV Adoption in Rural Areas*, Union of Concerned Scientists (Mar. 14, 2023), https://blog.ucsusa.org/cecilia-moura/survey-shows-pathway-to-speeding-up-ev-adoption-in-rural-areas/.

[484] *Id.*

[485] Forsythe et al. (2023) at 1–2.

[486] *See, e.g.*, Consumer Reports, *Consumer Attitudes Towards Fuel Economy: 2020 Survey Results* 3-4, 6 (Feb. 2021), https://advocacy.consumerreports.org/wp-content/uploads/2021/02/National-Fuel-Economy-Survey-Report-Feb-2021-FINAL.pdf (showing high value placed on fuel economy in purchase decisions); Alexey Sinyashin, *Optimal Policies for Differentiated Green Products: Characteristics and Usage of Electric*, U.C. Berkeley Haas School of Business (Nov. 8, 2021) https://drive.google.com/file/d/1KEYJWa25DjH_g89ukSRW3PymjsTkUq4c/view (finding range and charging station availability as key elements in purchase decisions); J.D. Power, *EV Price Pressure Grows as Government Incentives and Lease Deals Wield Outsized Influence on Consumer Demand* (Mar. 29, 2023), https://www.jdpower.com/business/resources/ev-price-pressure-grows-as-government-incentives-and-lease-deals-wield-outsized-influence-on-consumer-demand#:~:text=At%20the%20current%20trajectory%2C%20J.D..is%20expected%20to%20surpass%2075%25 ("Consumer interest in EVs is increasingly being heavily swayed by price"); Consumer Reports, *Consumer Attitudes Towards Fuel Economy: 2020 Survey Results* 6 (Feb. 2021), https://advocacy.consumerreports.org/wp-content/uploads/2021/02/National-Fuel-Economy-Survey-Report-Feb-2021-FINAL.pdf (finding that 94% of potential vehicle purchasers considered fuel economy to be "extremely important," "very important," or "somewhat important" when purchasing a vehicle).

XIX.C and XX, PEVs offer superior satisfaction of these consumer preferences. Any existing or perceived barriers to PEV adoption based on consumer acceptance are either minimal or surmountable, policies are already in place to support rapid elimination of any remaining barriers, and the pace of PEV incorporation into the fleet will allow for consumer preferences to be fulfilled.

1. PEVs are increasingly favorable from a total cost of ownership perspective and save drivers money over the life of the vehicle. As more models become available, this benefit will be accessible to more consumers.

First, PEVs are increasingly favorable from an operating cost and total cost of ownership (TCO) perspective—a factor that is very important to U.S. consumers when deciding which vehicles they want to buy. A 2020 nationally representative survey of potential vehicle purchasers found that 94% of potential purchasers considered fuel economy to be important when purchasing a vehicle.[487] PEVs excel in the area of fuel cost savings. As EPA's Proposal shows, the incremental costs of PEVs over combustion vehicles are increasingly insignificant or nonexistent—especially in light of various state and federal incentives—resulting in PEVs saving drivers money in very short periods of time. And as operating costs are reduced, consumers are willing to pay more for their vehicles. Forsythe et al. (2023) found car buyers willing to pay upfront an additional $1,960 per 1 cent/mile reduction in operating cost, and SUV buyers willing to pay an additional $1,490.[488] The paper also found that any perceived PEV disadvantages were made up for by favorable operating costs (along with fast-charging capability), and that lower operating costs "can help increase consumer adoption."[489] Forsythe et al. (2023) further found that reductions in the BEV price-premium, which are projected to occur, "have driven substantial increases in consumer choices of BEV cars and SUVs over their conventional gasoline vehicle counterparts."[490] A March 2023 J.D. Power survey reflected one example of this consumer responsiveness to price, finding that consumer interest in the Ford Mustang Mach-E and Tesla Model Y measurably increased when both manufacturers announced price drops and both models were made eligible for the IRA's $7,500 federal tax credit.[491] A June 2023 J.D. Power survey also indicated that consumers are recognizing these savings, finding that "[t]he more miles that vehicle owners drive, the more likely they are to consider an EV. As in

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[487] Consumer Reports, *Consumer Attitudes Towards Fuel Economy* at 3-4, 6.
[488] Forsythe et al. (2023) at 5.
[489] Forsythe et al. (2023) at 1–2, 6 (assuming sufficiently long range).
[490] Forsythe et al. (2023) at 2.
[491] J.D. Power, *EV Price Pressure Grows as Government Incentives and Lease Deals Wield Outsized Influence on Consumer Demand* (Mar. 29, 2023), https://www.jdpower.com/business/resources/ev-price-pressure-grows-as-government-incentives-and-lease-deals-wield-outsized-influence-on-consumer-demand#:~:text=At%20the%20current%20trajectory%2C%20J.D.,is%20expected%20to%20surpass%2075%25.

prior-year studies, daily commuters faced with higher fuel expenses are trading in their gas-powered vehicles for EVs."[492]

Up until recently, nearly all PEV models on the market were sedans or hatchbacks, or vehicles in the luxury car segment of the market,[493] leaving vehicle purchasers looking for other types of vehicles without many options. But dozens of new models are entering the market in the next year, in all vehicle segments.[494] Additional PEV model availability will provide a wider range of price points and greater diversity of vehicle types and features for potential PEV purchasers, further driving down average PEV costs and resulting in a PEV "fit" superior to a comparable combustion vehicle for more consumers. Research by ICCT has shown that "[g]reater availability of models in more vehicle segments and in higher volumes that meet consumers' wide range of needs and preferences is critical to market growth," and "states with greater model availability tend to have higher electric vehicle uptake."[495] In recent years, average PEV costs have appeared higher than average combustion vehicle costs because many PEVs have been offered only in the luxury vehicle market. Gillingham et al. (2023)'s review of its dataset containing every new LDV sale in the United States between 2014 and 2020 revealed that, during that time period, "the market share of EVs and PHEVs is quite high in several price brackets at the high end, but the number of vehicles sold in these high price brackets is relatively small," and that "EVs *can* make up a large market share in the U.S. new car market," and "there is a great deal of untapped product space for EVs in the lower price brackets."[496] Drivers of non-luxury vehicles want PEVs—and their benefits—as well. Automakers understand this demand and are expanding their PEV options, and an appropriately stringent rule by EPA will go further to accelerate this trend by offering automakers regulatory certainty.

Already, the number of light-duty PEV options has grown dramatically. The Alliance for Automotive Innovation states that at the end of 2022, there were 95 PEV models available in the United States.[497] More models are forthcoming, including additional truck and SUV models

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[492] J.D. Power, *Action Needed to Keep Charging from Short Circuiting EV Purchase Consideration, J.D. Power Finds* (June 15, 2023), https://www.jdpower.com/business/press-releases/2023-us-electric-vehicle-consideration-evc-study.

[493] *See, e.g.*, Gillingham et al. (2023) at 329, 332–333 (noting that EVs are overrepresented in the luxury market segments and that in the hatchback category—"a small market segment with a relatively large number of EV offerings"—sales of PEVs have been "close to 15% of the market in some years").

[494] Jeff S. Bartlett & Ben Preston, *Automakers are Adding Electric Vehicles to Their Lineups. Here's What's Coming*, Consumer Reports (Mar. 10, 2023), https://www.consumerreports.org/hybrids-evs/why-electric-cars-may-soon-flood-the-us-market-a9006292675/.

[495] Anh Bui, Peter Slowik & Nic Lutsey, *Briefing: Evaluating Electric Vehicle Market Growth Across U.S. Cities*, ICCT 13-14 (Sept. 2021), https://theicct.org/wp-content/uploads/2021/12/ev-us-market-growth-cities-sept21_0.pdf.

[496] Gillingham et al. (2023) at 331–332.

[497] Alliance for Automotive Innovation, *Get Connected: Electric Vehicle Quarterly Report, First Quarter, 2023* 2 (2023), https://www.autosinnovate.org/posts/papers-reports/Get%20Connected%20EV%20Quarterly%20Report%202023%20Q1.pdf.

along with the expansion of a wider range of EV sedans.[498] EPA's Proposal notes research by EDF and ERM projecting that there will be over 180 PEV models available by the end of 2025, 88 Fed. Reg. at 29190 n.59, but EDF and ERM have since updated their analysis and now project that there will be 197 PEV models available by the end of 2025.[499] Many of the world's largest automakers have committed to significantly expanding PEV production in the next few years, even absent additional standards,[500] which will naturally lead to a larger array of model choices. For example, BMW, Volkswagen, and Stellantis have each committed to fleets half comprised of zero-emission vehicles by 2030.[501] Mercedes-Benz, Ford, and GM have committed to an entirely zero-emission fleet by 2035.[502] Volvo announced its fleet will be all electric by the end of the decade.[503] J.D. Power's EV Index and EV Consideration Pulse Survey found that half of all new car shoppers will have a viable EV option by the end of 2023, and three out of four shoppers will have a viable EV option by the end of 2026.[504]

2. PEVs offer meaningful refueling (charging) benefits to consumers.

Americans are interested in how quickly they can refuel their vehicles. Again, PEVs have real advantages that should not be underestimated. While opponents to PEVs frequently assert what they believe will be fundamental changes to how Americans get to work, school, and run errands, a closer look at the issue reveals that PEVs can offer meaningful benefits. Most trips are well below the average PEV range, and charging for these trips can often be done when vehicles are parked at home, work, or in public in between trips. In fact, recent research has shown that 90% of trips could be completed in vehicles with 124 miles of range—well below the capabilities of the current average EV range in the United States (almost 300 miles).[505] Even as of 2016, researchers at MIT found that electric vehicles at the time could handle almost 90% of all car travel in the U.S.[506]

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[498] Consumer Reports, *Hot, New Electric Cars That Are Coming Soon* (June 9, 2023), https://www.consumerreports.org/cars/hybrids-evs/hot-new-electric-cars-are-coming-soon-a1000197429/.

[499] Rachel MacIntosh et al., *Electric Vehicle Market Update*, Environmental Defense Fund and ERM 7 (Apr. 2023), https://www.edf.org/sites/default/files/2023-05/Electric%20Vehicle%20Market%20Update%20April%202023.pdf.

[500] Zifei Yang, *Beyond Europe: Are There Ambitious Electrification Targets Across Major Markets?*, Int'l Council on Clean Transp. Staff Blog (Nov. 15, 2022), https://theicct.org/global-oem-targets-cars-ldvs-nov22/.

[501] *Id.*

[502] *Id.*

[503] *Id.*

[504] J.D. Power, *EV Price Pressure Grows as Government Incentives and Lease Deals Wield Outsized Influence on Consumer Demand* (Mar. 29, 2023), https://www.jdpower.com/business/resources/ev-price-pressure-grows-as-government-incentives-and-lease-deals-wield-outsized-influence-on-consumer-demand#:~:text=At%20the%20current%20trajectory%2C%20J.D.,is%20expected%20to%20surpass%2075%25.

[505] Mario Herberz, Ulf J. J. Hahnel & Tobias Brosch, *Counteracting Electric Vehicle Range Concern with a Scalable Behavioural Intervention*, Nature Energy 503 (2022) (finding that 90% of trips could be completed in vehicles with 124 miles of range); Tom Randall, *Americans Insist on 300 Miles of EV Range. They're Right*, Bloomberg (May 4, 2023), (noting that U.S. EVs have almost reached 300 mile average range).

[506] Catherine Caruso, *Why Range Anxiety for Electric Cars is Overblown*, MIT Technology Review (Aug. 15, 2016), https://www.technologyreview.com/2016/08/15/158319/why-range-anxiety-for-electric-cars-is-overblown/.

Drivers with access to a garage or dedicated overnight parking spot may simply charge at home while they sleep, and most do. EY's Mobility Consumer Index 2022 survey found that 80% of EV owners use home charging,[507] and other research has found that more than half of all reported EV charging takes place at home.[508] Once a home charger is installed, "the home then has its own permanent home refueling station that can likely be used with all future PEVs."[509] Substantial investments in infrastructure incentives will help to reduce any consumer concerns over range or charging availability. About half of Americans (49%) say "discounts to install a home charger" are the incentives that would most encourage them to get an EV.[510] The Inflation Reduction Act extended the EV charger credit, which covers 30% (up to $1,000 per unit) of the cost of charging equipment for individual/residential uses. *See* 26 U.S.C. § 30C. Many states and local jurisdictions offer additional installation incentives that can further reduce costs.

Furthermore, "[e]lectric vehicles have the meaningful advantage of refueling at a far wider array of locations than gasoline stations."[511] Gas stations "must be carefully located to achieve scale economies to pay for expensive sturdy buried fuel storage tanks, environmental and safety protection methods, and gas pumps. In contrast, PEVs can charge at millions of potential home, work, or public locations."[512] And, with increasing numbers of chargers available in places where drivers otherwise spend their time, "drivers can simply plug in and charge at a variety of locations where they would naturally park their vehicle for long periods of time."[513] Recently, Walmart announced plans to install new BEV fast-charging stations at thousands of Walmart and Sam's Club locations across the country, in addition to the 1,300 BEV fast-charging stations the retailer has already made available.[514] Other retailers already offering significant levels of BEV charging include 7-Eleven, Cinemark, Ikea, Kohl's, Kroger, Macy's, Starbucks,

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[507] Gaurav Batra, Ankit Khatri, Akshi Goel & Menaka Samant, *EY Mobility Consumer Index 2022 Study* 5 (May 2022), https://assets.ey.com/content/dam/ey-sites/ey-com/en_gl/topics/automotive-and-transportation/automotive-transportation-pdfs/ey-mobility-consumer-index-2022-study.pdf.

[508] Rob Stumpf, *Americans Cite Range Anxiety, Cost as Largest Barriers for New EV Purchases: Study* (Feb. 26, 2019), https://www.thedrive.com/news/26637/americans-cite-range-anxiety-cost-as-largest-barriers-for-new-ev-purchases-study.

[509] David P. Tuttle & Ross Baldick, *Technological, Market and Policy Drivers of Emerging Trends in the Diffusion of Plug-In Electric Vehicles in the U.S.*, Electr. J. 7 (Aug./Sept. 2015), https://users.ece.utexas.edu/~baldick/papers/plugindiffusion.pdf.

[510] Consumer Reports, *Battery Electric Vehicles & Low Carbon Fuel Survey: A Nationally Representative Multi-Mode Survey* 4 (Apr. 2022), https://article.images.consumerreports.org/image/upload/v1657127210/prod/content/dam/CRO-Images-2022/Cars/07July/2022_Consumer_Reports_BEV_and_LCF_Survey_Report.pdf.

[511] Tuttle & Baldick (2015) at 7.

[512] *Id.*

[513] *Id.*

[514] Vishal Kapadia, *Leading the Charge: Walmart Announces Plan to Expand Electric Vehicle Charging Network*, Walmart (Apr. 6, 2023), https://corporate.walmart.com/newsroom/2023/04/06/leading-the-charge-walmart-announces-plan-to-expand-electric-vehicle-charging-network (noting that this will offer customers and members the convenience of "being able to pick up essentials for their families or grab a bite to eat while they charge").

Subway, Taco Bell, Walgreens, and Whole Foods.[515] PlugShare's charger locator can be searched based on various types of charging locations, revealing chargers at hiking, dining, shopping, camping, park, and grocery locations throughout the country.[516] As far back as 2015, drivers who parked on the street could access street lights for charging in some dense urban areas,[517] and this cost-effective technology[518] is expanding in Europe and the United States, with U.S. pilot programs in New York, Charlotte, and Kansas City,[519] and a large number of BEV charging stations on streetlight poles in Los Angeles.[520] In addition, experts anticipate that charging equipment will increasingly be distributed widely throughout apartment building and multi-family garages.[521] Research on parking has found that the average car is parked for 95% of its useful life,[522] leaving plenty of time to charge in a large variety of locations. As these public chargers increase, PEVs become a viable and attractive option for more drivers, including those without access to easy home-charging.[523]

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[515] Dan Avery, *12 Places That Offer EV Charging While You Shop*, CNET (Apr. 19, 2023), https://www.cnet.com/roadshow/news/12-places-that-offer-ev-charging-while-you-shop/.

[516] PlugShare, Map of EV Charging Locations, https://www.plugshare.com/.

[517] *See* Tuttle & Baldick (2015) at 8 ("Charging cords with wireless revenue-grade meters that plug into street lights are now offered for drivers who park on the street in dense urban areas.").

