ZETA | ZERO EMISSION TRANSPORTATION ASSOCIATION

July 5, 2023

U.S. Environmental Protection Agency
EPA Docket Center
Office of Air and Radiation Docket
Mail Code 28221T
1200 Pennsylvania Avenue, NW
Washington, DC 20460

RE: Docket No. EPA–HQ–OAR–2022–0829
Multi-Pollutant Emissions Standards for Model Years 2027 and Later Light-Duty and Medium-Duty Vehicles
Submitted via Rulemaking Portal: http://www.regulations.gov.

The Zero Emission Transportation Association (ZETA) is an industry-backed coalition of over 60 member companies advocating for 100% electric vehicle (EV) sales. ZETA is committed to enacting policies that drive EV adoption, create hundreds of thousands of jobs, dramatically improve public health, and significantly reduce emissions. Our coalition spans the entire EV supply chain including vehicle manufacturers, charging infrastructure manufacturers and network operators, battery manufacturers and recyclers, electricity providers, and critical minerals producers, among others.

We thank the U.S. Environmental Protection Agency (EPA) for the opportunity to comment on its notice of proposed rulemaking to set multipollutant emission standards for model years 2027 and later light- and medium-duty vehicles. ZETA encourages the agency to finalize more stringent standards than Alternative One for light-duty greenhouse gas emissions and finalize light-duty multipollutant standards that are equally as stringent. We also encourage the agency to finalize medium-duty GHG and multipollutant standards that are as stringent as possible. We believe these standards are achievable and will ensure the supply chain has the regulatory certainty needed to protect the investments being made today that will put the sector on a path to a zero-emission future.

Contrary to much of the public discourse surrounding these proposed emissions standards, these do not constitute a mandate to sell electric vehicles. The intent of these standards is to reduce tailpipe emissions. The automotive industry, and others that supply it, have chosen electrification as the most commercially viable pathway to achieving the emissions reductions necessary to protect public health, our climate, and the environment. Backtracking on the stringency of these

proposed standards in the final rule will not only jeopardize the health, climate, and environmental benefits but would create regulatory chaos.

Electrification will not only reduce emissions but it will also promote American economic competitiveness, create good-paying jobs, and improve local health outcomes. Private sector investments in the domestic EV supply chain total billions of dollars and support hundreds of thousands of American jobs. Moreover, research has indicated that without adequate regulation of vehicle emissions, U.S. communities would experience avoidable increases in mortality.

Recent trends suggest charging deployment is keeping pace with vehicle deployment. The Department of Energy's Alternative Fuels Data Center has mapped over 139,000 individual charging ports across 54,100 public EV charging stations in the U.S.–and that doesn't include at-home charging where a majority of charging occurs. Coupled with the $7.5 billion in federal IRA investments to expand our national charging network and billions of dollars in private capital means we're well on track today to meet the EV charging needs of tomorrow.

Expanded EV deployment will lead to significant changes to the 24-hour electricity demand cycle. By incorporating emerging technologies such as power storage and grid-scale battery technology, using smart software to optimize charging schedules, capitalizing on time-of-use rates, and ensuring strategic charging buildout, transportation electrification has the potential to become a mechanism for reinforcing and stabilizing U.S. electricity infrastructure.

ZETA supports many of the provisions included in the proposed rule such as the phaseout of off-cycle credit multipliers, the clarification of the medium-duty passenger vehicle definition, and the flattening of the light-duty footprint curves. We also believe there are areas where the proposal could be strengthened to further protect public health and the environment. We expand upon these and many more points in our comments below.

ZETA and our member companies appreciate the opportunity to submit comments on this proposed rule. If you have any questions or concerns, please contact me at al@zeta2030.org.

Sincerely,

Albert Gore
Executive Director

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1. Introduction

The Zero Emission Transportation Association (ZETA) appreciates the opportunity to comment on EPA's proposed rulemaking[1] to set multi-pollutant emission standards for model years 2027-2032 light- and medium-duty vehicles (LMDVs), consistent with Executive Order 14037.[2] ZETA applauds EPA's ambition shown in these proposed standards and we believe EPA should finalize more stringent standards than Alternative One to further incentivize zero emission vehicle deployment and improve local health outcomes. This proposed rulemaking offers an opportunity to begin to phase out internal combustion engine vehicles (ICEVs)—thereby locking in significant emissions reductions, protecting public health and the environment, and backstopping the industry's investments in electrification technologies. These standards will also play a key role in helping achieve the Biden-Harris Administration's blueprint for decarbonizing the transportation sector while adhering to U.S. commitments under the Paris Climate Agreement.[3] The blueprint calls for continuously strengthened vehicle emissions standards through the next two decades as a central pillar of the U.S. GHG reduction strategy.

The light- and medium-duty electric vehicle (LMDEV) markets are primed for rapid growth in the coming years. As discussed further in these comments, hundreds of thousands of vehicles have already been put on U.S. roadways, the diversity of available EV[4] models are growing exponentially, and battery prices are falling rapidly. Significant investments are being made throughout the supply chain to support a smooth transition to mass consumer adoption of EVs. Robust EPA emissions standards will provide the regulatory certainty needed to not only ensure manufacturers continue to invest in LMDEV technologies but that the entire supply chain supporting the transition to electrification will have a clearer picture of how to plan capital expenditures today to meet the increased demand for its products over the coming years.

ZETA again commends EPA for its work on this proposal and we look forward to continued discussion on these critical issues. We believe there are some key areas where the proposed MY 2027-2032 LMDV multipollutant and GHG emissions standards can be improved and strengthened, which we discuss further below in sections 5, 6, and 7 of these comments. These comments will also discuss the public health, environmental, economic, and consumer benefits of electric vehicles while also covering the EV supply chain's preparations for an electrified and decarbonized transportation future.

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[1] *See* 88 FR 29184 (May 5, 2023)
[2] Executive Order 14037 "Strengthening American Leadership in Clean Cars and Trucks," (August 5, 2021) https://www.federalregister.gov/documents/2021/08/10/2021-17121/strengthening-american-leadership-in-clean-cars-and-trucks
[3] The U.S. National Blueprint for Transportation Decarbonization (January 2023) https://www.energy.gov/sites/default/files/2023-01/the-us-national-blueprint-for-transportation-decarbonization.pdf
[4] Unless otherwise noted, ZETA refers to "EVs" in these comments to mean battery-electric vehicles.

2. There is Strong Consumer Demand for EVs

American consumers are quickly becoming accustomed to EVs, and demand is rising rapidly as EVs become more ubiquitous. From 2020 to 2022, Consumer Reports found there was a 350% increase in consumer demand for EVs.[5] A similar ZETA poll found that 71% of Americans are considering an electric vehicle for their next car.[6] The best-selling vehicle worldwide in the first quarter of 2023 was Tesla's Model Y, an all-electric SUV.[7] In the U.S., Tesla's Model 3 was ranked 10th for overall vehicle sales, and the Model Y came in 4th–behind the top-3 vehicles which were all pickup trucks.[8]

This strong interest in EVs is expected to continue to grow throughout 2023, with more than two million EVs sold in the first quarter of this year. IEA expects more than 14 million EVs will be sold globally this year, which would comprise 18% of total passenger vehicle sales.[9] In fact, demand for EVs is expected to exceed supply at the current trajectory. Consumer Reports found there are 45 buyers for every EV produced.[10] Today, EV demand is driven by factors that include cost-savings, environmental protection, increasing model availability, and the ability of an EV to meet a driver's day-to-day needs. The adoption of more stringent emissions standards would incentivize the production of more EVs to meet growing consumer demand while also spurring innovation and increased model availability to meet the needs of an increasingly wider range of consumers.

a. Consumers Prefer to Drive EVs

One of the easiest ways to convert drivers to an EV is to get them behind the wheel of one. EVs have faster acceleration, are a quieter ride, and have a low center of gravity making for a safer and more enjoyable drive.[11] As a result, performance is the most frequently cited reason (75%)

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[5] "Excess Demand - The Looming EV Shortage," Consumer Reports, (March 2023) https://advocacy.consumerreports.org/wp-content/uploads/2023/03/Excess-Demand-The-Looming-EV-Shortage.pdf