[518] Research by WRI found that compared to ground-mounted chargers, pole-mounted chargers result in installation cost savings of up to 55% and overall cost reductions of 30% because they use existing electrical connections and have minimal costs associated with construction, materials, and labor. *See* Emmett Werthmann & Vishant Kothari, *Pole-Mounted Electric Vehicle Charging: Preliminary Guidance for a Low-Cost and More Accessible Public Charging Solution for U.S. Cities*, World Resources Institute 12 (Nov. 2021), https://files.wri.org/d8/s3fs-public/2021-11/pole-mounted-electric-vehicle-charging-preliminary-guidance.pdf?VersionId=xNjP5je_Ohc5WnFVVCbxWGmmk_vMIqpu.

[519] Jay Ramey, *Are Lamppost EV Chargers Ideal for City Dwellers?*, Autoweek (Jan. 23, 2023), https://www.autoweek.com/news/green-cars/a42618155/ubitricity-lamppost-ev-chargers-curbside/; EVANNEX, *Study Finds On-Street Lampost EV Chargers Are Lowest-Carbon Solution*, Inside EVs (Nov. 5, 2022), https://insideevs.com/news/619989/using-lamposts-for-ev-charging-reduces-carbon-footprint/.

[520] Bradley Berman, *LA Adds Hundreds of EV Chargers to Streetlights, Giving Renters a Place to Plug In*, Electrek (Nov. 13, 2019), https://electrek.co/2019/11/13/la-adds-hundreds-of-ev-chargers-to-streetlights-giving-renters-a-place-to-plug-in/ (noting over 130 EV chargers on streetlights as of 2019); LA Lights, *EV Charging Stations*, https://lalights.lacity.org/connected-infrastructure/ev_stations.html (map showing streetlight chargers across Los Angeles); Emmett Werthmann & Vishant Kothari, *How Utility Poles and Streetlights Can Improve Equitable Access to EV Charging in U.S. Cities*, The City Fix, World Resources Institute (Nov. 30, 2021), https://thecityfix.com/blog/how-utility-poles-and-streetlights-can-improve-equitable-access-to-ev-charging-in-u-s-cities/ (noting 431 streetlight chargers and 44 utility pole chargers in Los Angeles and a pilot project in Charlotte, North Carolina).

[521] Joshua Stein, *How Electric Cars Might Affect Multifamily And Other Real Estate*, Forbes (May 25, 2023), https://www.forbes.com/sites/joshuastein/2023/05/25/how-electric-cars-will-affect-multifamily-and-other-real-estate/?sh=59d16f66317c.

[522] Ruth Eckdish Knack, *Pay As You Park*, Planning Magazine (May 2005), http://shoup.bol.ucla.edu/PayAsYouPark.htm#:~:text=%22Most%20people%20in%20transportation%20focus,learn%20from%20that%2095%20percent.

[523] Cassandra Cole, Michael Droste, Christopher Knittel, Shanjun Li & James Stock, *Policies for Electrifying the Light-Duty Fleet in the United States*, American Economic Association: Papers & Proceedings 321 (May 2023) (noting that "providing additional [public] charging stations enables EV ownership" for more drivers).

PEV charging is increasingly taking less time, further enhancing the convenience benefits of PEV ownership. Hyper-fast Level 3 DC fast chargers can charge a BEV in as little as 30 minutes or less, adding up to 10 miles of range for each minute of charging time,[524] and consumers have expressed strong willingness-to-pay for this capability.[525] Research has shown that availability of more fast-chargers "reduce[s] range anxiety and make[s] it possible to use EVs in the way that drivers now use ICEs."[526]

PEV charging has additional benefits on top of saving drivers money and eliminating weekly trips to the gas pump. First, PEVs with bi-directional charging capability have potential to serve as back-up home generators in temporary power outages, with a typical BEV storing about 67 kWh in its battery—more than three days' worth of electricity.[527] In fact, when a 2021 ice storm in Texas left millions of residents without electricity, Ford "lent out their hybrid F-150s as home generators."[528] More makes and models are expected to offer bi-directional charging,[529] with the potential that this capability becomes the norm. Additionally, vehicle-to-grid (V2G) charging offers potential benefits for both the grid and PEV owners. RMI found that by 2030, "virtual power plants" including parked vehicles supplying energy to the grid could reduce peak loads in the United States by 60 gigawatts.[530] As this capability continues to develop, there could be additional "revenue opportunities for PEV owners for providing these grid services."[531] Research in Germany has shown that bidirectional EV charging can generate significant revenue for the typical German household: between 310 and 530 euros per year.[532] A recent successful vehicle-to-grid demonstration in North Carolina, taking place over two years, reveals the potential for V2G not only to improve grid optimization and resilience, but also to save

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[524] Electrify America, *Charging with Electrify America*, https://www.electrifyamerica.com/what-to-expect/ (noting full charging in 30 minutes); Jessica Shea Choksey, *What is DC Fast Charging?*, J.D. Power (May 10, 2021), https://www.jdpower.com/cars/shopping-guides/what-is-dc-fast-charging (noting ability to charge to 80% "in anywhere from 15 minutes to 45 minutes"); DriveClean, *Electric Car Charging Overview*, CARB https://driveclean.ca.gov/electric-car-charging (noting that DC fast charging can add "up to 10 miles of range per minute of charging time"); ICCT, *Five Things You Know About Electric Vehicles That Aren't Exactly True* (July 19, 2021), https://theicct.org/stack/explaining-evs/ (high-powered DC fast chargers can charge a long-range EV in 20–36 minutes).

[525] Forsythe et al. (2023) at 5 (noting additional willingness to pay $4,140 for BEV fast charging capability).

[526] Cassandra Cole, Michael Droste, Christopher Knittel, Shanjun Li & James Stock, *Policies for Electrifying the Light-Duty Fleet in the United States*, American Economic Association: Papers & Proceedings 321 (May 2023).

[527] Michael J. Coren, *Electric Vehicles Can Now Power Your Home for Three Days*, Washington Post (Feb. 17, 2023), https://www.washingtonpost.com/climate-environment/2023/02/07/ev-battery-power-your-home/.

[528] *Id.*

[529] *Id.* (noting that makers of the Hyundai Ioniq 5, Lucid Air, Kia EV6, VW ID.4, Mitsubishi Outlander, and Chevy Silverado EV, in addition to Ford's F-150, have announced plans for offering electricity services in the next year or so).

[530] *Id.*; Kevin Brehm, Avery McEvoy, Connor Usry & Mark Dyson, *Virtual Power Plants, Real Benefits*, Rocky Mountain Institute (2023), https://rmi.org/insight/virtual-power-plants-real-benefits/.

[531] Tuttle & Baldick (2015) at 11 (citing Quinn, C. et al., *The Effect of Communication Architecture on the Availability, Reliability and Economics of Plug In Hybrid Vehicle-to-Grid Charging*, 195 J. Power Sources 1500-1509 (Mar. 5, 2010)).

[532] Timo Kern, Patrick Dossow & Elena Morlock, *Revenue Opportunities by Integrating Combined Vehicle-to-Home and Vehicle-to-Grid Applications in Smart Homes*, 307 Applied Energy 1 (Feb. 2022), https://www.sciencedirect.com/science/article/pii/S0306261921014586.

consumers money. The North Carolina Clean Energy Technology Center explained that "[q]uantifying the potential value streams from bidirectional charging allows utilities to begin considering incentive payments and other EV program options for customers and members. By demonstrating significant positive value, this study encourages utilities in similar market conditions to help customers overcome the financial barriers to purchasing an EV, particularly in low- and moderate-income areas where these costs may restrict EV adoption."[533] The University of Delaware has partnered with local electric utilities and a regional transmission organization to have their vehicles plugged in and available when called upon for grid support, with the transmission organization paying the university the market rate, or roughly $1,200 per year per BEV.[534] Research by NREL has also considered net revenue generation from V2G services, including from private LDVs, and found significant potential.[535]

3. PEV range has increased enough to meet the demands of nearly all American car trips.

American consumers are interested in how far their cars can travel, as Americans currently drive an above average number of vehicle miles per day (compared to the rest of the world),[536] and demand "roughly a third more [range] than the global average."[537] While range was therefore once a key challenge for PEV adoption, it is no longer. In fact, "many EVs are approaching the range of an average gasoline vehicle," and "the combined electric and gasoline range for PHEVs often exceeds gasoline-only vehicles."[538]

The average BEV range has skyrocketed in recent years, making range issues no longer a real concern. Average BEV range reached 298 miles in MY 2021, "or about four times the range of an average EV in 2011,"[539] when range was in fact a real concern. Longer-range BEVs are available for consumers with more substantial driving needs,[540] PEVs are becoming more

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[533] North Carolina Clean Energy Technology Center, *NC Cooperative Demonstration of Vehicle-to-Grid Smart Charger Concludes with Positive Results* (May 8, 2023), https://nccleantech.ncsu.edu/2023/05/08/nc-cooperative-demonstration-of-vehicle-to-grid-smart-charger-concludes/.

[534] U.S. Department of Energy, Federal Energy Management Program, *Bidirectional Charging and Electric Vehicles for Mobile Storage*, https://www.energy.gov/femp/bidirectional-charging-and-electric-vehicles-mobile-storage.

[535] Darlene Steward, *Critical Elements of Vehicle-to-Grid (V2G) Economics*, NREL (Sept. 2017), https://www.nrel.gov/docs/fy17osti/69017.pdf.

[536] Bryn Huxley-Reicher, *Fact File: Americans Drive the Most*, Frontier Group (Feb. 14, 2022), https://frontiergroup.org/resources/fact-file-americans-drive-most/.

[537] Tom Randall, *Americans Insist on 300 Miles of EV Range. They're Right*, Bloomberg (May 4, 2023).

[538] EPA, *The 2022 EPA Automotive Trends Report: Greenhouse Gas Emissions, Fuel Economy, and Technology Since 1975* E-2, 60 (Dec. 2022), https://www.epa.gov/system/files/documents/2022-12/420r22029.pdf (finding that the efficiency of EVs has increased by about 18% in the last ten years).

[539] *Id.* at 60.

[540] *See, e.g.*, Nicholas Wallace et al., *Longest Range Electric Cars for 2023, Ranked*, Car and Driver (Mar. 23, 2023), https://www.caranddriver.com/features/g32634624/ev-longest-driving-range/ (listing U.S. PEVs with longest driving range).

efficient,[541] and several PHEVs exceed 500 miles of total range.[542] The well-designed stated-preference experiment conducted by Forsythe et al. (2023) found that "[m]ost vehicles with a range of at least 300 miles were valued by consumers equivalently or more than their conventional gasoline vehicle counterparts."[543] BEV range is "on the cusp of exceeding 300 miles, a key psychological barrier."[544] This level of range handily fulfills the needs and preferences of almost every American driver. The average U.S. one-way commute is about 27.6 minutes,[545] and the average single-car American household drives about 30 miles per day[546]—both well within the range of all PEVs in today's vehicle market. ICCT has explained that "87% of American car drivers drive on average less than 100 kilometers (60 miles) a day—that is, only half the range capacity of the e-Golf, one third of the Leaf's, and less than a quarter of the Tesla's range on a single charge."[547] Chakraborty et al. (2021) examined how much PEVs were used within households, and concluded that "BEVs and PHEVs appear to be viable as alternatives to conventional vehicles in terms of meeting the travel needs of households," and that "[s]ince most new and upcoming BEVs are longer-range vehicles, we expect this to mean BEVs will largely be suitable replacements for conventional vehicles in household fleets."[548]

As consumer understanding of the capabilities inherent in this amount of range increases, range anxiety would be expected to decline and consumer acceptance of PEVs to match the vehicles' other benefits. Forsythe et al. (2023) explained that range increase is a key advancement in BEV technology that has "driven substantial increases in consumer choices of BEV cars and SUVs over their conventional gasoline vehicle counterparts."[549] And Herberz et al. (2022) found that 90% of trips could be completed in cars with less than half of the current U.S. average range, but that most drivers do not understand this.[550] Surveys by automakers have also found that range anxiety is the largest factor in consumers refraining from purchasing PEVs, explaining that drivers can be fearful they will run out of power before being able to recharge

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[541] EPA, *The 2022 EPA Automotive Trends Report*, at 60.
[542] *Id.* at E-2.
[543] Forsythe et al. (2023) at 6.
[544] Tom Randall, *Americans Insist on 300 Miles of EV Range. They're Right*, Bloomberg (May 4, 2023).
[545] Charlynn Burd et al., *Travel Time to Work in the United States:2019*, U.S. Census Bureau 1 (2019), https://www.census.gov/content/dam/Census/library/publications/2021/acs/acs-47.pdf.
[546] U.S. Department of Energy, *Daily Vehicle Miles Traveled Varies with the Number of Household Vehicles* (Sept. 17, 2018), https://www.energy.gov/eere/vehicles/articles/fotw-1047-september-17-2018-daily-vehicle-miles-traveled-varies-number.
[547] ICCT, *Five Things You Know About Electric Vehicles That Aren't Exactly True* (July 19, 2021) https://theicct.org/stack/explaining-evs/.
[548] Debapriya Chakraborty, Scott Hardman & Gil Tal, *Integrating Plug-In Electric Vehicles (PEVs) into Household Fleets – Factors Influencing Miles Traveled by PEV Owners in California*, U.C. Davis 2, 33 (Aug. 2021), https://escholarship.org/content/qt2214q937/qt2214q937.pdf.
[549] Forsythe et al. (2023) at 1-2.
[550] Herberz et al. (2022) at 503, 506–507. *See also* Jennifer Sensiba, *Putting Two Ford Announcements Together Shows Us How It Thinks About EV Range* (May 29, 2023), https://cleantechnica.com/2023/05/29/putting-two-ford-announcements-together-shows-us-how-it-thinks-about-ev-range/ (noting that 90% of all drives are within range of home).

their vehicles, though some of these surveys were conducted in 2019 or earlier, when average PEV ranges were lower.[551] Simply providing tailored compatibility information regarding the ability of BEVs to fulfill drivers' range needs increased willingness to pay for BEVs even more than information about easy access to charging infrastructure.[552]

Even for longer travel and trips in excess of the average daily drive—which make up a very small percentage of U.S. driving—PEVs provide a good fit for most consumers' needs and wants. U.S. Bureau of Transportation Statistics data shows that trips longer than 250 miles make up a miniscule fraction of U.S. daily driving. In 2022, U.S. drivers took between 1.3 billion and 1.5 billion vehicle trips per day, with fewer than 2 million trips per day 500 miles or longer and between about 1.5 million and 2.5 million trips per day between 250 and 500 miles.[553] Charging infrastructure is rapidly developing to support this small percentage of longer drives. As Section XVII explains, the number of public PEV charging stations is growing rapidly,[554] and the BIL and IRA are funding new PEV charging corridors. Alternative Fuels Data Center's map of nationwide PEV charging stations shows that already—with 8.3% PEV sales penetration in the first quarter of 2023[555]—charging stations are widespread.[556] In May, U.S. and Canadian officials announced the first Binational EV Corridor, covering a nearly 900-mile stretch between the United States and Canada, with PEV chargers every 50 miles.[557] Similarly, last year four states announced plans to build a 1,100-mile PEV charging circuit along Lake Michigan.[558] In Washington, Oregon, and California, the West Coast Electric Highway provides DC fast charging stations every 25 to 50 miles along Interstate 5, Highway 99, and other major roadways.[559] Electrify America's DC fast-charging network includes two cross-country routes (one from Los Angeles to Washington, DC, and another from San Diego to Jacksonville), along with a route covering much of the East Coast on Interstate 95 (from Portland, Maine to Miami,

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551 Rob Stumpf, *Americans Cite Range Anxiety, Cost as Largest Barriers for New EV Purchases: Study*, The Drive (Feb. 26, 2019), https://www.thedrive.com/news/26637/americans-cite-range-anxiety-cost-as-largest-barriers-for-new-ev-purchases-study.

552 Herberz et al. (2022) at 503.

553 *See* U.S. Bureau of Labor Statistics, *Trips by Distance Band*, https://www.bts.gov/browse-statistical-products-and-data/covid-related/trips-distance-groupings-national-or-state.

554 Alternative Fuels Data Center, *Alternative Fueling Station Locator*, https://afdc.energy.gov/stations/#/analyze?country=US&fuel=ELEC&ev_levels=all&access=public&access=private (noting 57,882 station locations and 155,449 EVSE ports available) (last accessed June 30, 2023); *see also* EPA, *The 2022 EPA Automotive Trends Report*, at E-2.

555 Argonne National Laboratory, *Light Duty Electric Drive Vehicles Monthly Sales Updates*, https://www.anl.gov/esia/light-duty-electric-drive-vehicles-monthly-sales-updates.

556 Alternative Fuels Data Center, *Electric Vehicle Charging Station Locations*, https://afdc.energy.gov/fuels/electricity_locations.html#/find/nearest?fuel=ELEC.

557 Kalea Hall, *EV Corridor to Run Nearly 900 Miles from Kalamazoo to Quebec, US and Canada Officials Say*, The Detroit News (May 16, 2023), https://www.detroitnews.com/story/business/autos/2023/05/16/binational-ev-corridor-to-run-860-miles-from-kalamazoo-to-quebec/70224111007/.

558 *Id*.

559 West Coast Green Highway, *West Coast Electric Highway*, http://www.westcoastgreenhighway.com/electrichighway.htm.

Florida), and most of the West Coast along Interstate 5 (from Seattle, Washington to San Diego, California).[560] GM and Pilot Company just announced plans to collaborate on a national DC fast charging network of 2,000 charging stalls at up to 500 travel centers across the country, to "help enable long-distance electric travel of people and vehicles across the U.S."[561] These chargers will be capable of the fastest 350 kW charging speeds.[562]

Infrastructure will continue to build out rapidly on highways with increasing PEV penetration, fulfilling the needs for even these comparatively less frequent longer drives. Survey data from Europe shows that as PEV penetration rates increase and drivers become more experienced with PEV operation, they become comfortable taking longer trips in their vehicles and are "more relaxed" about traveling long distances and when they charge their vehicles.[563] In addition, other developing technologies could make both short and longer drives even more seamless, such as possible "electrified" roadways that contain wireless charging infrastructure under the asphalt and wirelessly charge PEVs while driving.[564] Such projects are already in development or testing in the United States and Europe.[565]

4. PEVs have additional attributes that are superior to combustion vehicles.

PEVs have additional superior attributes related to the driving and ownership experience that are widely attractive to drivers. These include faster acceleration; improved performance; better noise, vibration, and harshness characteristics; and reduced maintenance. Sections XIX.C, XX, and XXI detail these additional superior attributes and the benefits that they provide for drivers and vehicle owners. These attributes will continue to further increase consumer preference for PEVs.

5. American consumers also place high importance on environmental sustainability, and EPA should not ignore these preferences.

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[560] Stephen Edelstein, *Electrify America Finishes First Cross-Country Fast-Charging Route for EVs*, Green Car Reports (June 24, 2020), https://www.greencarreports.com/news/1128610_electrify-america-finishes-first-cross-country-fast-charging-route-for-evs. *See also* Electrify America, *Locate A Charger*, https://www.electrifyamerica.com/locate-charger/ (showing map of fast-charging network across the United States).

[561] Anne LeZotte, *GM and Pilot Company to Build Out Coast-to-Coast EV Fast Charging Network*, Pilot Flying J, https://pilotflyingj.com/press-release/19335.

[562] *Id*.

[563] Shell Global, *Shell Recharge Research Suggests Increasing EV Adoption is Driving Range Confidence* (June 23, 2023), https://www.shell.com/energy-and-innovation/mobility/mobility-news/shell-recharge-research-suggests-increasing-ev-adoption-is-driving-range-confidence.html.

[564] Joann Muller, *A Roadway Will Charge Your EV While You're Driving*, Axios (Feb. 6, 2022), https://www.axios.com/2022/02/02/a-roadway-will-charge-your-ev-while-youre-driving.

[565] *Id*.

When considering consumer preferences, EPA cannot overlook the importance that American consumers place on sustainability. U.S. consumers increasingly place high priority on protecting the environment, and PEVs are well positioned to satisfy this aspect of consumer preference. Numerous consumer surveys, including by YouGov, CarMax, and others have found that protecting the environment is a top consideration in purchasing a vehicle.[566] In CarMax's survey, over 60% of people said a car's "fuel emissions are moderately or extremely important to them, while only 7.3% of people found fuel emissions not at all important."[567]

6. PEVs are a great fit for the needs and demands of rural drivers.

PEVs are a great fit even for rural drivers. Although rural Americans are currently adopting PEVs at slower rates than urban Americans,[568] PEVs actually excel at meeting the demands of rural drivers. "Fuel savings for rural households are larger than for urban households, because trips in rural areas are longer than in urban areas, and vehicles tend to be older and less efficient, requiring more fuel per mile, [P]EVs require fewer trips to a mechanic for repairs and maintenance. Because of the high torque and low center of gravity, they have excellent performance, which is important on rough, curvy and steep roads."[569] A survey by the Union of Concerned Scientists and Consumer Reports found that "there is plenty of interest [in PEVs] in rural areas, but there is a huge knowledge gap about what it is like to own an EV."[570] Correcting for this knowledge gap and educating rural consumers on PEVs' real benefits will undoubtedly significantly increase PEV adoption in rural areas, allowing all Americans to reap their benefits.

7. Most PEV drivers purchase or plan to purchase another PEV, indicating high satisfaction.

The appeal of these beneficial PEV attributes is made clear from the fact that most PEV buyers purchase another PEV for their next vehicle and through the ample available information

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[566] Bill Howard, *Survey: 23% of Americans Would Consider EV as Next Car*, Forbes (Oct. 8, 2021), https://www.forbes.com/wheels/features/ev-survey/ (YouGov poll for Forbes Wheels); CarMax, *Green-Conscious: Exploring Americans' Views on Hybrid and Electric Vehicles* (Aug. 23, 2021), https://www.carmax.com/articles/green-cars-trend.

[567] CarMax, *Green-Conscious: Exploring Americans' Views on Hybrid and Electric Vehicles* (Aug. 23, 2021), https://www.carmax.com/articles/green-cars-trend.

[568] U.S. Department of Transportation, *Individual Benefits of Rural Vehicle Electrification* (May 4, 2023), https://www.transportation.gov/rural/ev/toolkit/ev-benefits-and-challenges/individual-benefits (noting that rural EV adoption is currently roughly 40% lower than urban EV adoption, but explaining that EVs can have significant benefits for rural drivers); Maria Cecilia Pinto de Moura, *Survey Shows Pathway to Speeding Up EV Adoption in Rural Areas*, Union of Concerned Scientists (March 14, 2023), https://blog.ucsusa.org/cecilia-moura/survey-shows-pathway-to-speeding-up-ev-adoption-in-rural-areas/.

[569] Maria Cecilia Pinto de Moura, *Survey Shows Pathway to Speeding Up EV Adoption in Rural Areas*, Union of Concerned Scientists (March 14, 2023), https://blog.ucsusa.org/cecilia-moura/survey-shows-pathway-to-speeding-up-ev-adoption-in-rural-areas/.

[570] *Id.*

pointing to satisfied PEV drivers. As far back as almost a decade ago, Tesla's Model S had the highest owner satisfaction of any vehicle in the U.S. market.[571] A recent analysis of S&P Global Mobility vehicle registration data found that roughly two-thirds of EV-owning households that bought a new car in 2022 purchased another EV.[572] Other surveys and analyses have found the same. In 2021, Plug In America surveyed over 5,500 EV owners and more than 1,400 potential EV purchasers and found that 90% of EV owners said that it was "likely" (13%) or "very likely" (77%) that their next vehicle purchase would be an EV.[573] In Plug In America's most recent survey (conducted between December 2022 and February 2023), again 90% of EV owners said it is "likely" or "very likely" that their next purchase will be another EV.[574] Even as of January 2017, CARB found that over 10% of recent PEV buyers were already driving their second or subsequent PEV.[575]

As Forsythe et al. (2023) explain, "technology progress projections are key for future BEV adoption projections used in policy planning and cost–benefit analyses."[576] Here, it is clear that technological progress is sufficient to support significant consumer acceptance of (and satisfaction with) PEVs. Even considering consumer acceptance as a relevant and permissible factor in EPA's analysis, EPA should enact standards consistent with Alternative 1 with increasing stringency after MY 2030. Consumer acceptance is not a barrier to PEV sales at a pace consistent with this level of stringency, when desirable vehicles are available—as they are expected to be—and purchasers have information about their benefits.[577]

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[571] Consumer Reports, *Tesla Model S Takes the Top Spot in Consumer Reports Car Owner-Satisfaction Ratings* (Nov. 21, 2013).

[572] Joann Muller, *Most Electric Car Buyers Don't Switch Back to Gas*, Axios (Oct. 5, 2022), https://www.axios.com/2022/10/05/ev-adoption-loyalty-electric-cars.

[573] Plug In America, *The Expanding EV Market: Observations in a Year of Growth* 1, 11 (Feb. 2022), https://pluginamerica.org/wp-content/uploads/2022/03/2022-PIA-Survey-Report.pdf.

[574] Plug In America, *2023 EV Driver Survey* 1 (May 2023), https://pluginamerica.org/wp-content/uploads/2023/05/2023-EV-Survey-Final.pdf.

[575] CARB, *California's Advanced Clean Cars Midterm Review, Appendix B: Consumer Acceptance of Zero Emission Vehicles and Plug-in Hybrid Electric Vehicles* B-2 (Jan. 18, 2017), https://ww2.arb.ca.gov/sites/default/files/2020-01/appendix_b_consumer_acceptance_ac.pdf.

[576] Forsythe et al. (2023) at 6.

[577] EPA's approach to modeling consumer acceptance through the Global Change Analysis Model ("GCAM"), utilizing an S curve, while by no means the only approach to modeling consumer acceptance, is a reasonable one. Specifically, as recent analyses show, GCAM is a random utility discrete choice model equivalent to a logit model with a particular utility function form. Eric G. O'Rear et al., *Projecting Vehicle Sales: A Review of Light-Duty Vehicle Adoption Models*, Rhodium Group 15-16 (Mar. 24, 2023), https://rhg.com/wp-content/uploads/2023/03/Projecting-Vehicle-Sales-A-Review-of-Light-Duty-Vehicle-Adoption-Models.pdf.

XX. BEVs Provide Additional Economic and Performance Benefits to Consumers.

A. Slightly higher upfront costs are offset by lower operating and fuel costs, saving drivers money.

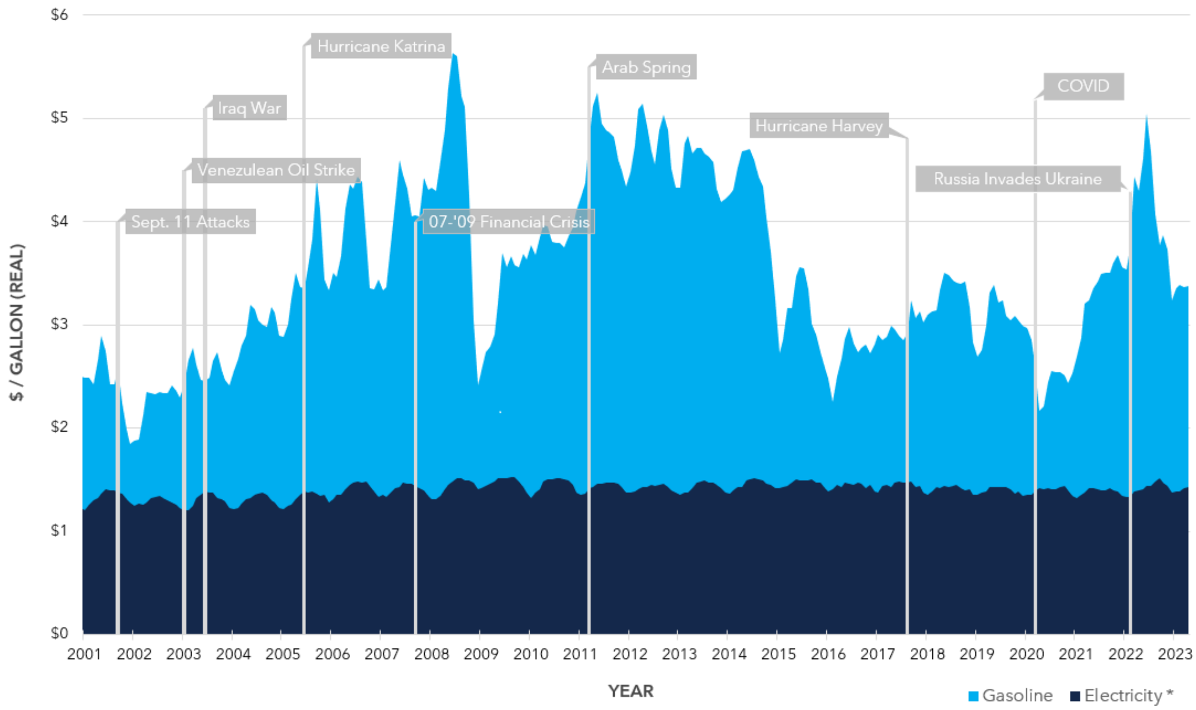
EPA is correct to conclude that consumers experience net economic benefits when purchasing electric vehicles because lower operating costs offset increases in vehicle technology costs, irrespective of purchase incentives. 88 Fed. Reg. at 29344. EPA projects that aggregate vehicle technology costs through 2055 will range from $260 billion to $380 billion (7 and 3% discount rates). *Id*. Yet EPA estimates that total fuel savings over the same period will range from $560 billion to $1.1 trillion, while reduced maintenance and repair costs will range from $280 billion to $580 billion. *Id*. On net, consumers benefit from the Proposed Standards.

These savings also filter down to the individual buyer. Even under the "high battery costs" sensitivity analysis, EPA found that the average incremental vehicle cost for the Proposed Standards was $1,632, and $2,066 for Alternative 1 (6-year average). Table 117, 88 Fed. Reg. at 29337. (Under the "low battery costs" analysis, incremental cost increases are far lower: $441 for the Proposed Standards, and $1,360 for Alternative 1 (6-year average). *Id*. at 29336.) These upfront costs are quickly eclipsed as the broader picture of overall costs emerges. First, some BEV models would be eligible for the full $7,500 purchase incentive in the Inflation Reduction Act, while others would be eligible for a partial credit. As EPA notes, this means that net purchase expenses are lowest across all body styles for BEVs (assuming the maximum incentive applies). DRIA at 4-20. Moreover, in operating expenses over 8 years (the average length of time a new owner keeps a vehicle), BEV owners save between $9,040 for sedans to $12,880 for pickups. *Id*. These operating expenses, which include lower maintenance and repair costs, are highly significant, and only grow larger the longer the owner retains the vehicle.

B. Consumers and businesses will appreciate the stability of electricity prices relative to the volatility of gasoline prices.

In addition to providing significant absolute fuel cost savings relative to gasoline or diesel, driving on electricity also provides a significant price-stability advantage. As shown in Figure XX.B-1, for more than the last two decades, driving a passenger BEV on residential electricity prices has been the cost equivalent of driving on dollar-a-gallon gasoline, whereas the price of gasoline itself jumps up and down in response to world events.

Figure XX.B-1: Equivalent Electricity and Gasoline Prices: January 2001-April 2023[578]



While gasoline prices fluctuate wildly due to uncontrollable events, electricity prices are inherently more stable because electricity is produced from a diverse mix of largely domestic energy sources. Electricity prices also are more stable because the power industry is regulated, while the world oil market and petro-dictatorships are not.

Households and businesses both stand to benefit from the predictable savings that driving on electricity can provide. And low-income households that spend a disproportionate share of their disposable income at the gas pump will benefit financially from getting off the rollercoaster of the world oil market.

C. BEVs provide additional performance and handling improvements for consumers, improving their overall driving experience.

In addition to the clear economic benefits of BEV purchase and ownership described in the previous section, there are other "intangible" factors that make the overall BEV experience better for consumers. EPA cites several of these factors, including responsive acceleration,

[578] Source data: EIA, *Short Term Energy Outlook*. Electricity prices shown in "eGallons" a Department of Energy metric that "represents the cost of driving an electric vehicle (EV) the same distance a gasoline powered vehicle could travel on one (1) gallon of gasoline." Methodology available at: https://www.energy.gov/articles/egallon-methodology.

improved performance and handling, and quiet operation. DRIA at 3-15. Many examples confirm these advantages.

As Consumer Reports notes, "most electric cars deliver instant power from a stop, and they are both smooth and quiet when underway. The driving experience is quite different from a traditional gasoline-fueled car because EVs feel like they glide effortlessly."[579] Other reviewers have found that the lower center of gravity in BEVs improves their handling by allowing turning and cornering more quickly and smoothly than gas-powered cars.[580] In addition, BEVs' regenerative braking capabilities, which captures energy normally lost during braking, may also improve the driving experience by extending the vehicle's range and provide a "smoother and more controlled" braking experience.[581]

Car and Driver tested dozens of EVs and compared the data with gasoline-powered cars, finding that EVs are quieter at "max-attack acceleration" as well as at 70 miles per hour, have a more even weight distribution due to battery packs positioned low and in the vehicle's center, and accelerate almost as quickly as their combustion counterparts.[582] Several other analysts have concluded that EVs accelerate faster than gas-powered vehicles because they provide instant torque to the wheels.[583] For example, a Tesla Model S Plaid (with a starting price of around $108,000) accelerates from 0 to 60 miles per hour in just under two seconds, a full second faster than a supercar like the Ferrari Daytona SP3 that starts at $2,226,935 (about 20 times the cost of the Tesla).[584] And the same holds for more affordable vehicles. For example, the Volvo EX30 promises to be a full second faster to 60 miles per hour than a comparably priced Chevy Camaro.[585] While EPA did not place undue emphasis on these factors when making its assumptions about BEV adoption rates, these benefits are nonetheless significant and support EPA's finding that BEV performance and handling factors will contribute to high rates of adoption in coming years.