[6] "New National Poll Shows That A Large, Bipartisan Majority of Voters Favor Policies To Accelerate Electric Vehicle Adoption," ZETA, (March 28, 2022) https://www.zeta2030.org/news/new-national-poll-shows-that-a-large-bipartisan-majority-of-voters-favor-policies-to-accelerate-electric-vehicle-adoption

[7] "Tesla Model Y Was The World's Best-Selling Car In Q1 2023," Motor1, (May 25, 2023) accessed June 18, 2023 https://www.motor1.com/news/669135/tesla-model-y-worlds-best-selling-car-q1-2023/

[8] "The 25 Bestselling Cars, Trucks, and SUVs of 2023 (So Far)," Car and Driver, (April 10, 2023) https://www.caranddriver.com/news/g43553191/bestselling-cars-2023/

[9] "Demand for electric cars is booming, with sales expected to leap 35% this year after a record-breaking 2022," IEA, (April 26, 2023) https://www.iea.org/news/demand-for-electric-cars-is-booming-with-sales-expected-to-leap-35-this-year-after-a-record-breaking-2022

[10] *Id.* at footnote 5

[11] "Top 5 Reasons to Drive Electric," California Air Resource Board, accessed June 30, 2023 https://driveclean.ca.gov/top-reasons

among drivers who switched to a premium EV. [12] According to J.D. Power, the Rivian R1T ranks highest overall among premium EVs, with a satisfaction score of 794 out of 1,000-points. In particular, owners are pleased with the R1T's driving performance and style.[13]

A study by AAA found that once drivers own an EV, their previously held concerns (e.g., range anxiety, cost, lack of charging) largely disappear. For example, 77% said they had little to no range anxiety after owning an EV.[14] This underscores that many of the commonly-cited barriers to EV adoption can be addressed through experience and education.

In addition to vehicle owners who purchase an EV for personal use, there are a growing number of rideshare operators purchasing or renting EVs. These drivers travel significantly more miles than a typical American, which is on average 40 miles a day.[15] Additionally, they have expressed satisfaction with the EV driving experience. Because of the greater distance traveled, rideshare drivers stand to see the greatest fuel and maintenance cost savings. In fact, cost savings were the number one reason ride-share drivers adopted an EV. Not only have EV drivers seen higher earnings, but 94% of drivers have reported a positive experience with their EV,[16] and up to 93% of them would choose an EV as their next vehicle according to a survey of Uber drivers.[17] Among drivers who do not currently use an EV, more than 60% would switch to an EV.[18]

Many consumers prefer to purchase American-made products and vehicles are no exception. Fortunately, some of the top-selling EVs are made in America. In fact, the top two vehicles on Cars.com American Made Index are the Tesla Model Y and Model 3, with the Model X and Model S coming in 5th and 6th place, respectively.[19] With increasing domestic production requirements tied to the EV tax credit in the IRA, more EVs will be manufactured in America. Automakers have already announced new EV factories across the country, with new models such as the Rivian R1T, Lucid Air, Ford's F-150 Lightning, Polestar 3, and Volkswagen ID.4 being produced in the U.S.

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[12] "Owner Satisfaction Gets a Jolt from New Models as Electric Vehicle Market Grows, J.D. Power Finds," J.D. Power, (February 28, 2023)
https://www.jdpower.com/business/press-releases/2023-us-electric-vehicle-experience-evx-ownership-study
[13] *Id.* at footnote 12
[14] "Owning an Electric Vehicle is the Cure for Most Consumer Concerns," AAA Newsroom, (January 22, 2020)
https://newsroom.aaa.com/2020/01/aaa-owning-an-electric-vehicle-is-the-cure-for-most-consumer-concerns/
[15] "Average Miles Driven Per Year: Why It Is Important," Kelley Blue Book, (May 15, 2023)
https://www.kbb.com/car-advice/average-miles-driven-per-year
[16] "Equitable Electrification: Early Findings from the Uber-Hertz Partnership," Uber Under the Hood, (September 15, 2022)
https://medium.com/uber-under-the-hood/equitable-electrification-early-findings-from-the-uber-hertz-partnership-2774b6f39d9b
[17] "How Uber helps drivers go electric," Uber Under the Hood, (August 29, 2022)
https://medium.com/uber-under-the-hood/how-uber-helps-drivers-go-electric-9e637b69f4de
[18] *Id.* at footnote 17
[19] "2023 Cars.com American-Made Index: Which Cars Are the Most American?," Cars.com, (June 21, 2023)
https://www.cars.com/articles/2023-cars-com-american-made-index-which-cars-are-the-most-american-467465/

Another reason the EV market is growing is simply because consumers prefer the new features and technology in EVs. An article published in June 2023 from Inside Climate News indicated that while some people buy an EV on principle, the rapid rise in sales is poised to continue because consumers like the features that EVs offer.[20] This includes features such as longer battery ranges, faster acceleration, lower total cost of ownership, and that EVs have a higher ride quality than comparable ICEV. As more features are added and technology of EVs improves, more consumers are likely to switch just based on those facts, independent of the environmental or climate change incentive to do so. This indicates that the EV market is broadening to a wider consumer base, which further amplifies the trend of greater adoption among consumers that the market is currently experiencing.

A common misconception is that range anxiety continues to pose a significant barrier to adoption across all vehicle classes. The average U.S. household travels 37 miles per day.[21] The average range on an electric vehicle is 291 miles. The EV models currently available can meet the needs of most American households.[22] Vehicles capable of traveling distances up to 520 miles, such as the Lucid Air Dream Edition R,[23] are being produced today and those with ranges greater than 600 miles are expected after 2023.[24]

In the LDV segment, a recent study found that the majority of EVs that have been driven more than 100,000 miles still have at least 90 percent of their original range left.[25] Bloomberg recently reported that the average range for an EV in the U.S. has quadrupled since 2011, and is today a third higher than the global average.[26] Average range climbed to 291 miles for U.S. EVs in 2022 which addresses another key consumer-focused barrier as EV adoption becomes more widespread.

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[20] "It's the Features, Stupid: EV Market Share Is Growing Because the Vehicles Keep Getting Better," Inside Climate News, (June 8, 2023) https://insideclimatenews.org/news/08062023/inside-clean-energy-electric-vehicle-market-features/

[21] "Average Miles Driven Per Year: Why It Is Important," Kelley Blue Book, (May 15, 2023) https://www.kbb.com/car-advice/average-miles-driven-per-year/#:~:text=Drivers%20in%202021%20drove%20an,about%2035%20miles%20per%20day.

[22] "Longest Range Electric Cars for 2023, Ranked," Car and Driver, (March 23, 2023) https://www.caranddriver.com/features/g32634624/ev-longest-driving-range/

[23] "An absolute triumph of efficiency, Lucid Air achieves 520 miles of range," Lucid Newsroom, (September 16, 2021) https://www.lucidmotors.com/stories/lucid-air-achieves-520-miles-of-range

[24] "Volvo targets 621-mile EV range by 2030 as part of tech focus," Autocar, (June 30, 2021) https://www.autocar.co.uk/car-news/electric-cars/volvo-targets-621-mile-ev-range-2030-part-tech-focus

[25] "New Study: How Long Do Electric Car Batteries Last?" Recurrent Auto, (March 27, 2023) https://www.recurrentauto.com/research/how-long-do-ev-batteries-last

[26] "US Electric Cars Set Record With Almost 300-Mile Average Range," Bloomberg, (March 9, 2023) https://www.bloomberg.com/news/articles/2023-03-09/average-range-for-us-electric-cars-reached-a-record-291-miles#xj4y7vzkg

b. EV Sales are Increasing

Consumer demand for EVs has grown exponentially over the last few years and so too have EV sales. Global passenger EV sales jumped from 1 million in 2017 to over 10 million in 2022. In the first half of the decade, it took the same amount of time for sales to grow from 100,000 to 1 million.[27] This is because Consumer demand is increasing, and will continue to do so as more and more models for all different use cases are offered.

In California, EVs comprised more than 21% of new car sales in the first quarter of 2023.[28] Much of the growth in the electric vehicle stock has occurred over the last few years, with nearly 10% of all EVs sold in the U.S. occurring in the first quarter of 2023. The U.S. is on pace to sell over 1 million EVs this year.[29] The more than 300,000 EVs sold in Q1 is nearly equivalent to the total number sold in the entirety of 2020. Figure 1 depicts the exponential growth in EV sales since 2011.