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[579] Consumer Reports, *Electric Cars 101: The Answers to All Your EV Questions* (March 2, 2023), https://www.consumerreports.org/cars/hybrids-evs/electric-cars-101-the-answers-to-all-your-ev-questions-a7130554728/.
[580] Steer EV, *8 Reasons Why Electric Vehicles Are Safer Than Traditional Cars* (Apr. 27, 2023), https://steerev.com/steer-vs-other/8-reasons-why-electric-vehicles-are-safer-than-traditional-cars/.
[581] *Id.*
[582] Dave Vanderwerp, *How EVs Compare to Gas-Powered Vehicles in Seven Performance Metrics*, Car and Driver (May 15, 2021), https://www.caranddriver.com/features/g36420161/evs-compared-gas-powered-vehicles-performance/.
[583] *See, e.g.*, Jeremy Laukkonen, Lifewire, *Want a High-Performance Car? Think EV* (Sept. 29, 2021), https://www.lifewire.c/want-a-high-performance-car-think-ev-5203444; Electric Driver, *Electric Vehicle Performance*, https://electricdriver.co/articles/electric-vehicle-performance/.
[584] *See* Christian Seabaugh, *2022 Tesla Model S Plaid First Test: 0–60 MPH in 1.98 Seconds*, Motortrend (Jun. 17, 2021), https://www.motortrend.com/reviews/2022-tesla-model-s-plaid-first-test-review/; Angus MacKenzie, *Driven! The Ferrari Daytona SP3 Isn't Rational—and That's the Point*, Motortrend (Jul. 31, 2022), https://www.motortrend.com/reviews/2023-ferrari-daytona-sp3-supercar-first-drive-review/
[585] *See* Viknesh Vijayenthiran, *2025 Volvo EX30 hits 0-60 in 3.4 seconds, starts at $36,145*, Motor Authority, https://www.motorauthority.com/news/1139801_2025-volvo-ex30-price.

XXI. Consumers Will Experience Significant Savings Due to Reduced Repair and Maintenance Costs for BEVs.

EPA's Proposal accurately projects significant consumer savings due to reduced repair and maintenance costs for BEVs. EPA relies on comprehensive repair and maintenance cost estimates developed by Argonne National Laboratory (ANL) in 2021 to project per vehicle maintenance and repair savings per year of between $430 (BEV sedan/wagons) and $470 (BEV pickups) in 2032. DRIA at 4–20; *see also* DRIA at 4–32 to 4–37. Other analyses—both those that have relied on the same underlying ANL cost estimates and those that have relied on other data—have found similarly significant maintenance and repair savings.

A 2022 ICCT study considering LDV costs and benefits in the United States between 2022 and 2035 also relied on the ANL cost estimates and found almost identical reductions in per vehicle maintenance costs.[586] The ICCT analysis concluded that maintenance costs for BEVs are expected to be about $2,650 lower than for gasoline vehicles over a six-year period,[587] which averages to about $442 savings per year. A survey conducted by Consumer Reports in 2019 and 2020 also found very significant self-reported consumer savings on repair and maintenance. The data from surveys of thousands of Consumer Reports members revealed that "BEV and PHEV owners are paying half as much as ICE owners are paying to repair and maintain their vehicles," with lifetime savings of BEVs and PHEVs over combustion vehicles being approximately $4,600.[588] Similarly, a study by UBS estimated that the Chevy Bolt (BEV) has total annual maintenance costs of $255 and the VW Golf (combustion vehicle) has repair and maintenance costs of $610.[589] An analysis using U.S. Office of Energy Efficiency and Renewable Energy data regarding maintenance and repair costs and U.S. General Services Administration data regarding federal vehicle use calculated that "a hypothetical full-electric government fleet would have saved just over $78 million in maintenance costs" in one year.[590] An analysis of repair and maintenance costs in Canada, which found 47% repair and maintenance cost savings for BEVs over combustion vehicles, noted that U.S. studies have found cost savings in similar ranges, and explained that when looking at the top 10 most common U.S. car repair items, none of the repairs in the list apply to a BEV.[591] These significant repair and maintenance savings are expected to

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[586] Peter Slowik et al., *Assessment of Light-Duty Electric Vehicle Costs and Consumer Benefits in the United States in the 2022–2035 Time Frame*, ICCT (Oct. 2022), https://theicct.org/wp-content/uploads/2022/10/ev-cost-benefits-2035-oct22.pdf.

[587] *Id.* at 24.

[588] Chris Harto, *Electric Vehicle Ownership Costs: Today's Electric Vehicles Offer Big Savings for Consumers*, Consumer Reports at 9, 11 (Oct. 2020), https://advocacy.consumerreports.org/wp-content/uploads/2020/10/EV-Ownership-Cost-Final-Report-1.pdf.

[589] UBS, *UBS Evidence Lab Electric Car Teardown — Disruption Ahead?* 7 (May 18, 2017), https://neo.ubs.com/shared/d1ZTxnvF2k/.

[590] Nick Yekikian, *The Government Confirms Obvious: Electric Cars Cheaper to Maintain Than Internal Combustion Vehicles*, Motortrend (June 21, 2021), https://www.motortrend.com/news/government-ev-ice-maintenance-cost-comparison/.

[591] Ryan Logtenberg, James Pawley & Barry Saxifrage, *Comparing Fuel and Maintenance Costs of Electric and Gas Powered Vehicles in Canada*, 2 Degrees Institute at 5 (Sept. 2018),

occur because "[t]ypical BEV drivetrains have 90% fewer moving parts, require no maintenance such as oil changes or timing belts and their ability to use regenerative braking saves energy and makes their brake pads last longer."[592] Thus, U.S. drivers and vehicle purchasers stand to gain significant benefits from reduced automotive repair and maintenance needs for BEV.

XXII. BEV Ownership, Combined with Supportive Policies, Will Benefit Lower-Income Consumers.

EPA describes several expected outcomes of the Proposed Standards on lower-income households: first, that increased upfront purchase costs may impact highly price-sensitive consumers; and second, that decreased fuel and maintenance costs from BEV ownership may benefit these consumers disproportionately. 88 Fed. Reg. at 29368. While upfront BEV cost concerns may serve as an initial barrier to lower-income consumers, a suite of targeted policies can mitigate this concern.

First, several policies may help with the upfront cost concerns, including the (maximum) $7,500 new vehicle purchase incentive and the first-of-its-kind (maximum) $4,000 incentive for used vehicles in the Inflation Reduction Act. These policies may also be supplemented by state-level initiatives that further reduce the purchase cost for buyers falling under defined income thresholds, such as California's Clean Vehicle Rebate Project.[593] Also, as EPA notes, for used BEVs, there is evidence that the original purchase incentive is passed on to the next buyer, which reduces the effective price of BEVs. Taken together, these savings bring the initial cost of several BEV models–and undoubtedly more to come in future years–below the purchase price of a comparable combustion vehicle. *See* DRIA Ch. 4.2.2.

Moreover, because lower-income households spend a disproportionate amount on vehicle repair and fuel costs,[594] they should benefit from these savings that come with BEVs, which continue to accrue year after year. This is especially true because fuel economy, and therefore fuel savings, tends not to degrade much as a vehicle ages, even when the vehicle is sold and resold for a lower price over time. 88 Fed. Reg. at 29368. Separately, from an overall ownership perspective, modifications to the Alternative Fuel Refueling Property Tax Credit in the IRA limit applicability to charging infrastructure in low-income areas and areas that are not urban. DRIA at

https://www.2degreesinstitute.org/reports/comparing_fuel_and_maintenance_costs_of_electric_and_gas_powered_vehicles_in_canada.pdf.

[592] *Id*.

[593] California Clean Vehicle Rebate Project, Eligibility & Requirements, https://cleanvehiclerebate.org/en/eligibility-guidelines.

[594] *See, e.g.*, Hardman, Fleming et al., A Perspective on Equity in The Transition to Electric Vehicles, MIT Science Policy Review (Aug. 30, 2021), https://sciencepolicyreview.org/wp-content/uploads/securepdfs/2021/08/A_perspective_on_equity_in_the_transition_to_electric_vehicles.pdf.

5-26. This change may help residents in those communities afford home charging or incentivize businesses to install public chargers, which would improve the BEV ownership experience.

For these reasons, EPA was correct to consider the effects of BEV purchase and ownership on lower-income consumers. Inclusive policies that ease the burden of any potential higher costs on these consumers merit further study, and it is essential that the benefits of BEV ownership are accessible to all and shared equitably. EPA has shown that the cost savings over time make BEV ownership worthwhile for lower-income households, and that additional policies like the IRA purchase incentives can lessen any upfront cost disparities.

XXIII. BEV Charging Times Are Constantly Improving and Are Not a Constraint on Strong Standards.

Taking refueling considerations into account, BEV charging times are consistent with setting strong final standards. Charging technologies have come a long way in recent years, increasing in their capability to deliver more energy to a vehicle in the same unit of time. EPA notes that its assumptions for BEV refueling times are outdated, 88 Fed. Reg. at 29200, and that is indeed the case. EPA's analysis assumes 100 miles of driving added for each hour of charging as the "charge rate" across all BEVs. DRIA at 4-29. That equates to an average power delivery of just over 30 kilowatts, using the current on-road fleet average BEV efficiency.[595] While power delivery during a charging session does taper off as the vehicle battery approaches a full charge, the average power delivery for mid-trip charging events will be much higher than 30 kW. Those events are likely to be done with fast charging, where available, and the availability of high-powered, fast charging will expand greatly leading up to and through the lifetimes of vehicles sold during the period of the Proposed Standards.

Not only is consumer demand for fast charging for mid-trip fueling pushing the market in the direction of higher-powered ports, the minimum power requirements for federal programs, as well as some state programs, ensure the market will meet those consumer needs in a timely manner. For example, the minimum standards and requirements for the National EV Charging Formula Program specify that each charging location must have at least four charging ports that can deliver 150 kW (or higher) simultaneously. 88 Fed. Reg. at 12754. A 150 kW port would deliver closer to 450 miles of range in an hour, greatly reducing the disbenefit of refueling time associated with BEVs. That number of miles per hour of charging is really a theoretical construct, as the hourly output is more energy than light- and medium-duty vehicle batteries can hold. A vehicle would not spend a full hour fueling at a 150 kW charging station, even if the battery is fully depleted.

[595] David Reichmuth, Jessica Dunn, & Don Anair, *Driving Cleaner*, Union of Concerned Scientists (July 2022) at 20, https://www.ucsusa.org/sites/default/files/2022-07/driving-cleaner-report_0.pdf.

The hourly charging speed of a 150 kW station is, however, a useful apples-to-apples comparison to the 100 miles/hour figure used in EPA's analysis. It suggests that many vehicles will charge nearly four and a half times faster than the speed assumed in the analysis. Still other vehicles may use even faster charging for their mid-trip events, with chargers on the market approaching 350 kW, for vehicles that can accept that output.[596] Thus, EPA's charging rate assumption could be quadrupled (and the refueling time disbenefit for BEVs greatly reduced) and still result in a conservative assumption that leaves room for vehicles that may do some mid-trip charging at more moderate DC charging power levels.

XXIV. EPA's Consideration of Sales Impacts Is Reasonable, but the Agency Should Consider Using a Sales Elasticity of Demand Lower in Magnitude for LDVs.

In this section, we turn to EPA's consideration of sales impacts. While we support EPA's proposal to use a sales elasticity of demand of zero for MDVs, we recommend that it use a sales elasticity of demand lower than –0.4 for LDVs.

A. EPA should consider using a sales elasticity of demand lower in magnitude than –0.4 for LDVs.

EPA continues to use the new vehicle demand elasticity of –0.4 for its modeling of LDV sales impacts, based on the Agency's final 2021 rule and a 2021 EPA peer reviewed report on this topic. 88 Fed. Reg. at 29,370.[597] Recent research supports a sales elasticity value of –0.4, or one even lower in absolute value, as EPA suggests. *See* 88 Fed. Reg. at 29370 (noting that " –0.4 appears to be the largest estimate (in absolute value) for a long-run new vehicle demand elasticity in recent studies," and that "EPA's report examining the relationship between new and used vehicle markets shows that, for plausible values reflecting that interaction, the new vehicle demand elasticity varies from –0.15 to –0.4"); *see also* 83 Fed. Reg. at 43075 (based on the available research, the 2020 Rule NPRM conducted a data analysis and projected an elasticity in the range of –0.2 to –0.3.)[598]

Using a price elasticity of demand that is lower in absolute value could provide a more realistic picture of the sales impacts of LDV GHG regulations, and EPA should consider whether

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[596] Andrei Nedelea, *800V EV Charging Will Drastically Reduce Waiting Times At The Charger*, Inside EVs (June 5, 2020), https://insideevs.com/features/427039/800-volt-charging-to-change-industry/.
[597] Citing EPA, *The Effects of New-Vehicle Price Changes on New- and Used-Vehicle Markets and Scrappage*, EPA–420–R–21–019 (2021), https://cfpub.epa.gov/si/si_public_record_Report.cfm?dirEntryId=352754&Lab=OTAQ.
[598] This number was actually incorrectly calculated and too high due to a spreadsheet error identified in a Comment to the 2018 NPRM. It should be -0.07. *See* J.H. Stock et al., Comments on Notice of Proposed Rulemaking for The Safer Affordable Fuel-Efficient (SAFE) Vehicles Rule for Model Years 2021–2026 Passenger Cars and Light Trucks, EPA-HQ-OAR-2018-0283-6220, at 6–8 (Oct. 26, 2018). *See also* Brief of Amici Curiae Economists in Support of Coordinating Petitioners, Competitive Enterprise Institute v. NHTSA, D.C. Cir. No. 20-1145, at 26 (filed Jan. 21, 2021) (hereinafter "Amicus Brief of Economists").

a value lower in magnitude than –0.4 is appropriate here. The price elasticity of demand for new vehicles is a critical factor to consider in setting LDV regulations because without this input EPA could not quantify the rule's effect on vehicle purchases. Changes in demand for new vehicles can have an impact on jobs, emissions, safety, and other factors relevant to the net benefits of revised standards.

Vehicles have different price elasticities depending on the timeframe considered, and sales of automobiles tend to be less sensitive to price fluctuations, especially in the long run.[599] This is because in most areas of the United States vehicles are essential goods.[600] EPA's Science Advisory Board explained that while "a consumer can easily hold on to their existing vehicle a bit longer[,] . . . an old vehicle will not be functional forever, and thus the long-run price elasticity for new vehicles is likely to be smaller [in magnitude] than the short-run elasticity."[601] Therefore, it is common to distinguish between short-run elasticity values (sales effects that take place within one year of a price change)[602] and long-run elasticity values (sales effects beginning approximately five years into the future).[603] Thus, the 2012 Final Rule explained, while short-run elasticity may apply very briefly at the start of a program, "over time, a long-run elasticity may better reflect behavior." 77 Fed. Reg. at 63102 n.1300. Similarly, in the 2016 Midterm Evaluation Proposed Determination, EPA explained that "short run elasticity estimate[s] . . . may not be appropriate for standards that apply several years into the future."[604]

Because analyses of LDV GHG emissions standards project sales many years into the future, the long-run price elasticity is the relevant value to apply to the analysis. And because

[599] Howard, P. & M. Sarinksy, *Turbocharged: How One Revision in the SAFE Rule Economic Analysis Obscures Billions of Dollars in Social Harms*, N.Y.U. Inst. for Policy Integrity, at 3 (Nov. 2020), https://policyintegrity.org/files/publications/Turbocharged_How_One_Revision_in_the_SAFE_Rule_Economic_Analysis_Obscures.pdf ("Because automobiles are essential goods in most areas of the United States (and lack any comparable substitute), both economic theory and observed behavior finds that vehicle sales are relatively inelastic—meaning that price fluctuations produce just modest changes in vehicle sales").

[600] *See, e.g.*, Anderson P.L. et al., *Price Elasticity of Demand* (1997), https://scholar.harvard.edu/files/alada/files/price_elasticity_of_demand_handout.pdf.

[601] EPA, Science Advisory Board (SAB) Consideration of the Scientific and Technical Basis of the EPA's Proposed Rule titled The Safer Affordable Fuel-Efficient (SAFE) Vehicles Rule for Model Years 2021-2026 Passenger Cars and Light Trucks, EPA-HQ-OAR-2018-0283-7659, at 22 (Feb. 27, 2020).

[602] *See* Pindyck, R.S. & D.L. Rubinfeld, *Microeconomics* (8th ed.), at 39 (1989) (describing short-run elasticity as measuring "one year or less").

[603] *See* Klier, T. & J. Linn, *The Effect of Vehicle Fuel Economy Standards on Technology Adoption*, Resources for the Future Discussion Paper, at 3, 6 (Rev'd 2015), https://media.rff.org/archive/files/document/file/RFF-DP-13-40-REV2.pdf (noting that long-run impacts measure across engine design cycles, and that "models contain redesigned engines about once every five years in the United States"); *see also* Amicus Brief of Economists at 20 (noting that "long-run" concerns sales effects that begin approximately five to ten years into the future).

[604] EPA, Proposed Determination on the Appropriateness of the Model Year 2022-2025 Light-Duty Vehicle Greenhouse Gas Emissions Standards under the Midterm Evaluation, EPA-HQ-OAR-2018-0283-7640, at A-40 (Nov. 2016). *See also* NHTSA CAFE Model Peer Review, at B-35 (rev. July 2019) (advising EPA and NHTSA that the long-run price elasticity of demand provides the "proper focus" for analyzing the 2020 Final Rule's impacts).

vehicle sales are less elastic in the long run, the price elasticity of demand for vehicles is substantively lower in magnitude in the long run than in the short run.

The chart below provides a comprehensive review of current and historical long-run and short-run elasticity estimates.[605] The median elasticity of the studies published since 2000 (including an outlier estimate) is approximately –0.35, with a mean of –0.4, and those numbers decrease when looking only at studies published since 2010.[606] The most recent reliable studies, such as Leard (2021) and Stock et al. (2018), would support values even lower in magnitude than –0.4.

<u>Sales Elasticity Estimates</u>

Author(s)	**Year**	**Time Period**	**Short-Run**	**Long-Run**
McAlinden et al. (2016) CAR Report[607]				
Atkinson	1952	1925–1940	-1.33	–
Nerlove	1957	1922-1941; 1948-1953	-0.9	-1.2
Suits	1958	1929-1941; 1949-1956	–	-0.57
Chow	1960	1921-1953	–	-0.7
Suits	1961	1929-1941; 1949-1956	–	-0.675
Hymans, Ackley, and Juster	1970	1954-1968	-1.14	-0.46
Hess	1977	1952-1972	-1.63	–
Trandel	1991	1983-1985	-1.43	–

605 This review included the sources cited by the agencies in the 2020 Final Rule, 85 Fed. Reg. 24174 (June 29, 2020), as well as other relevant sources (in particular those in National Research Council, *Cost, Effectiveness, and Deployment of Fuel Economy Technologies for Light-Duty Vehicles* (June 2015), and previous EPA rules) and more recent studies.

606 These values are consistent with a review done by several economists and detailed in an amicus brief filed in the litigation over the 2020 Final Rule. That review considered what the economists viewed as the four most relevant, distinct estimates of long-run elasticity based on original data analysis since 2000, and found a long-run price elasticity of demand for vehicles subject to the Proposal of between -0.03 and -0.61. *See* Amicus Brief of Economists at 25-26.

607 Sean P. McAlinden et al., *The Potential Effects of the 2017–2025 EPA/NHTSA GHG/Fuel Economy Mandates on the U.S. Economy*, Center for Automotive Research (Sept. 2016), https://www.cargroup.org/wp-content/uploads/2017/02/The-Potential-Effects-of-the-2017_2025-EPANHTSA-GHG Fuel-Economy-Mandates-on-the-US-Economy.pdf.

Levinsohn	1988	1983-1985	-0.82	–
McCarthy	1996	1989	-0.87	–
Bordley	1993	Assumed	-1	–
Fischer, Harrington, and Parry	2007	Not indicated	-1	-0.36
Irvine (1983)[608] (basis for Kleit (1990)[609])				
Dyckman	1975	1929-1962	-1.45	–
Hamburger	1967	1954-1964	-1.17	–
Evans	1969	1948-1964	-3.1	-1.5
Hymans	1970	1954-1968	-1.07	-0.36
Rippe and Feldman	1976	1958-1973	-1.14	-0.6
Carlson	1978	1965-1975	-1.1	–
Additional estimates				
Goldberg	1998	1984-1990	-0.9	–
Juster and Wachtel	1972	1949-1967	-0.7	–
Lave and Train	1979	1976	-0.8	–
McAlinden et al.*	2016	1953-2013	-0.79	-0.61
Berry et al.	2004	1993	–	-1
Stock et al.	2018	1967-2016	-0.27	-0.03 to -0.09
Leard	2021	2013	–	-0.34
Bento et al.	2020	Not indicated	–	-0.13
Dou and Linn	2020	1996 to 2016	-1.5	–
Averages				
Mean			-1.15	-0.6

[608] F. Owen Irvine, Jr., *Demand Equations for Individual New Car Models Estimated Using Transaction Prices with Implications for Regulatory Issues*, 49 Southern Economic Journal 764–782 (Jan. 1983).
[609] Andrew N. Kleit, *The Effect of Annual Changes in Automobile Fuel Economy Standards*, 2 Journal of Regulatory Economics 151–172 (1990).

Median			-1.07	-0.6
Averages of Recent Estimates				
Mean published since 2000			-0.9	-0.4
Median published since 2000			-0.9	-0.35
Mean published since 2010			-0.85	-0.3
Median published since 2010			-0.79	-0.24
*Averages Without Inconsistent Estimates***				
Mean			-1.1	-0.4
Median			-1.07	-0.46
Mean: Published since 2000			-0.9	-0.3
Median: Published since 2000			-0.9	-0.34

* McAlinden et al. (2016) conducted both a literature review, represented at the top of this table, and separately produced its own elasticity estimates, shown here.
** Inconsistent estimates: Nerlove (1957) as long-run elasticity is higher than short-run elasticity; Evans (1969) as elasticities are extreme outliers with long-run elasticity that is elastic contrary to intuition in the literature; and Berry et al. (2004) as estimate was suggested by General Motors staff despite "impl[ying] a large (in absolute value) own-price semi-elasticity of demand equal to −10.56" and conducted sensitivity analysis using –0.2 and –0.4 (the latter producing more realistic own-price semi-elasticity) (Leard (2021)).[610]

B. EPA is correct to use a sales elasticity of zero for MDVs.

For MDV sales impacts, EPA's Proposal assumes an elasticity of zero, reasoning that MDVs largely serve commercial applications and that business owners are less sensitive to changes in vehicle price. 88 Fed. Reg. at 29372. As EPA explains, "as long as the characteristics of the vehicle do not change, commercial buyers will still purchase the vehicle that fits their needs," even with a change in price. *Id.* We agree with EPA that, for this reason, the literature examining LDV sales elasticity does not directly translate to MDV sales elasticity, and that factors such as the importance of fuel efficiency, warranty considerations, maintenance cost, and replacement parts could be more relevant to commercial vehicle purchasers than changes in vehicle price. DRIA at 4-43.

[610] Benjamin Leard, *Estimating Consumer Substitution Between New and Used Passenger Vehicles*, Resources for the Future 12 (rev. Aug. 2021), https://media.rff.org/documents/WP_19-01_rev_2021.pdf.

Attributes of MD ZEVs also could help to mitigate vehicle sales impacts, particularly for commercial applications. For example, as with commercial HDVs, educating commercial MDV purchasers regarding the benefits of ZEV ownership such as reduced operating and maintenance costs can be especially effective in mitigating possible sales impacts, 88 Fed. Reg. at 26068,[611] as TCO has long been a key consideration for commercial vehicle owners and operators.[612] The availability of data analytics tools for commercial fleets also makes it easier for commercial purchasers to understand and evaluate the TCO.[613] Medium-duty ZEVs largely have reached TCO parity with their conventional counterparts, or will in the very near future and by the time period covered by the Proposed Rule.[614] For commercial HDVs, EPA has projected little to no sales impacts as a result of its newly proposed GHG standards, which are likely to be complied with through increased ZEV penetration,[615] and EPA is correct to do the same for MDVs.

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[611] *See also,* EPA, Greenhouse Gas Emissions Standards for Heavy-Duty Vehicles: Phase 3, Draft Regulatory Impact Analysis (Apr. 2023), at 411–412.

[612] *See, e.g.*, Seth Skydel, *Determining ROI to Lower TCO*, Fleet Equipment (Nov. 5, 2014), https://www.fleetequipmentmag.com/truck-investment-cost-ownership/ (explaining the importance of TCO to commercial fleets); David A. Kolman, *The True Costs of a Truck Purchase*, Fleet Maintenance (June 9, 2015), https://www.fleetmaintenance.com/home/article/12072830/the-true-costs-of-a-truck-purchase ("TCO is far more important than initial price when acquiring a vehicle"); Patrick Gaskins, *Despite Initial Cost, Purchase Decision is Always About TCO*, Fleet Owner (Jan. 13, 2022), https://www.fleetowner.com/operations/article/21213521/despite-initial-cost-purchase-decision-is-always-about-tco ("Don't base your decision on whether to buy a new piece of equipment on the upfront cost alone. Take the time to do a TCO calculation that includes both hard and soft costs. That will tell you whether the time is right to buy."); ICCT & Ricardo Strategic Consulting, *E-Truck Virtual Teardown Study* 6 (June 11, 2021), https://theicct.org/wp-content/uploads/2022/01/Final-Report-eTruck-Virtual-Teardown-Public-Version.pdf; ("Zero emission truck price should be viewed in the wider context of overall TCO."); McKinsey Center for Future Mobility, *Preparing the World for Zero-Emission Trucks* 6 (Sept. 2022), https://www.mckinsey.com/~/media/mckinsey/industries/automotive%20and%20assembly/our%20insights/preparing%20the%20world%20for%20zero%20emission%20trucks/preparing-the-world-for-zero-emission-trucks.pdf (explaining that TCO is a "key factor" in deployment of zero-emission trucks).

[613] *See, e.g.*, Seth Skydel, *Determining ROI to Lower TCO*, Fleet Equipment (Nov. 5, 2014) (detailing data analytics tools that aid fleets in making equipment purchase decisions based on TCO); David A. Kolman, *The True Costs of a Truck Purchase*, Fleet Maintenance (June 9, 2015) (explaining the use of telematics software in analyzing TCO, and noting that "OEM dealer sales representatives are trained on effectively calculating TCO costs and on assisting truck buyers [to] evaluate and assess planned operation of their trucks.").

[614] Saxena et al., *Electrification Cost Evaluation*, at 26 ("While the economics vary based on several factors, the TCO of most MY 2027 and MY 2030 class 2b–3 BEV types is lower than the TCO of comparable ICEVs, largely due to BEVs' lower maintenance and energy costs. Across the vehicle types and three scenarios of electrification considered in this report, the TCO of BEVs averages $0.334 per mile (ranging from $0.291 per mile to $0.39 per mile), while the TCO of ICEVs averages $0.428 per mile (ranging from $0.336 per mile to $0.574 per mile)."); Ari Kahn, et al., *The Inflation Reduction Act Will Help Electrify Heavy-Duty Trucking*, RMI (Aug. 25, 2022), https://rmi.org/inflation-reduction-act-will-help-electrify-heavy-duty-trucking/ (finding that the IRA will result in the TCO of electric trucks falling below the TCO of comparable diesel trucks about five years faster than without the IRA).

[615] EPA, Greenhouse Gas Emissions Standards for Heavy-Duty Vehicles: Phase 3, Draft Regulatory Impact Analysis (Apr. 2023), at 414.

XXV. EPA's Use of a 10% Rebound Effect for Combustion Vehicles, While Reasonable, Is Clearly at the High End of Estimates, Leading to a Possible Overestimation of Costs and Underestimation of Benefits.

This section explores EPA's consideration of rebound effects. As detailed below, while the Agency has justified a 10% rebound effect in its prior rulemakings, it should consider using a lower value here. It is also reasonable for EPA to assume no rebound driving for BEVs.

A. EPA has provided a thorough and sufficient justification for a 10% rebound effect in several prior rulemakings.

EPA's Proposal estimates the vehicle miles traveled (VMT) rebound effect for combustion vehicles to be 10%. DRIA at 4-16. The quantitative estimate of the rebound effect—which indicates the amount of additional driving that will occur as the cost of driving decreases due to fuel economy improvements—significantly influences multiple factors considered in promulgating new GHG regulations for light-duty vehicles. Additional driving leads to more accidents, road congestion, and noise, while also reducing the fuel savings and emission reductions associated with more stringent standards. Therefore, without a reasonable estimate of the rebound effect, the magnitude of a new rule's costs and benefits cannot be properly understood.

The use of a 10% rebound effect is not new. EPA also estimated the rebound effect to be 10% in the 2010 and 2012 Final Rules and the Revised 2023 and Later Model Year Light-Duty Vehicle GHG Emissions Standards finalized in 2021. *See* 75 Fed. Reg. 25324, 25517 (May 7, 2010); 77 Fed. Reg. 62624, 62716 (Oct. 15, 2012); 86 Fed. Reg. 74434, 74476 (Dec. 30, 2021). During each of these previous rulemakings, EPA considered a large body of both historical and recent literature that reported a very broad range of rebound estimates arrived at through a variety of research methods. EPA understood that simply averaging all of the rebound estimates from all of the studies was an unreasonable and inadequate method for reaching an accurate estimate of rebound for the vehicles subject to the relevant standards.[616] For example, many of the studies considered old research, data from other countries with vastly different driving habits, or estimates that were not forward-looking to the years when the covered vehicles would be driven. 77 Fed. Reg. at 62924. Historically, EPA has correctly acknowledged that rebound research should be weighted based on its relevance to GHG emissions regulations in the United States.[617]

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[616] 77 Fed. Reg. at 62924; EPA & NHTSA, *Joint Technical Support Document, Final Rulemaking for 2017-2025 Light Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards*, EPA-HQ-OAR-2018-0283-0654, at 4-22 to 4-26 (Aug. 2012) (2012 TSD); EPA & NHTSA, *Joint Technical Support Document, Final Rulemaking to Establish Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards*, at 4-15 to 4-22 (Apr. 2010).

[617] *See* 77 Fed. Reg. at 62924 (noting a focus on U.S. estimates and declining to use estimates of elasticity of demand for gasoline to measure the VMT rebound effect); 2012 TSD at 4-25 (noting that historical estimates may overstate

In the 2010 Final Rule, EPA concluded that while the historical research dating back to the 1950s suggested higher rebound values, the most recent literature supported a 10% "or lower" rebound effect. 75 Fed. Reg. at 25517. In the 2012 Final Rule, EPA again assumed a 10% rebound effect, and in 2016, EPA confirmed three times that a 10% rebound effect was appropriate. In both the 2016 Draft Technical Assessment Report and the 2016 Final Technical Support Document under the Midterm Evaluation, EPA cited multiple studies demonstrating that the rebound effect shrinks as incomes rise, and again explained that older studies were likely to be less reliable than more recent research.[618] Also in 2016, EPA used a 10% rebound effect in adopting standards for heavy-duty pickups and vans.[619]

The 2020 Rule was the only recent rule to depart from this 10% rebound rate, and the revised MY 2023 and later standards, finalized in 2021, returned to the 10% rebound rate after EPA conducted a rigorous review of the rebound literature in order to prioritize the most relevant rebound studies. EPA's current Proposal refers to the 2021 rule as support for its proposed 10% rebound rate for combustion vehicles. In the 2021 rule, EPA built on well-established precedent, citing much of the same support provided in the 2010 and 2012 rulemakings, along with additional more recent research. EPA also provided even more clarity into the Agency's approach to the broad body of rebound literature spanning many decades. EPA is correct in its belief that "it is important to critically evaluate which studies are most likely to be reflective of the rebound effect that is relevant to the final standards," and that "one cannot just take the 'average' rebound estimates from literature to use for the VMT rebound effect." *See* EPA, Revised 2023 and Later Model Year Light Duty Vehicle GHG Emissions Standards: Regulatory Impact Analysis (Dec. 2021) ("2021 RIA"), at 3-13. When agencies consider a range of studies, they should focus on those that are similar to the relevant policy context.[620]

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the rebound effect because the magnitude of the rebound effect declines over time, so more recent studies were entitled to increased weight). *See also* EPA, T*echnical Support Document, Proposed Determination on the Appropriateness of the Model Year 2022-2025 Light-Duty Vehicle Greenhouse Gas Emissions Standards under the Midterm Evaluation*, at 3-20 to 3-21 (Nov. 2016), available at https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P100Q3L4.pdf (2016 TSD) (finding some rebound estimates in the literature to be more applicable to the standards than others and according those more weight).