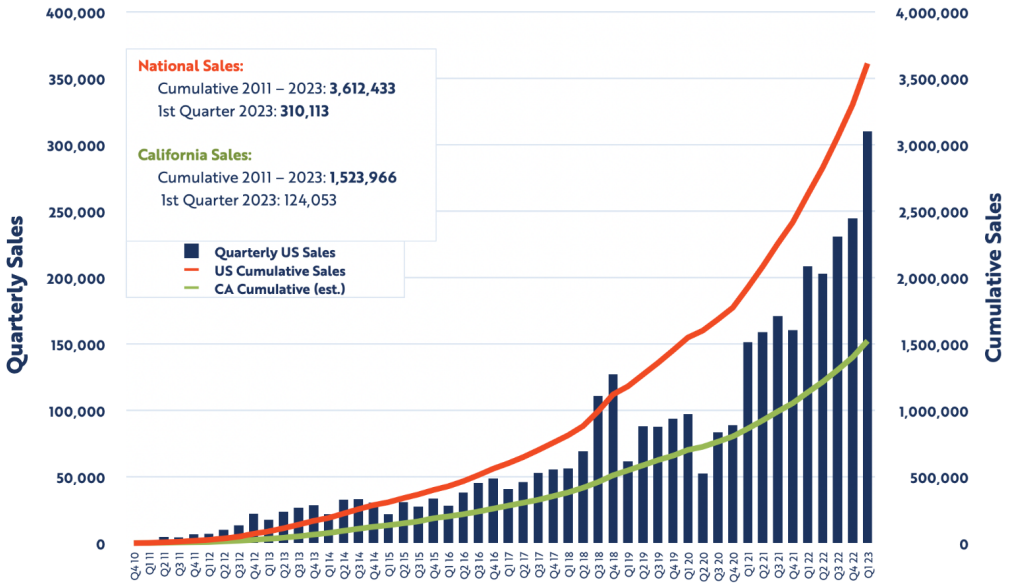

Figure 1: EV Sales in California and the U.S. as of April 2023[30]

[27] "Global EV Outlook 2023: Trends in electric light-duty vehicles," IEA, (2023) https://www.iea.org/reports/global-ev-outlook-2023/trends-in-electric-light-duty-vehicles

[28] "Record-Shattering EV Sales Continue in Q1 2023 as California Reaches the 1.5 Million EVs Sold Milestone Two Years Ahead of Schedule," Veloz, (April 21, 2023) https://www.veloz.org/record-shattering-ev-sales-continue-california-reaches-1-5-million-evs-sold/

[29] "Chart: EV sales on pace to break 1 million in US this year," Canary Media, (April 21, 2023) https://www.canarymedia.com/articles/electric-vehicles/chart-ev-sales-on-pace-to-break-1-million-in-us-this-year

[30] *Id.* at footnote 28

c. State Consumer Incentive Programs are Well-Utilized

In the United States, clear evidence exists that consumer incentives drive EV sales. The states with the greatest number of EV registration per thousand people were California, Hawaii, Washington, Oregon, Vermont, and Colorado.[31] These states all have relatively generous state and local subsidies in addition to available federal subsidies. However, the surge in EV demand and uptick in applications for state rebates and incentives is leading several states to actually halt their programs due to overwhelming demand. It is evident that consumers are increasingly choosing an EV for their next vehicle, and policy development must keep pace.

New Jersey

Rebate programs like "Charge Up New Jersey" have contributed to the significant growth in EV sales in the Garden State. In May 2020, New Jersey began to offer a $5,000 rebate for EV purchases. Since then, annual EV sales increased by over 40% in 2020 from 2019, which was the highest growth rate in the nation.[32] Over that period, Charge Up New Jersey has dispersed funding for more than 25,000 new EVs in the state. In total, there are more than 91,000 EVs on the roads of New Jersey.[33]

However, the program well exceeded expectations and the program was paused three months earlier than planned as it had already exceeded its $35 million annual budget after providing rebates to more than 10,000 New Jerseyans who qualified that year.[34]

Oregon

A similar situation occurred in Oregon, as they paused the Oregon Clean Vehicle Rebate program in May of 2023. It surpassed its $15.5 million budget as the program became more popular than anticipated.[35] Unless additional funding is provided by the state, the program will not be restarted until the next fiscal year begins March 2024.

Next year, the estimated program costs are over $33 million, more than doubling this year's budget.[36] While the pause on the credit might be disappointing for EV purchasers in the state, it

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[31] "These 7 US states lead the nation in EV registrations," Green Car Reports, (March 12, 2023) https://www.greencarreports.com/news/1138974_these-7-us-states-lead-the-nation-in-ev-registrations

[32] "Annual Enacted EV Policies More Than Double Between 2015 and 2020," Atlas EV Hub, (May 7, 2021) https://www.atlasevhub.com/data_story/annual-enacted-ev-policies-more-than-double-between-2015-and-2020/

[33] "New Jersey halts electric vehicle rebates; demand too high," Associated Press, (April 18, 2023) https://apnews.com/article/new-jersey-electric-vehicle-rebate-02c6965ef22f23ffc88fcc4f68857955

[34] *Id.* at footnote 33

[35] "Oregon to temporarily suspend popular EV rebate program," OPB, (March 15, 2023) https://www.opb.org/article/2023/03/15/oregon-ev-rebate-program-electric-vehicles-environment-greenhouse-gas-emissions

[36] *Id.* at footnote 35

is a positive sign that EV adoption is growing and federal, state, and local policies need to adopt accordingly.

California
California leads the U.S. in EV sales with over 1 million full BEV registrations as of April 2023–making up 40% of the total US EV fleet. In the first quarter of 2023, EVs comprised 21.1% of all vehicle sales in the state.[37]

California's success in EV market share is partially due to their Clean Vehicle Rebate Project (CVRP), the first state incentive for EV purchasers. Since 2010, the program has provided more than 500,000 rebates.[38] To cut costs, the program was modified to target more lower-income residents by setting income and MSRP caps. This was because the program was oversubscribed, with demand far exceeding the program's budget. Every year, CVRP's funding runs out, with a lengthy waitlist for when more funding becomes available.[39] As of June 2023, there was more than $275 million in funding available for the CVRP program.[40]

d. EV Prices are Decreasing

One reason for the explosive growth in EV demand is the increasing cost competitiveness of EV models. In fact, ICCT reported that EVs could be the same cost this year for certain mass market models and are already at parity for a few luxury models due to the purchase and production incentives in the Inflation Reduction Act.[41]

Cost is the number one cited barrier when it comes to purchasing an EV. Approximately 60% of Americans would purchase an EV if it were the same price as an ICEV.[42] The price differential between EVs and ICEVs is rapidly shrinking. In 2020, an EV cost about 42% more than an ICEV.[43] Today, an EV costs about 20% more than a similar ICEV, with the average ICEV selling

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[37] "New ZEV Sales in California," California Energy Commission, accessed June 28, 2023 https://www.energy.ca.gov/data-reports/energy-almanac/zero-emission-vehicle-and-infrastructure-statistics/new-zev-sales
[38] "Why States Need Electric Vehicle Incentives Now," Center for Sustainable Energy, (March 27, 2023) https://energycenter.org/thought-leadership/blog/why-states-need-electric-vehicle-incentives-now
[39] "California Electric Car Rebate: Everything You Need to Know," Car and Driver, accessed June 28, 2023 https://www.caranddriver.com/research/a31267652/california-ev-tax-credit/
[40] "CVRP Overview," California Clean Vehicle Rebate Project, accessed June 30, 2023 https://cleanvehiclerebate.org/en/cvrp-info
[41] "Electric Vehicles Could Match Gasoline Cars on Price This Year," The New York Times, (February 14, 2023) https://www.nytimes.com/2023/02/10/business/electric-vehicles-price-cost.html
[42] "International Electric-Vehicle Consumer Survey 2019," AlixPartners, accessed June 21, 2023 https://www.alixpartners.com/insights-impact/insights/international-electric-vehicle-consumer-survey/
[43] "The Average Price of an Electric Car," CarEdge, (September 22, 2022) https://caredge.com/guides/average-price-of-an-electric-car

for $48,008, compared to $58,940 for an EV.[44] This average selling price is inflated by the popularity of luxury EVs on the market. Out of the top ten best-selling EVs in the U.S., the average starting price is $53,509, which drops to a 10% cost premium over ICEVs.[45]

Upfront cost parity might be achieved even sooner than anticipated. The tax incentives in the IRA bring down the cost premium even further, with up to $7,500 available from the federal government, in addition to any state and local incentives. After factoring in the $7,500 federal tax incentive under section 30D, the average starting price is $46,009 for the top-10 best-selling EVs, $2,000 cheaper than the average ICEV.