[618] EPA & NHTSA, *Draft Technical Assessment Report, Midterm Evaluation of Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards for Model Years 2022-2025*, EPA-HQ-OAR-2015-0827-0926, at 10-10, 10-13 & 10-20 (July 2016), available at https://nepis.epa.gov/Exe/ZyPDF.cgi/P100OXEO.PDF?Dockey=P100OXEO.PDF (2016 Draft TAR); 2016 TSD at 3-10 to 3-13, 3-16 & 3-20.

[619] *Greenhouse Gas Emissions and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles—Phase 2, Proposed Rule*, 80 Fed. Reg. 40138, 40453 (July 13, 2015) ("Since [HD pickups and trucks] are . . . more similar in use to large light-duty vehicles, we have chosen the light-duty rebound effect of 10 percent . . ."); *Greenhouse Gas Emissions and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles—Phase 2, Final Rule*, 80 Fed. Reg. 73478, 73746 (Oct. 25, 2016) (finalizing use of 10%).

[620] *See, e.g.*, U.S. Office of Management and Budget, Circular A-4 (Sept. 17, 2003) at 25. https://www.whitehouse.gov/sites/whitehouse.gov/files/omb/circulars/A4/a-4.pdf; *see also* EPA, Science Advisory Board (SAB) Consideration of the Scientific and Technical Basis of the EPA's Proposed Rule titled The Safer Affordable Fuel-Efficient (SAFE) Vehicles Rule for Model Years 2021-2026 Passenger Cars and Light Trucks, EPA-HQ-OAR-2018-0283-7659, at 27 (Feb. 27, 2020) (SAB Report) (stating that "the rebound estimate [should] be

Specifically, in the 2021 rule reasoning on which EPA continues to rely for its 10% combustion vehicle rebound estimate, EPA appropriately identified factors for weighting rebound studies that reflect their relevance to the proposed rulemaking: (1) geography/timespan relevance (priority given to U.S. studies as opposed to international estimates); (2) time period of study (priority given to recent studies); (3) reliability/replicability of studies (priority given to studies using odometer readings vs. household surveys such as the 2009 National Household Travel Survey); and (4) statistical/methodological basis (priority given to studies employing a strong statistical/methodological basis). 2021 RIA at 3-13. EPA further explained why these factors are important and why they lead to more accurate estimates of the rebound effect. As a result, the Agency provided a clear and well-reasoned basis for its decision to give more weight to studies based on these four key criteria, and thus to conclude that the seven papers listed in Table 3-4 of the 2021 RIA should be given the most significant weight in developing the rebound estimate used in the Proposal. *See* 2021 RIA at 3-14 to 3-15.

B. Even the 10% rebound effect is too high, and EPA should consider using a rebound effect of a lesser magnitude.

The two most reliable rebound estimates based on U.S. national data from EPA's preferred studies are 10% (Greene (2012)) and around 4% (Hymel and Small (2015)).[621] Hymel and Small (2015) noted that their data indicated that fuel economy rebound could be lower than fuel price rebound, meaning that even the 4.0% and 4.2% values could be too high.[622] Moreover, another paper in the list of EPA's seven preferred studies, Gillingham et al. (2015), estimates the rebound effect at 10%. But the study also found that "a high percentage of vehicles are almost entirely inelastic in response to gasoline price changes" and that "the lowest fuel economy vehicles in the fleet drive the responsiveness, with higher fuel economy vehicles highly inelastic with respect to gasoline price changes."[623] While Gillingham et al. (2015) does not offer an alternative best rebound estimate for higher fuel economy vehicles, it is fair to assume that the 10% estimate is at the high end of reasonable estimates for the vehicles impacted by this rulemaking.

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reconsidered to account for the broader literature, and that it be determined through a full assessment of the quality and relevance of the individual studies rather than a simple average of results," and "recent papers using strong methodology and U.S. data should be weighted more heavily than older papers, or those from outside the U.S., or those with weaker methodology.").

[621] *See* Kenneth A. Small, Comment Letter on Proposed MY 2021-2026 Standards, NHTSA-2018-0067-7789, at 1 (Sept. 14, 2018) ("A better characterization of the most recent study would be that it finds a long-run rebound effect of 4.0 percent or 4.2 percent under two more realistic models that are supported by the data.").

[622] Hymel K. & K. Small, *The Rebound Effect for Automobile Travel: Asymmetric Response to Price Changes and Novel Features of the 2000s*, 49 Energy Econ. 93, 97 (2015); *see also* Greene, D., *Rebound 2007: Analysis of U.S. Light-Duty Vehicle Travel Statistics*, 41 Energy Pol'y 14 (2012) (although fuel prices "had a statistically significant impact on VMT, . . . fuel efficiency did not.").

[623] Kenneth Gillingham et al., *Heterogeneity in the Response to Gasoline Prices: Evidence from Pennsylvania and Implications for the Rebound Effect*, 52 Energy Economics S41–S52 (2015).

Other factors would also suggest that even the best and most relevant existing studies could lead to a rebound estimate that is too large. For example, the rebound effect's magnitude diminishes over time, largely due to increasing income and decreasing driving costs, a fact that EPA has historically understood.[624] As incomes rise over time, any fuel efficiency improvement will have less of an effect on the total vehicle miles traveled, and thus the rebound effect will decline. In both 2010 and 2012, EPA chose to use a 10% rebound effect as "a reasonable compromise between historical estimates and projected future estimates."[625] The 2012 Final Rule noted, however, that several high-quality studies indicated that the rebound effect's magnitude is significantly diminishing over time as incomes rise.[626] This income effect on rebound makes clear that the projected future estimates are in fact much more accurate than historical estimates. Moreover, more than 15 years will have passed since the 2010 Final Rule found a 10% rebound effect to be a good compromise and the implementation of the Proposed Standards, and income has continued to grow since that time, supporting a substantially diminished rebound effect.

EPA should give more weight to the fact that the rebound effect varies with income over time. In the 2021 rule, the agency cited Gillingham (2014) to assert that the evidence of how the rebound effect varies with income is "mixed," but then also correctly excluded that study from its list of preferred studies. Gillingham (2014) specifically considers the response to the 2008 gasoline price shock in California. EPA is correct to conclude that this was "an unusual period when gasoline prices were particularly salient to consumers." 2021 RIA at 3-6 to 3-7. As EPA noted, Gillingham explained in a follow-up paper in 2020 that the Gillingham (2014) results should not be used for developing an estimate of the VMT rebound effect for fuel economy or GHG standards. 2021 RIA at 3-7. The Gillingham (2014) paper is equally irrelevant to the question of the income effect on rebound. Various papers have confirmed that the rebound effect is declining over time and one study certainly should not be used as the basis for giving this factor "less weight," especially a study whose own author acknowledges its irrelevance to this rulemaking context and to which EPA gives little to no weight otherwise. Because of this, EPA should more fully consider the impacts of the income effect on rebound, and in doing so, could support a rebound effect of a magnitude lower than 10%.

In fact, the income effect on rebound is particularly important in the context of setting LDV GHG emissions regulations for two reasons. First, even the most recent relevant studies on which rebound estimates are based consider data only from 2013 and earlier. The historical

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[624] *See, e.g.*, 2016 Draft TAR at 10-14 and 10-20; 77 Fed. Reg. at 62924, 62995; *accord* Small K. & K. Van Dender, *Fuel Efficiency and Motor Vehicle Travel: The Declining Rebound Effect*, 28 Energy J. 25 (2007); Hymel, K. et al., *Induced Demand and Rebound Effects in Road Transport*, 44 Transp. Rsch. Part B 1220 (2010).

[625] 77 Fed. Reg. at 62924.

[626] NHTSA, Corporate Average Fuel Economy for MY 2017-MY 2025 Passenger Cars and Light Trucks: Final Regulatory Impact Analysis, at 851-52 (2012) (citing Small & Van Dender (2007) (finding average rebound to be 22% for 1966-2001, but declining to 11% when looking at only 1997-2001); Hymel et al. (2010) (finding that average rebound for 1966 through 2004 was 24%, but rebound by 2004 was only 13%); Greene, D., *Rebound 2007: Analysis of Light-Duty Vehicle Travel Statistics* (Mar. 2010) (internal EPA research) (estimating the rebound effect would be 10% in 2010 and 8% in 2030, using 1966-2007 data); *see also* Greene (2012) (same)).

growth rate of per capita personal income was 1.4% between 2001 and 2019,[627] and thus income growth since 2013 would indicate a declining rebound effect even in the time since the most recent data utilized were collected. Second, EPA's final standards will affect the fuel efficiency—and therefore the rebound effect—for vehicles for the next 30 years or more. Private forecasts have estimated approximately 1.6% growth in real personal income per year over the next 30 years, *see* 85 Fed. Reg. at 24675 n.1763, meaning that when most vehicles subject to the regulations are retired, incomes will be at least 61% higher than they are today (which are already higher than during the time periods in which the available rebound studies were conducted).[628] More recent projections in AEO 2023 anticipate incomes rising even more than prior estimates—an average of 2.4% per year through 2050.[629] This income growth would be expected to cause a large reduction in the magnitude of the rebound effect, supporting a rebound effect for the vehicles subject to EPA's final standards of a magnitude well below 10%.

C. It is reasonable for EPA to assume no rebound driving for BEVs.

Based on several recent studies looking at VMT for BEVs, and two studies specifically considering BEV rebound, EPA's Proposed Rule assumes that the rebound effect for BEVs is 0% rather than the 10% value the Agency uses for combustion vehicles. It is reasonable for EPA to assume no rebound driving for BEVs for the reasons stated in the DRIA, *see* DRIA at 4-14 to 4-17, and because longstanding rebound research indicates that rebound is likely more a response to fuel prices than to fuel efficiency.

The rebound effect relevant to these standards—for all vehicles, but especially with respect to BEVs—is fuel efficiency rebound. A substantial body of research indicates that fuel price or fuel cost rebound effects are higher than fuel economy rebound effects, meaning that rebound may be more responsive to fuel prices than fuel efficiency. Both Greene (2012) and Hymel and Small (2015)—two of EPA's seven most preferred studies—came to this conclusion. Other studies cited by EPA—Gillingham (2012), Small and Van Dender (2007), West et al. (2015), and Wang and Chen (2014)—also concluded the same. Kenneth A. Small has explained that his studies indicate that the fuel economy rebound effect "is statistically indistinguishable from zero," and that "[t]his is also true of the vast majority of other studies that have tried to measure separately these two responses."[630] He further explained that "the most defensible result empirically is that people do respond to fuel prices as expected, but that they do not respond to fuel economy at all," and that "Small and Van Dender (2007) make this point explicitly, and point out that we are therefore assuming a positive [fuel economy] rebound effect when actually

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[627] *See* Amicus Brief of Economists at 16 for calculation of 1.4% growth rate.
[628] Amicus Brief of Economists at 16.
[629] U.S. Energy Information Administration, Annual Energy Outlook 2023, Table 20: Macroeconomic Indicators, https://www.eia.gov/outlooks/aeo/data/browser/#/?id=18-AEO2023&cases=ref2023&sourcekey=0.
[630] Kenneth A. Small, Comment Letter at 2.

we cannot prove that it's greater than zero."[631] Greene (2012) also found that the impact of fuel efficiency on VMT was not statistically significant, a point EPA referred to in the 2016 Draft TAR to suggest that the relevant rebound effect for policymaking purposes "could be zero." 2016 Draft TAR at 10-14.[632] And Wenzel & Fujita (2018) found that vehicles with the highest fuel economy—but still vehicles significantly less efficient than BEVs—had notably lower rebound rates than vehicles with lower fuel economy, with an average rebound effect well below 10%.[633]

Additional very recent research that has been presented but is not yet published provides further support for EPA's 0% BEV rebound effect. Spiller et al. (2023) investigated the existence of rebound effects in annual miles driven for BEV owners.[634] The study "compile[d] household level fleet data in Massachusetts to perform an event-study and difference-in-difference analysis, comparing miles driven after new vehicle purchases" across BEVs and combustion vehicles.[635] The analysis distinguished between BEVs purchased as additions to the household fleet versus replacement vehicles, and used propensity score matching to find an appropriate control group. Spiller et al. (2023) "estimate[d] the elasticity of VMT to changes in gasoline prices for households with and without BEVs, using a fixed effect model and instrumenting for the price of gasoline with the price of crude oil in the international markets," and found that "EV households shift VMT to EVs when gasoline prices increase, although the increase in driving after the purchase of a new vehicle does not differ across fuel type, suggesting the absence of a rebound effect."[636] EPA should include discussion of Spiller et al. (2023) in its final rule if the research is published or available in a working paper form prior to promulgation of the final rule.

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[631] *Id.* In the 2020 Final Rule, EPA relied on Linn (2016) to support an argument that fuel economy rebound is greater than fuel price rebound. Linn (2016), however, described the separate coefficients for fuel price and fuel economy changes as statistically insignificant. Linn, J., *The Rebound Effect of Passenger Vehicles*, 37 Energy J. at 277 (2016). Moreover, Linn also explained that self-reported VMT data (as was used for his research) "may be noisy when compared to VMT calculated from multiple odometer readings," and that therefore studies that use VMT based on multiple odometer readings—such as all of those enumerated above—"should have lower measurement error, and yield preferable estimates from a statistical point of view." Joshua Linn, Comment on Proposed MY 2021-2026 Standards, NHTSA-2018-0067-7188, at 2 (Oct. 11, 2018).

[632] Additionally, this point is relevant to the discussion above regarding 10% rebound being a maximum estimate for combustion vehicles. Because some of EPA's seven most preferred studies consider fuel prices rather than fuel efficiency, the most accurate rebound estimate would be no higher than—and likely lower than—the average of those studies' best estimates.

[633] Tom Wenzel & K. Sydney Fujita, *Elasticity of Vehicle Miles of Travel to Changes in the Price of Gasoline and the Cost of Driving in Texas*, Lawrence Berkeley National Laboratory (Mar. 2018) at iv (explaining that rebound for "high MPG" vehicles—which are still less efficient than BEVs—is estimated to be 5.2%).

[634] *See* American Economic Association, AASA Annual Meeting 2023 Program, Abstract for Beia Spiller, Kenneth Gillingham & Mart Talevi, *The Electric Vehicle Rebound Effect* (Jan. 6, 2023), https://www.aeaweb.org/conference/2023/program/1610?q=eNqrVipOLS7OzM8LqSxIVbKqhnGVrAxrawGlCArI.

[635] *Id.*

[636] *Id.*

XXVI. BEV Safety Should Not Be a Constraining Factor in This Rulemaking.

We agree with EPA's conclusion that, taking safety into consideration, the standards are appropriate under Section 202(a). 88 Fed. Reg. at 29347. While some have put forward misguided arguments about the safety of BEVs as a reason for EPA to set weak standards in this rulemaking, those claims miss the mark for many reasons. BEVs have been on the road in appreciable numbers for more than a decade already, and BEV sales will continue to grow due to market forces alone. OEMs, trade and professional associations, and safety authorities at all levels have long been studying, planning for, and responding to BEV safety matters.[637] With or without this rulemaking, the number of BEVs will continue to grow, and safety research, planning, and design efforts will continue apace. Thus, safety should not act as a constraining factor in this rulemaking.

In the Proposal, EPA considered the impact of projected changes in vehicle weight on safety, including heavier BEV vehicles. *See* 88 Fed. Reg. at 29387-88; DRIA Ch. 9.4. EPA relied on analysis developed by the National Highway Traffic Safety Administration (NHTSA), which found no statistically significant impact on safety due to vehicle weight changes, holding vehicle footprint constant. 88 Fed. Reg. at 29387 n.796.[638] EPA also considered the possible safety effects of changes in fleet composition due to changes in new vehicle sales and fleet turnover, also relying on underlying analysis by NHTSA. *See* DRIA Ch. 9.4. Based on these analyses, EPA concluded that "there are no changes to the vehicles themselves, nor the combined effects of fleet composition and vehicle design, that will have a statistically significant impact on safety." 88 Fed. Reg. at 29387.