Today, while most EVs are still more expensive than a comparable ICE vehicle, there are a range of models at all different price points. Some of the most affordable EVs start at around $27,495, before factoring in the federal 30D tax credit.[46] The Tesla Model 3–one of the most popular models in the world–recently reduced its starting price to $41,880 before any incentives.[47] In a similar move, Ford cut the price of its Mustang Mach-E, the third-best selling EV in 2022.[48] After two price cuts in 2023, the starting price of the Mach-E premium is $46,995.[49] Each year there is a growing number of EV models available under $50,000.

The economies of scale and decrease in the cost of components are driving down the price of new models. The production tax credits from the IRA are expected to cut the cost of producing batteries and EVs, savings that can be passed on to customers. With incentives for EV manufacturing, facility upgrades, critical mineral production, and battery manufacturing and assembly, the IRA subsidies could cut costs by up to $9,000 per vehicle.[50] The result is record-breaking EV sales every year, driving up the percentage of new car sales that are electric.

The EV battery is one of the most significant factors in the cost of an EV, comprising 20-50% of the total vehicle cost, though this percentage has decreased significantly over time. This decrease is driven by lithium prices, which have significantly dropped over the last year, from $85,000 to

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[44] "After Nearly Two Years, New-Vehicle Transaction Prices Fall Below Sticker Price in March 2023, According to New Data from Kelley Blue Book," Kelley Blue Book, (April 11, 2022) https://mediaroom.kbb.com/2023-04-11-After-Nearly-Two-Years,-New-Vehicle-Transaction-Prices-Fall-Below-Sticker-Price-in-March-2023,-According-to-New-Data-from-Kelley-Blue-Book

[45] *Id.* at footnote 43

[46] "Here Are the 11 Cheapest Electric Vehicles You Can Buy," Cars.com, (June 28, 2023) https://www.cars.com/articles/here-are-the-11-cheapest-electric-vehicles-you-can-buy-439849/

[47] "Tesla Model 3 and Model Y Prices Continue to Fluctuate," Car and Driver, (May 3, 2023) https://www.caranddriver.com/news/a43539838/tesla-model-3-price-reduced-again/

[48] "2022's top 10 best-selling electric vehicles in the US: Find out why they made the cut," Electrek, (January 9, 2023) https://electrek.co/2023/01/09/the-top-10-best-selling-electric-vehicles-in-the-us-of-2022/

[49] "Ford cuts prices of Mustang Mach-E after Tesla moves," Reuters, (May 3, 2023) https://www.reuters.com/business/autos-transportation/ford-cuts-prices-mustang-mach-e-2023-05-02/

[50] *Id.* at footnote 41

$30,000 per tonne from November 2022 to April 2023.[51] This trend is driven by a boom in lithium supply from China, Australia, and Chile. The reduction in critical mineral inputs means we will "see more and more electric vehicles selling for $25,000 to $40,000" according to Cox Automotive.[52] Overall, the cost of lithium-ion batteries has declined substantially since 2008, down to $153 per kWh, as shown in Figure 2.[53]

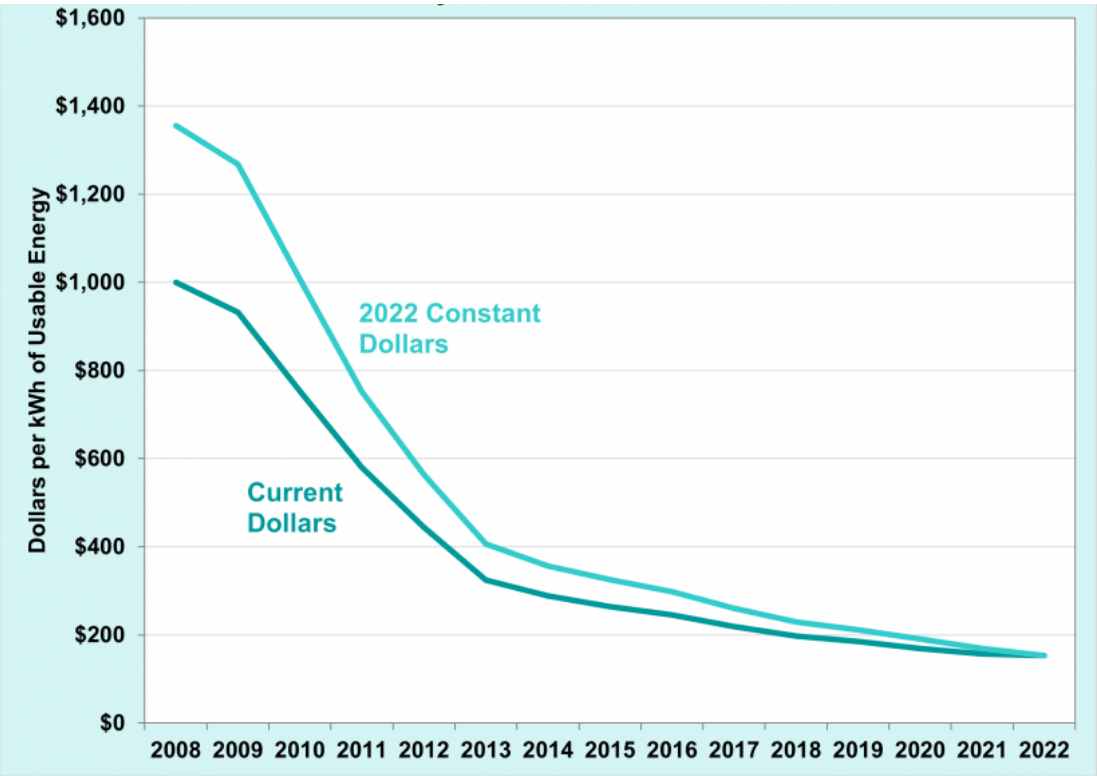

Figure 2: Estimated historical lithium-ion battery pack costs from 2008-2022[54]

3. Emissions Standards are Necessary to Protect Public Health and the Environment

This rule will accelerate investment in electric technologies that will lead to significant emissions reductions and improved health outcomes. Americans are keeping their cars longer, meaning the need for EPA action to reduce emissions from these types of personal vehicles is even more

[51] "Major drop in lithium prices could mean cheaper electric vehicles," CBC News, (April 17, 2023) https://www.cbc.ca/news/canada/sudbury/lithium-price-drop-electric-vehicles-1.6811105
[52] *Id.* at footnote 51
[53] "FOTW #1272, January 9, 2023: Electric Vehicle Battery Pack Costs in 2022 Are Nearly 90% Lower than in 2008, according to DOE Estimates," U.S. Department of Energy, (January 9, 2023) https://www.energy.gov/eere/vehicles/articles/fotw-1272-january-9-2023-electric-vehicle-battery-pack-costs-2022-are-nearly
[54] *Id.* at footnote 53

urgent.[55] Failing to rapidly electrify these classes of vehicles means that fossil fuel-powered vehicles rolling off assembly lines today will remain on the road for many years to come, adding millions of collective vehicle miles and associated deadly emissions over the coming decades.

As discussed in more detail below, ICEVs are a constant and ongoing hazard to public health and the environment. They are also major contributors to anthropogenic climate change. Electrification presents the most commercially viable pathway to reducing pollution from the transportation sector and unlocking tangible environmental and public health benefits. Accordingly, EPA should finalize emissions standards for LMDVs that result in deep cuts to GHG and criteria pollutant emissions through continued growth in the EV sector. Implementing and upholding robust emissions standards that decarbonize the transportation sector through electrification is a national public health, climate, and equity imperative.

a. Reducing Transportation Emissions Protects Public Health

Finalizing stringent emissions standards will save lives, as human interaction with on-road emissions has proven to yield detrimental health outcomes. When inhaled into the lungs, criteria pollutant emissions cause inflammation, chest tightness, shortness of breath, and increased risk of permanent health issues such as asthma.[56] Beyond respiratory health, new research also demonstrates that ground level ozone, exacerbated by LMDV tailpipe emissions, leads to worsening coronary disease. A 2023 study shows that "exceeding the World Health Organization ozone limit is associated with substantial increases in hospital admissions for heart attack, heart failure and stroke."[57] The study looked at coronary disease over three years and found that increased concentrations of ground-level ozone led to 109,400 of 3,194,577 documented hospital admissions.[58]

LMDVs are major contributors to U.S. emissions of particulate matter ($PM_{2.5}$), nitrogen oxides (NOx), volatile organic compounds (VOCs), and carbon dioxide (CO_2).[59] Such pollutants are directly linked to long-term respiratory, cognitive, and autoimmune impairment, and the rate of EV deployment is expected to have a direct relationship with improved health outcomes, particularly for millions of individuals living near high traffic areas.[60]

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[55] "Americans are keeping their cars longer amid sky-high prices, rising interest rates," CNBC, (May 15, 2023) https://www.cnbc.com/2023/05/15/americans-are-keeping-their-cars-longer-amid-rising-interest-rates.html
[56] "State of the Air Report 2023," American Lung Association, (April 2023) https://www.lung.org/research/sota
[57] "Ozone pollution and hospital admissions for cardiovascular events," European Heart Journal, (2023) https://academic.oup.com/eurheartj/article/44/18/1622/7070974
[58] *Id.* at footnote 57
[59] "Federal Vehicle Standards," C2ES, accessed May 18, 2023 https://www.c2es.org/content/regulating-transportation-sector-carbon-emissions/
[60] "PM2.5 polluters disproportionately and systemically affect people of color in the United States," Science Advances (April 28, 2021) https://advances.sciencemag.org/content/7/18/eabf4491

Despite efforts to curtail emissions through ICEV efficiency improvements and various emissions control technologies, a large portion of the U.S. population remains vulnerable to the dangers of vehicle pollution. In the United States, 45 million people live within 300 feet of a major traffic facility or corridor.[61] Proximity to these roadways exposes residents to needless health risks. Replacing combustion engine vehicles with electric alternatives will yield significant public health benefits. According to the American Lung Association, the widespread transition to zero-emission transportation and zero-emission generation over the next 30 years could bring $1.2 trillion in health benefits, save approximately 110,000 lives, prevent more than 2.7 million asthma attacks, and avoid 13.4 million lost workdays.[62] Conversely, a recent study concludes that oil and gas consumption leads to negative health impacts totaling $77 billion annually in the U.S. alone.[63]

It's also critical to highlight that tailpipe emissions from LMD ICEVs do not affect all communities equally. The intersections of negative health outcomes, their link to transportation-related pollution, and the ties to race are well-documented. In 2017, a national study found that in 2010, people of color experienced 37% more NO_X exposure than white populations and had 2.5 times higher concentrations of NO_X within their communities.[64] Furthermore, had these communities of color been exposed to the same level of NO_X as white populations, 5,000 deaths from heart disease could have been prevented. Likewise, the American Lung Association estimates that people of color are 3.2 times more likely to live in a county with at least one pollution-related "failing grade."[65]

A study conducted in New York State found that road emissions have a disproportionate impact on both lower-income communities and communities of color.[66,67] For example, 74% of New York's African American and Latino populations and 80% of its Asian American population experience higher NO_X emissions than the state-wide average. Another study found that the New York City metro area experiences 1,400 premature deaths annually, specifically as a result of road emissions. Within the city, $PM_{2.5}$ vehicle air pollution causes approximately 320 premature

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[61] "Research on Near Roadway and Other Near Source Air Pollution," Overviews and Factsheets, Environmental Protection Agency (December 15, 2022) https://www.epa.gov/air-research/research-near-roadway-and-other-near-source-air-pollution.
[62] "Road to Clean Air: Benefits of a Nationwide Transition to Electric Vehicles," American Lung Association, accessed May 5, 2023 https://www.lung.org/getmedia/99cc945c-47f2-4ba9-ba59-14c311ca332a/electric-vehicle-report.pdf
[63] Jonathan J Buonocore, et. al. (2023) *Environ. Res.: Health* https://iopscience.iop.org/article/10.1088/2752-5309/acc886
[64] "Changes in Transportation Related Air Pollution Exposures by Race, Ethnicity, and Socioeconomic Status: Outdoor Nitrous Oxide in the US in 2000 and 2010", Lara P. Clark, et. al., (September 14, 2017) https://ehp.niehs.nih.gov/doi/10.1289/EHP959
[65] *Id.* at footnote 62
[66] "Inequitable Exposure to Air Pollution from Vehicles in New York State," (June, 2019) https://www.ucsusa.org/sites/default/files/attach/2019/06/Inequitable-Exposure-to-Vehicle-Pollution-NY.pdf
[67] "Asthma alley - why minorities bear burden of pollution inequity caused by white people," The Guardian, (April 2019) https://www.theguardian.com/us-news/2019/apr/04/new-york-south-bronx-minorities-pollution-inequity

deaths from heart disease and other illnesses each year. The West Bronx in particular—whose population is 70% Latino and 29% African American—is home to the Cross Bronx Expressway and has the worst air quality in the state.

b. Reducing Transportation Emissions Protects the Environment and the Climate

Never has the evidence been more clear that climate change is anthropogenic, and recent atmospheric research provides new indications of human-caused climate change associated with increases in CO_2 emissions. Differences between tropospheric and lower stratospheric temperature trends have long been recognized as a fingerprint of human effects on the climate.[68] A new study published in the *Proceedings of the National Academy of Sciences* has factored in temperature from the mid to upper stratosphere–25 to 50 kilometers above the Earth's surface–into these comparisons.[69] The results further underscore the impact humans are having on our atmosphere and the potentially catastrophic effects that are increasingly likely to result such as more frequent wildfires, longer periods of drought in some regions, and an increase in the wind intensity and rainfall from tropical cyclones.[70,71]

As the nature of anthropogenic climate change is becoming increasingly evident, the urgency needed in addressing its causes is becoming greater.[72] Between 1971 and 2020, around 380,000,000,000,000,000,000,000 joules of energy—equivalent to 25 atomic bombs—have been trapped in the atmosphere as a result of warming, according to a 2023 study published in *Earth System Science Data*.[73] In 2021, the U.S. emitted 6,340 million metric tons of CO_2—of which, fossil fuel combustion was responsible for nearly 75%.[74] A significant portion of that fossil fuel combustion occurs within the transportation sector, which accounts for 28% of total emissions and is the largest emitting sector.[75] Light-duty vehicles account for 57% of transportation GHG emissions and light-duty ICEVs emit around 19 pounds of carbon dioxide and other global-warming gasses for every gallon of gasoline consumed.[76]

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[68] B. Santer, et.al. "Exceptional stratospheric contribution to human fingerprints on atmospheric temperature," PNAS, (May 8, 2023) accessed May 15, 2023 https://www.pnas.org/doi/10.1073/pnas.2300758120
[69] *Id.* at footnote 68
[70] "The Effects of Climate Change," NOAA, accessed June 23, 2023 https://climate.nasa.gov/effects/
[71] "AR6 Synthesis Report - Climate Change 2023" IPCC (March 2023) https://www.ipcc.ch/report/ar6/syr/
[72] "Carbon dioxide levels in atmosphere mark a near-record surge," Washington Post, (June 5, 2023) https://www.washingtonpost.com/climate-environment/2023/06/05/carbon-dioxide-growing-climate-change/
[73] von Schuckmann, K., et. al. "Heat stored in the Earth system 1960–2020: where does the energy go?," Earth Syst. Sci. Data, (April 17, 2023) https://doi.org/10.5194/essd-15-1675-2023
[74] "Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2021," (2023) U.S. Environmental Protection Agency, https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-andsinks-1990-2021
[75] "Sources of Greenhouse Gas Emissions," U.S. Environmental Protection Agency, accessed June 26, 2023 https://www.epa.gov/ghgemissions/sources-greenhouse-gas-emissions
[76] "Car Emissions and Global Warming," Union of Concerned Scientists, (July 18, 2014) https://www.ucsusa.org/resources/car-emissions-global-warming