While EPA did not find any statistically significant impacts on safety from changes in vehicle weight and fleet turnover, EPA nonetheless quantified those impacts, based on NHTSA's

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[637] Indeed, these efforts began more than a decade ago. For example, in 2010, the National Fire Protection Association and SAE International hosted a summit on EV safety standards. Am. Nat'l Standards Inst. (ANSI), U.S. *National Electric Vehicle Safety Standards Summit Report Released* (Jan. 5, 2011), https://www.ansi.org/news/standards-news/all-news/2011/01/us-national-electric-vehicle-safety-standards-summit-report-released-05. And in 2011, ANSI convened a workshop on behalf of the U.S. DOE "to consider current and future U.S. domestic, regional, and international standards, codes, and conformity assessment activities needed to facilitate the introduction and widespread deployment of grid-connected electric vehicles." ANSI, *ANSI Workshop: Standards and Codes for Electric Drive Vehicles* (Apr. 5-6, 2011), https://share.ansi.org/Shared%20Documents/Meetings%20and%20Events/EDV%20Workshop/EDVSponsorship.pdf

[638] In addition, the weight of future BEVs will be influenced by a variety of factors, including developments in battery chemistries and other technologies that could reduce weight. *See generally* Sebastian Blanco, *The Future of Solid-State Batteries*, J.D. Power (Apr. 3, 2023), https://www.jdpower.com/cars/shopping-guides/the-future-of-solid-state-batteries; Chris Teague, *What You Need To Know About Solid-State Batteries*, Autoweek, https://www.autoweek.com/news/technology/a36189339/solid-state-batteries/ (last visited June 15, 2023); Michael Bull, *Mass Reduction and Performance of PEV and PHEV Vehicles* (undated), https://www-esv.nhtsa.dot.gov/Proceedings/22/files/22ESV-000346.pdf; Stanley, *How Electric Vehicle Light-weighting is Changing the Automotive Industry*, https://www.stanleyengineeredfastening.com/en/News%20and%20Stories/How%20Electric%20Vehicle%20Light-weighting%20is%20Changing%20the%20Automotive%20Industry (last visited June 15, 2023).

underlying analysis, as well as the impacts of rebound driving (*i.e.*, increased driving due to lower fueling costs). *Id.* at 29387. EPA's modeling projected that over the full period of 2027-2055, the Proposal would lead to an increase of 1,595 vehicle fatalities from all three sources (weight changes, fleet turnover changes, and rebound driving). *Id.* As EPA notes, this is of a similar scale to the expected *reductions* in premature deaths from air pollution in just a single year (2055) that would result from the Proposed Standards. *Id.* at 29388.

As EPA explained in its proposal for the Phase 3 Heavy-Duty GHG standards, numerous standards and codes govern BEV safety. 88 Fed. Reg. at 25962; Phase 3 DRIA Ch. 1.5.2. BEVs must meet the same federal safety requirements and undergo the same safety testing as combustion vehicles.[639] Evidence shows that BEVs "are at least as safe" as combustion vehicles in terms of crashworthiness test performance, while "injury claims are substantially less frequent" for BEVs than for combustion vehicles.[640] And on some safety metrics, BEVs perform substantially *better* than combustion vehicles. Due to their battery architecture, for example, BEVs typically have a lower center of gravity than combustion vehicles, which increases stability and reduces the risk of rollovers[641] (the cause of up to 35% of accident deaths[642]).

Fire risk and emergency response can also be managed effectively. BEVs are significantly less likely to catch fire than combustion vehicles in the first place.[643] While BEVs can behave differently in fires than combustion vehicles, emergency responders have been gaining experience in BEV fire response as the number of BEVs on the road has grown. Numerous agencies and associations, including the National Transportation Safety Board,[644] National Highway Traffic Safety Administration,[645] and National Fire Protection Association,[646] have established fire safety and emergency response recommendations for BEVs. The National Fire Protection Association and other organizations offer BEV fire response trainings,[647] as do

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[639] DOE, *Maintenance and Safety of Electric Vehicles*, Alternative Fuels Data Center, https://afdc.energy.gov/vehicles/electric_maintenance.html (last visited June 15, 2023).
[640] Insurance Inst. for Highway Safety, *With More Electric Vehicles Comes More Proof of Safety* (Apr. 22, 2021), https://www.iihs.org/news/detail/with-more-electric-vehicles-comes-more-proof-of-safety.
[641] DOE, *Maintenance and Safety of Electric Vehicles*.
[642] CleanTechnica, *The EV Safety Advantage* 4 (2018), https://cleantechnica.com/files/2018/07/CleanTechnica-EV-Safety-Advantage-Report.pdf.
[643] *See* Rachel Bodine, *Gas vs. Electric Car Fires [2023 Findings]*, AutoinsuranceEZ (Nov. 11, 2022), https://www.autoinsuranceez.com/gas-vs-electric-car-fires/ (calculating rate of car fires using National Transportation Safety Board data).
[644] *See, e.g.*, NTSB, *Risks to Emergency Responders from High-Voltage, Lithium-Ion Battery Fires Addressed in Safety Report* (Jan. 13, 2021), https://www.ntsb.gov/news/press-releases/Pages/NR20210113.aspx.
[645] *See, e.g.*, NHTSA, *Interim Guidance for Electric and Hybrid-Electric Vehicles Equipped With High Voltage Batteries* (2012), https://www.nhtsa.gov/sites/nhtsa.gov/files/interimguide_emergencyresponse_012012_v3.pdf.
[646] *See, e.g.*, R. Thomas Long Jr., et al., *Best Practices for Emergency Response to Incidents Involving Electric Vehicles Battery Hazards: A Report on Full-Scale Testing Results* (2013), https://www.nfpa.org/-/media/Files/News-and-Research/Fire-statistics-and-reports/Electrical/EV-BatteriesPart-1.ashx.
[647] *See generally* Nat'l Fire Protection Ass'n, *Training that Helps Keep You Protected*, https://www.nfpa.org/EV (last visited June 15, 2023).

OEMs, which also produce emergency response guides for their vehicles.[648] The National Institute for Automotive Service has also developed safety-related standards and a testing and certification program for automotive technicians who service BEVs.[649] Expected future use of solid state batteries will further reduce BEV fire risk.[650] Other research efforts have identified battery designs that can improve thermal management,[651] as well as improved methods of extinguishing battery fires.[652]

In sum, EPA properly considered the impact of the Proposal on safety, including by placing vehicle safety impacts "in the context of all projected health impacts from the rule including public health benefits from the projected reductions in air pollution." 88 Fed. Reg. at 29345. In addition, the public and private sectors have been working diligently to address BEV safety considerations; those efforts will continue as the number of BEVs on the road grows, regardless of EPA's regulatory actions. EPA is correct in not treating safety as a constraining factor in this rulemaking.

XXVII. Stronger Standards Will Improve U.S. Energy Security.

Energy security considerations also support strong final standards. Reducing U.S. reliance on oil enhances U.S. energy security, and—with energy security in mind—Congress has specifically directed the U.S. to conserve energy. Energy Policy and Conservation Act of 1975, 42 U.S.C. § 32902(f). EPA defines energy security as "the uninterrupted availability of energy sources at affordable prices," 88 Fed. Reg. at 29388; DRIA at 11-1, and states that "[t]he goal of U.S. energy independence is the elimination of all U.S. imports of petroleum and other foreign sources of energy, but more broadly, it is the elimination of U.S. sensitivity to variations in the price and supply of foreign sources of energy." 88 Fed. Reg. at 29388. Despite increases in domestic oil production that have made the United States an energy exporter, EPA should continue to consider the energy security impacts of GHG standards. EPA notes that combustion vehicles continue to present an energy security risk because the United States remains vulnerable to "episodic oil supply shocks and price spikes." *Id.* U.S. refineries continue to import heavy crude oil from potentially unstable regions of the world, and sudden disruptions in supply pose a threat to U.S. financial and strategic interests. DRIA at 11-1. Moreover, EPA is correct that "oil exporters with a large share of global production have the ability to raise or lower the price of oil by exerting the market power associated with the Organization of Petroleum Exporting Countries

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[648] DOE, *Maintenance and Safety of Electric Vehicles*.
[649] FleetMaintenance, *ASE unveils new EV standards, testing, and certification* (May 4, 2023), https://www.fleetmaintenance.com/equipment/safety-and-technology/article/53059346/national-institute-for-automotive-service-excellence-ase-ase-unveils-new-ev-standards-testing-and-certification.
[650] Blanco, at 3; Teague, at 5.
[651] *See generally* Chuanbo Yang et al., *Compressible battery foams to prevent cascading thermal runaway in Li-ion pouch batteries*, J. Power Sources, Sept. 1, 2022, https://doi.org/10.1016/j.jpowsour.2022.231666.
[652] *See, e.g.*, Int'l Ass'n Fire & Rescue Services, *New revolutionary method tested extinguishes lithium-Ion EV fires in ten minutes with minimal water use* (Mar. 22, 2023), https://www.ctif.org/news/new-revolutionary-method-extinguishes-lithium-ion-ev-fires-ten-minutes-minimal-water.

(OPEC) to alter oil supply relative to demand," *id.*, which would cause oil price shocks that have greater impacts when nations are heavily reliant on oil. Because the Proposed Standards will significantly reduce U.S. reliance on foreign oil, *see* 88 Fed. Reg. at 29388, Tbl.198 (showing decrease of 42,000 barrels of imported oil per day in 2027 and decrease of 2.3 million barrels of imported oil per day by 2055, and even greater import reductions under Alternative 1), EPA's Proposal and Alternative 1 both enhance U.S. energy security and make progress toward the goal of energy independence.

For the Proposal, EPA has quantified the energy security risks using a macroeconomic oil security premium. 88 Fed. Reg. at 29389. Oil security premiums measure the extra cost of importing oil beyond the price paid for the oil itself (or, in the case of a reduction in demand, the extra benefit of reducing oil imports beyond the actual expenditures saved). The main input to calculating the oil security premium is the macroeconomic benefit, which measures the potential macroeconomic disruptions and increased oil import costs to the economy resulting from oil price spikes or "shocks," or the value of avoiding these costs due to less domestic reliance on oil. In estimating the macroeconomic benefit used to calculate oil security premiums, EPA has historically relied on research conducted by Oak Ridge National Laboratory (ORNL), and EPA again takes this approach in the Proposal.[653] *Id.* EPA has estimated macroeconomic oil security premiums based on ORNL's methodology developed in 1997 and updated in 2008[654] for a series of past rulemakings including the 2010, 2012, and 2021 Final Rules and the heavy-duty vehicle GHG and fuel economy Phase I and Phase II standards and Phase III proposal.[655] In this Proposal, EPA reasonably utilizes the long-used ORNL methodology and applies the same values for the price elasticity of demand for oil and elasticity of GDP to oil price shocks as for the 2021 Rule. DRIA at 11-28 to 11-29. Similarly, EPA reasonably calculates the oil import reduction factor by the same method used for the most recent rulemaking. *Id.* at 11-25.

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[653] In this Proposal, EPA reasonably calculates the macroeconomic oil security premiums using the same price elasticity of demand for oil and the same elasticity of GDP to an oil price shock as for the 2021 Rule. DRIA at 11-28 to 11-29.

[654] Leiby, P.N., *Estimating the Energy Security Benefits of Reduced U.S. Oil Imports, Final Report*, ORNL/TM-2007/028, Oak Ridge National Laboratory (Rev. Mar. 14, 2008); Leiby, P.N. et al., *Oil Imports: An Assessment of Benefits and Costs*, ORNL-6851, Oak Ridge National Laboratory (Nov. 1997); *see also* R. Uria-Martinez, et al., *Using Meta-Analysis to Estimate World Oil Demand Elasticity*, ORNL Working Paper (2018).

[655] The 2020 LDV GHG standards proposal also relied on the ORNL literature and methodologies for estimating oil security premiums, and only the 2020 Final Rule abandoned this research and methodology, instead relying on a single paper (Brown (2018)) to drastically reduce oil security premiums. Stephen A. Brown, *New Estimates of the Security Costs of U.S. Oil Consumption*, 13 Energy Policy 171-92 (2018). Reliance on Brown was inappropriate for two reasons: (1) EPA failed to provide adequate justification for departing from the established ORNL methodologies and research that had been used for over 20 years to instead rely on a single study; and (2) the 2020 Final Rule did not appear to have used Brown's best or most accurate estimates in setting oil security premiums, but rather used estimates that even Brown (2018) suspected to be inaccurate. *Id.* at 181 (noting that Brown's estimate of the "combined" value for oil security premiums "might best reflect the uncertainty in what we know about oil security premiums," and that the values derived from only the most recent research—which EPA used in the 2020 Final Rule—may not be the most reliable).

In addition to the macroeconomic oil security premium, military and monopsony benefits are considered energy security benefits of reduced U.S. oil demand. DRIA at 11-2, 11-30 to 11-32. While EPA has historically refrained from applying these values in any quantified way, it is important to recognize that energy security benefits that take into account only the macroeconomic oil security premiums could be low estimates. EPA's Proposal correctly explains that one cost of oil use is "maintaining a military presence to help secure a stable oil supply from potentially vulnerable regions of the world," *id.* at 11-30, and therefore, reducing domestic reliance on oil has the potential to result in some form of military benefit. EPA states that the Agency does not include these benefits because they are hard to quantify. *Id.* at 11-31 to 11-32. EPA is encouraged to consider methodologies for quantifying these benefits in the future, and to acknowledge that their existence makes EPA's current estimations of energy security benefits conservative.

Finally, EPA is correct that electricity used in PEVs will "improve the U.S.'s overall energy security position," 88 Fed. Reg. at 29389, because electricity is more affordable and less price volatile than oil, a point that numerous sources support.[656] Even more importantly, the electricity will be almost exclusively produced in the United States, "mov[ing] the U.S. towards the goal of energy independence." *Id.* Additionally, PEVs offer significant energy security benefits in that "[e]lectric vehicles can be powered by any energy source because all energy sources can be converted to electricity."[657] Unlike combustion vehicles—which can be powered only by oil—PEVs can utilize solar, wind, hydroelectric, geothermal, or any other electricity resources available to the grid.[658]

Critical minerals needed for EV batteries do not raise the same energy security concerns because these minerals are not the source of energy for U.S. vehicles, but a component of their manufacture. We agree with EPA that increased electrification does not constitute a vulnerability

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[656] *See, e.g.*, Talor Gruenwald, *Reality Check: The Myth of Stable and Affordable Natural Gas Prices*, Rocky Mountain Institute (Nov. 17, 2021), https://rmi.org/the-myth-of-stable-and-affordable-natural-gas-prices/ ("Electricity prices, which are driven by the costs of a variety of fuels including renewables, are much less susceptible to individual commodity price shocks."); Jeremy Martin, *Why Are Gasoline Prices So Volatile?*, Union of Concerned Scientists (Mar. 29, 2022), https://blog.ucsusa.org/jeremy-martin/why-are-gasoline-prices-so-volatile/ (explaining the price volatility of the oil market and noting that its global nature "means that U.S. consumers remain vulnerable to changes in oil prices across the globe" and that "electricity prices are far less volatile than gasoline."); U.S. Department of Energy, *Saving Money with Electric Vehicles* (Sept. 28, 2022), https://www.energy.gov/energysaver/articles/saving-money-electric-vehicles (noting that "electricity is less expensive than gasoline," and that "[p]etroleum prices are historically very volatile and change substantially over time," while "electricity prices are much more stable.").

[657] Nicholas Brown, *EVs Provide Energy Security, Aid Energy Transitions During Conflicts*, Clean Technica (July 12, 2022), https://cleantechnica.com/2022/07/12/evs-provide-energy-security-aid-energy-transitions-during-conflicts/.

[658] *Id.*; *see also* Lee F. Gunn, *Electric Vehicles Improve Our National Security*, Orlando Sentinel (June 9, 2023), https://www.orlandosentinel.com/2023/06/09/electric-vehicles-national-security-opinion/ ("Diversified energy resources and EVs are already beginning to reduce our dependence on unpredictable oil-exporting partners. Accordingly, EVs can reduce our exposure to energy supply shocks and, importantly, limit the risk of supply disruptions for military operations.").

to national security because the utilization of critical minerals is fundamentally different from the utilization of foreign oil. As EPA explains, oil is consumed as a fuel and is a continuous input necessary for vehicle operation, while minerals are used only in the vehicle production phase and become a constituent of manufactured vehicles, with the potential to be recovered and recycled. 88 Fed. Reg. at 29323.

Minerals are "an input to the construction" of vehicles and their infrastructure rather than "a fuel that is combusted on an ongoing basis," meaning that "the near term risk is not one of 'traditional' energy security (short-term supply constraints or high prices)."[659] Critical minerals do not pose energy security concerns because, "unlike reliance on oil (where the resource is consumed with each trip) EVs consume locally produced electricity with each trip and additional lithium is only required when the battery is replaced or a new vehicle is purchased."[660] An event squeezing or shutting off the supply of oil would have "an almost immediate deleterious effect on transportation," but a squeeze in critical mineral supply would allow "batteries in existence [to] continue to function," and "there [would] not be a fundamental disruption of the transportation sector."[661] Increases in oil prices and decreases in supply impact all drivers, and easing this dependence through electrification would shield drivers from daily price volatility. Moreover, whereas "fuel is burnt once," EV battery materials "can be reused and recovered in a circular loop to produce new batteries."[662] Recyclers such as Redwood Materials and Li-Cycle can recover up to 95% of the minerals from old batteries at commercial scale today.[663]

Finally, combustion vehicles will remain in production and operation for many years, diversifying the one-time and ongoing inputs needed for vehicles and allowing the U.S. battery supply chain time to stabilize through increased domestic mining and production, advances in battery design and recycling, and cooperation with allies over the next decade.