As EPA explains in the proposed rule, automaker investments in electric technologies implicitly acknowledge that the sector believes electric vehicles are the cleaner alternative. EVs produce zero tailpipe emissions and studies have shown that in every state in the U.S.—even states with fossil fuel intensive electricity grids—driving an electric vehicle leads to significantly fewer GHG emissions.[77] In Kentucky, for example, where the electricity mix is 71.8% coal and 20.6% natural gas, driving an EV results in 6,903 fewer pounds of CO_2 annually than driving an ICEV.[78]

Diesel emissions are of particular concern for environmental outcomes. Many class 2b and 3 vehicles continue to be powered by diesel engines.[79] Emissions from diesel engines have detrimental impacts not only on human health, but on natural ecosystems as well. A study from the University of Southampton demonstrated that exposure to diesel exhaust has negative impacts on pollinators and that NOx emissions altered the smell of five out of the eleven most common single compound floral odors.[80] In areas where diesel exhaust is present, a 2022 study found that there were 70% fewer pollinators and 90% fewer flower visits.[81] A separate study from the Journal of Environmental Health Science and Engineering suggests that prolonged exposure to internal combustion engine exhaust has potentially significant impacts on agro-ecosystems and plant germination.[82]

EPA's own compliance trends show that significant emissions reductions are being left on the table in the form of banked credits.[83] While credit banking and trading provisions are a key component of these emissions standards, the size of the OEMs' collective credit bank–as shown in Figure 3–highlights the need for EPA to set stringent standards that turn these theoretical CO_2 reductions into real-world, on-road reductions.

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[77] "Driving an EV Is Getting Greener, Especially in the U.S.," The Wall Street Journal (May 10, 2023) https://www.wsj.com/articles/how-clean-are-electric-cars-it-depends-4d1086d6?mod=hp_lista_pos2

[78] "Emissions from Electric Vehicles," Department of Energy's Alternative Fuels Data Center, accessed June 26, 2023 https://afdc.energy.gov/vehicles/electric_emissions.html

[79] "2023 Trucks With Diesel Engines: Cleaner, Meaner Torque Monsters," MotorTrend, (May 1, 2023) accessed June 26, 2023 https://www.motortrend.com/features/trucks-with-diesel-engines

[80] "Diesel fumes alter half the flower smells bees need," University of Southampton, (October 19, 2015) https://www.southampton.ac.uk/news/2015/10/diesel-fumes-alter-flower-smell-for-bees.page

[81] James M.W. Ryalls, et. al., 'Anthropogenic air pollutants reduce insect-mediated pollination services', *Environmental Pollution*, (March 15, 2022) https://doi.org/10.1016/j.envpol.2022.118847

[82] Afsharnia F, Moosavi SA. "Effects of diesel-engine exhaust emissions on seed germination and seedling growth of Brassicaceae family using digital image analysis." (September 28, 2021) ncbi.nlm.nih.gov/pmc/articles/PMC8617225/

[83] "Highlights of the Automotive Trends Report," U.S. Environmental Protection Agency, accessed June 27, 2023 https://www.epa.gov/automotive-trends/highlights-automotive-trends-report#Highlight6

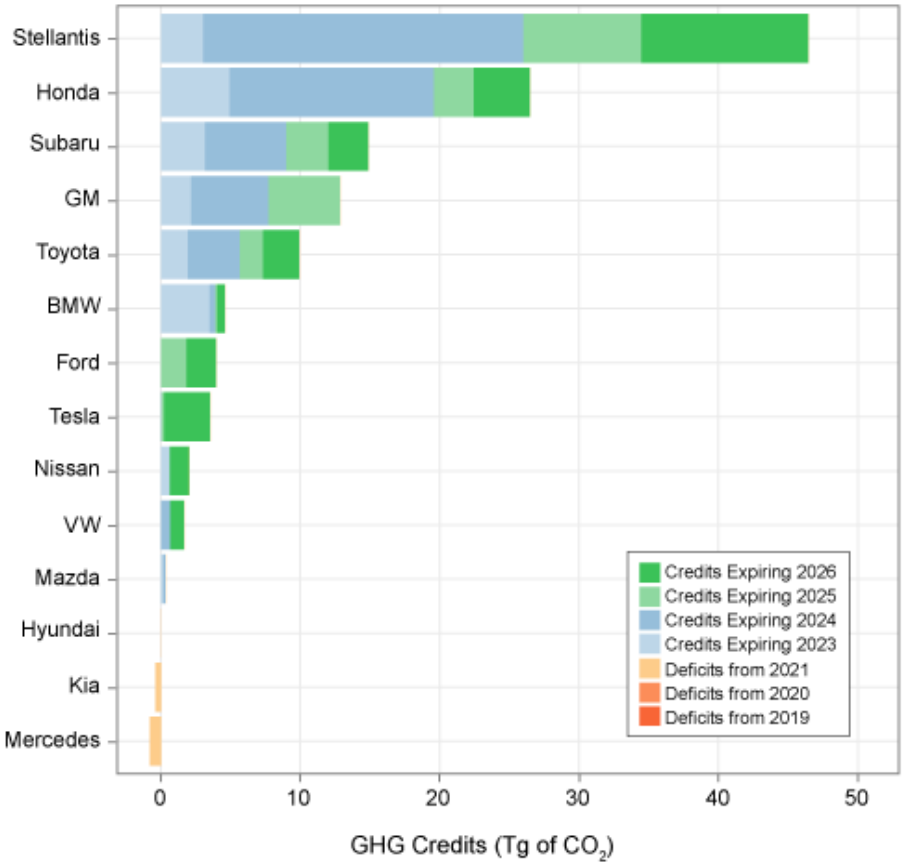

Figure 3. OEM Compliance with EPA LD GHG Standards Through Model Year 2021

The pressing need to reduce GHG and criteria pollutant emissions from the light- and medium-duty transportation sectors justifies EPA finalizing stringent emissions standards. While the standards are technology neutral, the auto industry has chosen electrification as the preferred option for reducing emissions and the standards should support the considerable investments being made to continue bringing these technologies to market.

4. Transportation Electrification Benefits Consumers and the Economy

Beyond health and environmental improvements, electrification will benefit the country's economic development and Americans' pocketbooks. The transition to EVs is already leading to

new manufacturing jobs, improved property values, and new investments in communities.[84,85,86] This trend should be expected to continue and accelerate in the coming years. The burgeoning EV industry will create new jobs for the manufacturing of components such as batteries, electric motors, and power electronics, as well as charging infrastructure. In addition, the manufacture of conventional vehicle component parts like brakes and windshields will continue to be a source of employment in the automotive industry.

Electrification will also help ensure the United States maintains its economic competitiveness with the rest of the world. As discussed further below, governments around the world are establishing more ambitious electrification goals to align with recent announcements from global manufacturers. Ensuring U.S. regulations match or exceed these ambitions is vital to encouraging domestic investments and accelerated job creation in the industry.

As EPA notes in the proposed rule, the light- and medium-duty GHG standards would reduce U.S. oil imports by 2.3 million barrels per day in 2055, meaning American consumers would be more insulated from foreign geopolitical turmoil and associated oil price volatility.[87] Finalizing more stringent standards than Alternative One would reduce U.S. oil imports by more than 2.5 million barrels per day in 2055. Mark Zandi, chief economist at Moody's has noted that fossil fuels were a major cause of every period of inflation since World War II. "Every recession since World War II has been preceded by a jump in oil prices."[88] As discussed further below, reducing exposure to such volatility that affects the transportation of goods, people and services, electrification can stabilize costs as these are often heavily affected by transportation fuel costs.[89]

a. Electrification Will Continue to Create Good-Paying American Jobs

EVs are the lynchpin to simultaneously tackling the climate crisis and restoring the United States as a global leader in automotive manufacturing. As of March 2023, more than 143,000 jobs in the EV industry had been created since the passage of the Bipartisan Infrastructure Law (BIL) in November 2021.[90] Combined with the Inflation Reduction Act (IRA) of 2022 and stringent

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[84] Sklarz and Miller, "The Impact of Noise on Residential Property Value," (September 20, 2018) https://www.collateralanalytics.com/wp-content/uploads/2018/10/CA-RESEARCH-The-Impact-of-Noise-on-Residential-Property-Values.pdf

[85] "Electric Vehicle Investments Provide Benefits Across the U.S.," ZETA, accessed June 27, 2023 https://www.zeta2030.org/education-fund/investments

[86] "U.S. Energy & Employment Jobs Report," U.S. Department of Energy, (June 2023) https://www.energy.gov/policy/us-energy-employment-jobs-report-useer

[87] *See* 88 FR 29388 (May 5, 2023)

[88] "Fight climate change. End fossilflation. Here's how," Vox, (August 12, 2022) https://www.vox.com/science-and-health/2022/8/12/23290488/fight-climate-change-end-fossil-fuel-inflation

[89] 'Energy Price Stability: The Peril of Fossil Fuels and the Promise of Renewables,' Roosevelt Institute, (2022) https://rooseveltinstitute.org/wp-content/uploads/2022/05/RI_EnergyPriceStability_IssueBrief_202205.pdf

[90] "Report Finds Investments in U.S. Electric Vehicle Manufacturing Reach $120 Billion, Create 143,000 New Jobs," Environmental Defense Fund, (March 14, 2023)

emissions standards from EPA, manufacturing investments and job creation will continue to grow. The IRA alone is projected to create around 9 million new clean energy jobs over the next decade.[91]

Researchers at the Goldman School of Public Policy found that a scenario with 100% electric LDV sales by 2030 and 100% MHDV by 2035 would result in 2 million *more* jobs than the current trajectory.[92] This is a result of the new jobs in the charging infrastructure, electricity, and maintenance sectors. The manufacturing and installation of charging infrastructure alone is projected to create more than 29,000 jobs.[93] In general, jobs in the EV industry are high-quality and high-paying and as a result, are attracting a new generation of workers who are eager to work in the sustainable transportation industry.

EV charging infrastructure buildout similarly promises to generate substantial job creation throughout the country. The International Energy Agency (IEA) estimates that 12 new jobs are created for every $1 million invested in charging infrastructure.[94] By comparison, ICE vehicle manufacturing creates an average of 7.2 jobs per million dollars invested. At this rate, the BIL's $5 billion allocations through the National Electric Vehicle Infrastructure (NEVI) formula program to build out a national EV charging network could create at least 60,000 direct jobs.

Beyond installation, ongoing electric vehicle supply equipment (EVSE) operations and maintenance will create thousands more jobs. This creates an entirely new occupation, that of an EVSE technician, that goes beyond the role of a traditional electrician. EVSE technicians are responsible for the ongoing maintenance and operations of chargers and are specially trained to handle electrical and parts malfunctions, software upgrades, cell signal issues, damages, and more.[95,96]

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https://www.edf.org/media/report-finds-investments-us-electric-vehicle-manufacturing-reach-120-billion-create-143000

[91] "Job Creation Estimates Through Proposed Inflation Reduction Act," University of Massachusetts, (August 4, 2022) https://peri.umass.edu/publication/item/1633-job-creation-estimates-through-proposed-inflation-reduction-act

[92] "Switching to Electric Cars and Trucks Would Support 2 Million Green Jobs in 2035," UC Berkeley School of Public Policy, accessed May 15, 2023, https://www.2035report.com/transportation/green-jobs

[93] "The Commanding Heights of Global Transportation: Quantifying the Employment Effects," SAFE, (March 9, 2021) https://secureenergy.org/the-commanding-heights-of-global-transportation-quantifying-the-employment-effects/

[94] "Sustainable Recovery - Transport," IEA, accessed June 23, 2023 https://www.iea.org/reports/sustainable-recovery/transport

[95] ChargerHelp Guiding Standards 2022, accessed June 23, 2023 https://www.chargerhelp.com/_files/ugd/30e128_0032898550534e609ce4188fa91bc926.pdf

[96] "FACT SHEET: Biden-Harris Administration Announces New Standards and Major Progress for a Made-in-America National Network of Electric Vehicle Chargers," The White House, accessed June 6, 2023 https://www.whitehouse.gov/briefing-room/statements-releases/2023/02/15/fact-sheet-biden-harris-administration-announces-new-standards-and-major-progress-for-a-made-in-america-national-network-of-electric-vehicle-chargers/

As discussed further in section eight of these comments, the U.S. battery manufacturing industry is quickly scaling to meet demand driven by transportation electrification. Since January 2021, the U.S. private sector has announced nearly $82 billion in domestic battery manufacturing investments, translating to 96 new or expanded processing and manufacturing plants creating thousands of new jobs in the process.[97]

b. EVs Have Lower Total Cost of Ownership than Comparable ICE Vehicles

Though a vehicle's total cost of ownership (TCO) depends on several factors, such as the region, driving characteristics, and fuel prices, EVs are consistently cheaper to own than gas-powered cars. A typical driver can expect to save between $6,000 and $12,000 over a vehicle's lifetime by switching to an EV.[98] These savings are magnified in rural areas where drivers travel an average of 38% more miles than urban drivers.[99]

EVs have fewer moving parts than their ICE counterparts, which makes them simpler to maintain and reduces the likelihood of a major malfunction.[100] Reduced maintenance saves customers both time and money. Notably, the average maintenance costs for an EV are 50% lower than those for a comparable ICEV.[101] EVs have significantly fewer components that require regular maintenance like engine oil, transmission fluid, and air filters. According to Argonne National Laboratory, the maintenance costs for an EV averages 6.1 cents per mile, compared to 10.1 cents per mile for a similar ICEV.[102] That means for vehicles driven 10,000 miles per year can save $400 per year, totalling $2,000 over five years. Over a vehicle's lifetime, an EV owner can save an average of $4,600 on maintenance costs alone by transitioning away from driving a gas vehicle.[103]

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[97] New US Battery Manufacturing and Supply Chain Investments Announced Under President Biden, US Department of Energy, (February 13, 2023) https://www.energy.gov/sites/default/files/2023-02/Battery%20Supply%20Chains%20Investments%20Map.pdf

[98] "Electric Vehicles Save Consumers Money," Consumer Reports, (June 2023) https://advocacy.consumerreports.org/wp-content/uploads/2023/06/CR_EVSavings_FACTSHEET_6.2023.pdf

[99] "Clean Transportation Strategies for Rural Communities in the Northeast and MidAtlantic States," Union of Concerned Scientists, (November 2020) https://www.ucsusa.org/sites/default/files/2020-11/rural-transportation-opportunities.pdf

[100] "Maintenance and Safety of Electric Vehicles" U.S. Department of Energy, accessed June 18, 2023 https://afdc.energy.gov/vehicles/electric_maintenance.html

[101] "Consumer Reports Study Finds Electric Vehicle Maintenance Costs Are 50% Less Than Gas-Powered Cars," Great Plains Institite, (November 16, 2020) https://betterenergy.org/blog/consumer-reports-study-finds-electric-vehicle-maintenance-costs-are-50-less-than-gas-powered-cars/

[102] "Comprehensive Total Cost of Ownership Quantification for Vehicles with Different Size Classes and Powertrains." (April 2021) https://doi.org/10.2172/1780970

[103] "EVs Offer Big Savings Over Traditional Gas-Powered Cars," Consumer Reports, (October 8, 2020) https://www.consumerreports.org/hybrids-evs/evs-offer-big-savings-over-traditional-gas-powered-cars/

The average cost of electricity in the U.S. is 16.5 cents per kWh as of May 2023.[104] If electricity costs 16.5 cents per kWh, charging an EV with a fully-depleted 100 kWh battery will cost about $16.50 to reach a full charge. While the range of a 100 kWh battery varies depending on a vehicle's efficiency, a typical Tesla Model S can go up to 400 miles on a single charge.[105] Comparatively, the average national gasoline price for regular grade was $3.685 in May 2023.[106] Filling up a 12-gallon passenger vehicle with a 30 mpg fuel economy would cost $45.96 to move the vehicle 360 miles. At $16.50 for a full charge, fueling an EV cuts fuel prices by 64%. According to AAA, over the course of a year the cost of refueling an EV is around $546, compared to $1,255 per year when fueling a gasoline car.[107]