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[659] Sara Hastings-Simon & Morgan Bazilian, *Critical Minerals Don't Burn Up – Why the Energy Security Playbook Needs a Re-Write*, Global Policy (July 23, 2020), https://www.globalpolicyjournal.com/blog/23/07/2020/critical-minerals-dont-burn-why-energy-security-playbook-needs-re-write.

[660] Fred Stein, *Ending America's Energy Insecurity: Why Electric Vehicles Should Drive the United States to Energy Independence*, 9 Homeland Security Affairs (Feb. 2013), https://www.hsaj.org/articles/236.

[661] *Id.*

[662] Transport & Environment, *From Dirty Oil to Clean Batteries* 6–7, 41 (2021), https://www.transportenvironment.org/wp-content/uploads/2021/07/2021_02_Battery_raw_materials_report_final.pdf.

[663] Redwood Materials, *Recycling, Refining, and Remanufacturing Battery Materials for a Clean Energy Future*, Redwood Materials, https://www.redwoodmaterials.com/solutions/.
Li-Cycle, Full-Service Solution for Recycling Lithium-ion Batteries, https://li-cycle.com/services/#closed-loop-battery-resource-recovery.

XXVIII. U.S. Employment in the Auto Sector is Likely to Increase as Electrification of the Vehicle Fleet Grows.

Finally, we turn to employment considerations. EPA is correct that the employment effects of environmental regulation "are difficult to disentangle from other economic changes (especially the state of the macroeconomy) and business decisions that affect employment, both over time and across regions and industries," 88 Fed. Reg. at 29390, and that there is some uncertainty in the data regarding specific job impacts of increased electrification, *id*. EPA notes that although BEVs have fewer parts than combustion vehicles, initial results of a vehicle tear-down study commissioned by the Agency and performed by FEV Consulting suggest that the labor hours needed to assemble BEVs and combustion vehicles are "very similar." 88 Fed. Reg. at 29392; DRIA at 2-57 to 2-58. The teardown study performed a side-by-side analysis of significant systems and subsystems to develop a projected cost model comparing a "relatively equivalent" BEV (2021 Volkswagen ID.4) and a combustion vehicle (2021 Volkswagen Tiguan). DRIA at 2-57.[664] Although the full final results of EPA's commissioned study are not yet publicly available, the information provided in the docket indicates a well-designed peer-reviewed analysis that considered platform optimization, used an absolute costing approach, considered potential differences in incremental costs, and involved a detailed labor assessment for each component. *Id*. The docket includes detailed slides from FEV Consulting summarizing the preliminary cost results of the study, and EPA should further incorporate these and other relevant results from the FEV Consulting research into the Agency's support for the final rule.[665]

EPA's DRIA notes two additional older teardown studies that the Agency considered in its analysis—a 2017 UBS teardown of the Chevy Bolt EV, and a 2017–2018 teardown study of several EV components performed for CARB—neither of which was as comprehensive or comparative as EPA's project with FEV Consulting, and neither of which specifically looked at total labor hours.[666] *See* DRIA at 2–58. At least one other recent teardown study has considered labor hours and come to a conclusion similar to FEV Consulting's analysis—that "very similar" labor hours are needed between BEVs and combustion vehicles—finding that BEVs require 99% of the total labor hours per vehicle compared to combustion vehicles, primarily due to battery cell manufacturing, and PHEVs require *more* labor than combustion vehicles.[667] As automakers have already begun taking significant steps toward on-shoring battery manufacturing and the rest

[664] *See also* Michael Safoutin, *Cost and Technology Evaluation, Conventional Powertrain Vehicle Compared to an Electrified Powertrain Vehicle, Same Vehicle Class and OEM*, Memo to EPA Docket # EPA-HQ-OAR-2022-0829-0422 (Apr. 18, 2023).
[665] *See* FEV Consulting, *EPA FEV Cost and Technology Evaluation VW Tiguan and VW ID4*, Attachment to Safoutin, *Cost and Technology Evaluation*, Memo to EPA Docket # EPA-HQ-OAR-2022-0829-0422 (Apr. 18, 2023).
[666] The UBS project was an EV teardown only, and UBS did not conduct a side-by-side comparison with a similar combustion vehicle, and the CARB project involved only specific components from strong hybrids and plug-in hybrids, which have cost profiles very different from BEVs.
[667] Daniel Kupper et al., *Shifting Gears in Auto Manufacturing*, Boston Consulting Group (Sept. 28, 2020), https://www.bcg.com/publications/2020/transformative-impact-of-electric-vehicles-on-auto-manufacturing.

of the PEV supply chain, supported by the significant funding incentives for domestic manufacturing in the BIL and IRA, the United States is well-positioned to capture battery-related and other PEV manufacturing jobs as the PEV sector grows. The positive impact on employment from this increase in vertical integration is illustrated in preliminary results from the Agency's FEV Consulting study, which finds nearly a 50% increase in labor hours in BEV compared to combustion engine manufacturing for a highly vertically integrated manufacturer.[668]

EPA cites reports by the Economic Policy Institute, Seattle Jobs Initiative, and Climate Nexus, all of which found that total U.S. employment in the auto sector could increase with electrification, in particular if the share of vehicles sold in the United States that are produced in the United States increases. 88 Fed. Reg. at 29390–92. In fact, Congress has recognized the benefits of ensuring that large shares of vehicles sold in the United States are produced in the United States. Through the on-shoring incentives in recent legislation, particularly the IRA, Congress has encouraged substantial growth in the domestic ZEV manufacturing and supply chain and has indicated congressional support for increasing numbers of ZEVs in the light-duty fleet in order to meet the nation's climate goals. These IRA incentives are having their intended effects of encouraging development of the domestic ZEV supply chain. As EPA notes, reports by the BlueGreen Alliance and the Political Economy Research Institute estimate that the IRA will create over 9 million jobs over the next decade, with about 400,000 attributed directly to the battery and fuel cell provisions. 88 Fed. Reg. at 29390–91.

Other analyses have found similar positive employment impacts. A University of Massachusetts study of job creation resulting from the IRA found that the IRA's programs, including the law's transportation-sector funding programs that encourage ZEV development, could lead to overall job creation.[669] The analysis estimated significant job increases in the transportation, electricity, and manufacturing sectors, both annually and in total job-years.[670] Analysis of the IRA and BIL by the Boston Consulting Group found that the two laws would increase new U.S. ZEV industry jobs through 2030 from about 455,000 to about 680,000, "primarily due to domestic manufacturing incentives."[671] And, supporting this post-IRA upward trend, EDF recently found that "46,400 announced jobs, representing approximately 32% of all EV job announcements, have occurred in the last 6 months since the passage of the IRA."[672]

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[668] FEV Consulting, *Assembly Times Comparison Draft Report*, EPA-HQ-OAR-2022-0829-0460, Slide 28 (May 9, 2023).
[669] Robert Pollin et al., *Job Creation Estimates Through Proposed Inflation Reduction Act*, University of Massachusetts Amherst Political Economy Research Institute 10-13 (Aug. 4, 2022), https://peri.umass.edu/publication/item/1633-job-creation-estimates-through-proposed-inflation-reduction-act.
[670] *Id.* at 3, 13 (estimating 447,472 additional job-years in relevant transportation jobs due to IRA, along with 31,510 additional job-years due to IRA's EV manufacturing grants under Section 50143 and 114,592 additional job-years due to IRA's clean manufacturing investment tax credit under Section 13501).
[671] Boston Consulting Group, *Impact of IRA, IIJA, CHIPS, and Energy Act of 2020 on Clean Technologies* 3 (April 2023), https://breakthroughenergy.org/wp-content/uploads/2023/04/EV-Cleantech-Policy-Impact-Assessment.pdf.
[672] EDF, *U.S. Electric Vehicle Manufacturing Investments and Jobs: Characterizing the Impacts of the Inflation Reduction Act after 6 Months* 5 (March 2023),

Other analyses in addition to those cited by EPA also have concluded that more stringent GHG standards can lead to positive job impacts. For example, several state-level analyses conducted by ERM using the Impact Analysis for Planning (IMPLAN) model found that state adoption of clean car standards would result in net job increases, assuming that incremental spending on PEV batteries and electric drivetrain components would be in the United States.[673] Moreover, each of these analyses found that the jobs created would be high-quality, high-paying jobs, with average wages for the new jobs between 33% and 100% higher than average wages for the jobs being replaced.[674] Similarly, a state-level analysis conducted by the World Resources Institute (WRI) on increased PEV penetration in Michigan found that the state "stands to gain tens of thousands of high-quality jobs," if it "seize[s] the opportunities" of the PEV sector.[675] Because PEVs are cheaper to drive, the analysis found that "[s]witching to EVs will allow drivers to save money on vehicle purchases, maintenance, and gasoline, which will improve household finances and have positive employment impacts" as consumers spend their extra money throughout the rest of the economy.[676] Analysis on the nationwide impacts of California's clean car policies also projects significant overall job gains resulting from increased production of ZEVs—with over 7.3 million full-time equivalent job-years of employment created through 2045.[677] Another nationwide study found that, compared to a "no new policy" scenario, a scenario with high levels of ZEVs would result in a peak of over 2 million jobs created in 2035, even without accounting for the impact of any additional on-shoring incentives such as those in the IRA.[678]

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https://blogs.edf.org/climate411/files/2023/03/State-Electric-Vehicle-Policy-Landscape.pdf?_gl=1*1uxcnl5*_ga*MTk3NDc4MzQ3NS4xNjMyODU4NDY0*_ga_2B3856Y9QW*MTY3ODgwMjg0Ny4xNTQuMC4xNjc4ODAyODQ5LjU4LjAuMA..*_ga_Q5CTTQBJD8*MTY3ODgwMjg0Ny4xNTMuMC4xNjc4ODAyODQ5LjU4LjAuMA.

[673] Dave Seamonds et al., *New York Advanced Clean Cars II Program*, ERM 20 (Feb. 2023), https://www.erm.com/globalassets/documents/global-policies/new-york-advanced-clean-cars-program-report_2023.pdf (evaluating impacts of Advanced Clean Cars II adoption in New York); Sophie Tolomiczenko et al., *The Benefits of the Colorado Clean Car Standard*, ERM 19–20 (May 2023), https://www.erm.com/globalassets/foundation-annual-report-2023/co_acc_ii_final_report_15may2023.pdf (evaluating Colorado's Clean Car Standards); Sophie Tolomiczenko et al., *New Jersey Advanced Clean Cars II Program*, ERM 21 (April 2023), https://www.erm.com/contentassets/0ea3b193115448cd9dd5c7e3622373a0/new-jersey-advanced-clean-cars-ii-program.pdf (evaluating impacts of Advanced Clean Cars II adoption in New Jersey).

[674] *Id.*

[675] Devashree Saha et al., *A Roadmap for Michigan's Electric Vehicle Future*, World Resources Institute 3 (May 2023), https://files.wri.org/d8/s3fs-public/2023-05/roadmap-michigan-ev-future.pdf?VersionId=v0C1QYM5LrUtDymSBYzR_PGHpKMUmRju.

[676] *Id.* at 10–11.

[677] Austin L. Brown et al., *Driving California's Transportation Emissions to Zero*, University of California Institute of Transportation Studies 327 (April 2021), https://escholarship.org/uc/item/3np3p2t0.

[678] University of California Berkeley Goldman School of Public Policy, *The 2035 Report: Transportation* ES-4 & 22–24 (April 2023), http://www.2035report.com/transportation/wp-content/uploads/2020/05/2035Report2.0-1.pdf?hsCtaTracking=544e8e73-752a-40ee-b3a5-90e28d5f2e18%7C81c0077a-d01d-45b9-a338-fcaef78a20e7.

These new clean vehicle jobs are also poised to have positive environmental justice impacts as they bring significant new jobs to communities of color. Research by Climate Power has found that "[a] majority of new clean energy jobs and projects [resulting from IRA investments] are located in communities of color across America," with Arizona, Georgia, South Carolina, Nevada, and Michigan home to the largest number.[679] Climate Power's report details numerous gigafactories, cathode manufacturing facilities, and ZEV factories that will bring jobs to communities of color nationwide. For example, Kore Power Gigafactory will bring 6,400 jobs to Arizona, in two counties that are 46.6% and 32% Hispanic/Latino, and Scout Motors will open an EV plant in South Carolina, bringing 4,000 jobs to two counties that are between 40% and 50% Black/African American.[680] Climate Power's Clean Energy Jobs Tracker provides detailed data on new clean energy jobs since the passage of the IRA, showing large job growth in numerous states related to battery and ZEV manufacturing.[681]

While certain employment sectors may be impacted over time by increased electrification, as EPA notes, 88 Fed. Reg. at 29392, we agree that this will "happen over a longer time span due to the nature of fleet turnover," *see* Table XVII.G-1 (L/MD PEVs as a Share of Total On-Road L/MD Fleet, 2020–2040), *supra*, with time to retrain workers for better, higher paying jobs, 88 Fed. Reg. at 29392. A World Resources Institute study considering Michigan's automotive industry noted that many new ZEV-sector jobs will require skill development, with opportunities to "re-skill, upskill, or shift to jobs of equal or greater quality," and that much of this "could be addressed as part of normal rates of retirement, given that 52% of all current auto manufacturing workers in Michigan will reach age 65 by 2040."[682] Moreover, programs have already been implemented to train workers with the skills they will need for jobs within ZEV manufacturing. California's Energy Commission, for example, created the state's Clean Transportation Program to "invest[] in manufacturing and workforce training and development, working with a variety of public and private partners."[683] Electric bus company Proterra and community colleges in California joined together to provide a nine-week training program to become electric bus manufacturing technicians, which workers have already used to transition from lower-paying restaurant jobs, for example, to higher-paying union jobs at Proterra.[684] General Motors launched the Automotive Manufacturing Electrical College (AMEC)

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[679] Climate Power, *The Clean Energy Boom in Communities of Color* 1, 4, https://climatepower.us/wp-content/uploads/sites/23/2023/05/Clean-Energy-Boom-Communities-of-Color-Report.pdf (noting plans for 51 new battery manufacturing sites in places like Augusta, Georgia; Tucson, Arizona; and St. Louis, Missouri; and plans for 26 new or expanded EV manufacturing facilities in Pryor, Oklahoma; Montgomery, Alabama; and Detroit, Michigan).
[680] *Id.* at 4–5.
[681] Climate Power, *The Clean Energy Plan*, https://thecleanenergyplan.com/.
[682] Devashree Saha et al., *A Roadmap for Michigan's Electric Vehicle Future* at 8, 10.
[683] California Energy Commission, Workforce Development, https://www.energy.ca.gov/programs-and-topics/programs/clean-transportation-program/clean-transportation-funding-areas-4.
[684] Jill Replogle, *Training a New Workforce for California's Move to Electric Vehicles*, Marketplace (June 28, 2021), https://www.marketplace.org/2021/06/28/training-a-new-workforce-for-californias-move-to-electric-vehicles/.

“to train current and future employees to work on evolving electrical systems in future GM vehicles.”[685] States are also funding training for ZEV-related jobs.[686]

XXIX. Conclusion

EPA should finalize emission standards for light- and medium-duty vehicles that are at least as stringent as Alternative 1 but with increasing stringency from 2030 to 2032 to put the country on track for 100% new ZEV sales by 2035. EPA can and must go further than it has proposed. Adopting the recommendations set forth in this comment letter would result in feasible, cost-beneficial emission standards that would better serve EPA’s statutory mandate to protect public health and welfare.

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[685] General Motors, *Training Manufacturers for the Vehicles of Tomorrow*, https://www.gm.com/stories/amec-electric-manufacturing-workforce.

[686] *See, e.g.*, State of Illinois, *Illinois Drives Electric: Training and Degree Programs*, https://ev.illinois.gov/grow-your-business/training-and-degree-programs.html (noting various job programs with state funding); State of Michigan, *Gov. Whitmer Announces New EV Jobs Academy Website to Connect Michiganders to Careers in Electric Vehicle Industry* (March 1, 2023), https://www.michigan.gov/leo/news/2023/03/01/gov-whitmer-announces-new-ev-jobs-academy-website-to-connect-michiganders-to-careers-in-ev-industry (“The EV Jobs Academy is designed to provide Michiganders with tuition assistance and supportive services, including “earn while you learn” opportunities through a Registered Apprenticeship, to support and streamline onramps to high-wage, in-demand careers. With more than 100 partners including employers, industry stakeholders and education institutions, the EV Jobs Academy is driving the state’s advanced mobility talent development for the future.”).

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