With the price of oil subject to a wide range of economic, geopolitical, and operational factors, EVs help protect consumers from rapid fuel price spikes. As shown in Figure 4 below, EVs are not only cheaper to drive per mile but their fuel costs are more consistent and predictable compared to similar ICEVs. Electricity prices tend to be less volatile and subject to fewer supply shocks than oil prices.[108] Even when sourcing petroleum domestically, disturbances can have dramatic price consequences. For example, on December 24, 2022, Suncor shut down its 103,000-barrel per day (bpd) oil refinery in Commerce City, Colorado, just outside of Denver. Suncor announced that extreme cold weather earlier in the month had damaged equipment and that the repairs would require a full shutdown of the facility and delay operations until the end of the first quarter of 2023. By February 2023 gasoline prices in the Rocky Mountain region had increased by 51%, considerably higher than the 9% national average.[109]

[104] "Average energy prices for the United States, regions, census divisions, and selected metropolitan areas," U.S. Bureau of Labor Statistics, accessed July 3, 2023 https://www.bls.gov/regions/midwest/data/averageenergyprices_selectedareas_table.htm
[105] "Fuel Economy of the 2021 Tesla Model S Long Range," U.S. Department of Energy, accessed July 3, 2023 https://www.fueleconomy.gov/feg/noframes/44051.shtml
[106] *Id.* at footnote 104
[107] "True Cost of Electric Vehicles," AAA Automotive, accessed July 3, 2023, https://www.aaa.com/autorepair/articles/true-cost-of-ev
[108] *Id.* at footnote 89
[109] "Colorado refinery outage is causing higher gasoline prices in Rocky Mountain region," U.S. Energy Information Administration, (February 28, 2023) https://www.eia.gov/todayinenergy/detail.php

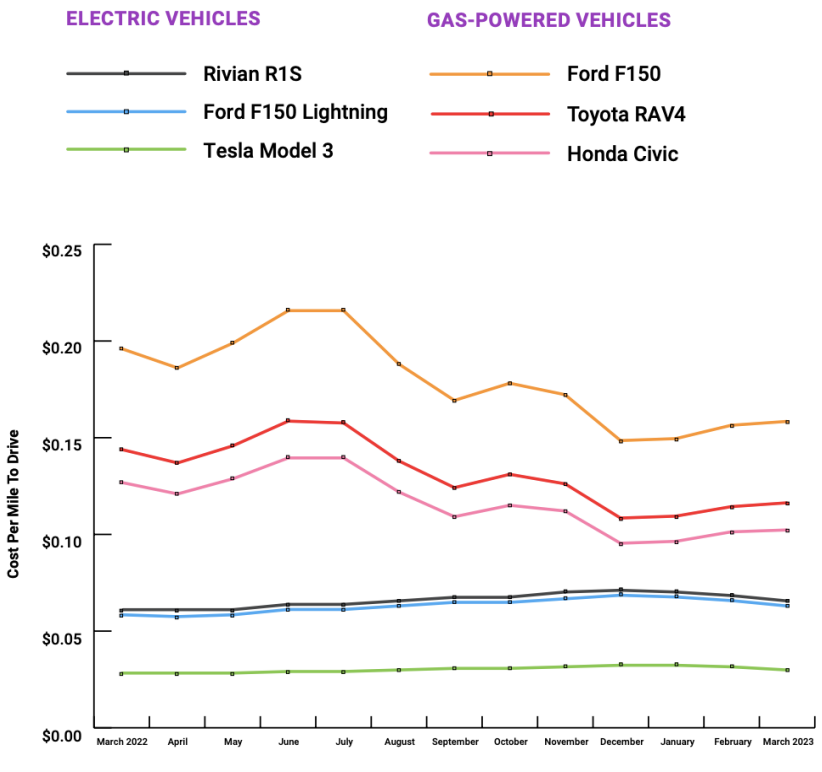

Figure 4: A comparison of operating costs for electric and gas-powered vehicles from March 2022 to March 2023.[110]

Reliance on petroleum for light- and medium-duty vehicles also exposes American consumers' wallets to geopolitical instability. The February 2022 Russian invasion of Ukraine resulted in rapid, significant spikes in the price of crude oil, which contributes about half the cost of finished gasoline.[111] In June 2023, Saudi Arabia announced it would cut oil production by 1 million bpd, pushing up oil prices in the short term and causing them to be projected to remain high through at least summer 2023.[112] This will ultimately result in higher prices for gasoline in the US per oil analysts at Rystad Energy who believe gas will become marginally more expensive for consumers. In addition to Saudi Arabia, other members of OPEC agreed on recent surprise cuts in oil production, adding to the ultimate uncertainty for consumers that relying on oil provides.[113]

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[110] "Electric vehicles are far cheaper to drive than gas-powered cars," ZETA, (March 2023) https://8829857.fs1.hubspotusercontent-na1.net/hubfs/8829857/ZETA-EV%20vs.%20Gas%20Report_V4.pdf

[111] "Yes, Russia's War on Ukraine Did Raise the Price of Gasoline," Cato Institute, (April 6, 2022) https://www.cato.org/blog/yes-russias-war-ukraine-did-raise-price-gasoline-0

[112] "Saudi Arabia is slashing oil supply. It could mean higher gas prices for US drivers," Associated Press, (June 4, 2023) https://apnews.com/article/opec-oil-prices-saudi-arabia-russia-8d70999cb8258aebc3edbfdfcae278b7

[113] *Id.* at footnote 112

Americans are at the mercy of these decisions with the reliance of ICEVs. The shift to EVs is a hedge against this price volatility and will bring stability to the cost of transportation in the U.S.

c. Electrification Promotes American Economic Competitiveness

Governments around the world are setting more stringent emissions standards to align with recent announcements from global manufacturers. Ensuring U.S. regulations match or exceed these ambitions is vital in allowing certainty and encouraging investment in the industry. If the U.S. does not move more aggressively on LMDEV deployment, it risks ceding market share to other countries and regions who are moving faster, such as China, the European Union, and others.

Complimentary incentives embedded in the IRA will facilitate onshoring of the EV supply chain while robust EPA emission standards will help ensure the United States becomes and remains a leader in EV technology development and manufacturing. While more work remains to craft supportive policies in other areas of the supply chain, EPA emissions standards are crucial drivers of domestic EV supply.

Many countries have made commitments to accelerate EV development and deployment in their borders. An increase in EV sales is taking place across the world, but has been dominated by the Chinese market, which accounts for the majority of all new EV registrations. As of 2022, China had 10.7 million BEVs on the road and the U.S. had 2.1 million.[114] Part of this dominance is due to China's purchase incentives, high registration fees for ICEVs, a robust charging network, and national "new energy vehicle" targets.[115]

With its own emissions targets, countries in Europe are sending strong signals about the continent's future electric fleet. Europe is the second-largest market for EVs in the world, with 30% of the global share.[116] With robust LMDV emissions standards, the U.S. would be encouraging quicker adoption of EV technology to ensure the country remains at the forefront of this global transition. Below is a list of regional and national goals for light- and medium-duty zero-emission vehicle deployment that further underscores the need for the U.S. via EPA to maintain pace with the rest of the world:

[114] *Id.* at footnote 27
[115] "An evaluation of government incentives for new energy vehicles in China focusing on vehicle purchasing restrictions," *Energy Policy,* (October 2017) https://doi.org/10.1016/j.enpol.2017.07.057
[116] *Id.* at footnote 27

- European Union: Target to reduce CO2 emissions from new cars and vans by 55% in 2030 and 100% in 2035 compared to 2021 emissions.[117]
- Norway: 100% of LDV sales to be zero-emission by 2025.[118]
- Switzerland: ZEV sales of 28% in 2025, 60% in 2030, and 100% from 2040.[119]
- Denmark: End the sale of new petrol and diesel cars from 2030, and PHEVs from 2035.[120]
- Netherlands: 100% ZEV sales by 2030.[121]
- United Kingdom: Phase out new petrol and diesel cars and vans by 2030. All new cars to be fully zero emission after 2035.[122]
- Canada: ZEV targets for light-duty sales of 20% by 2026, 60% by 2030 and 100% by 2035.[123]
- Chile: 100% of LDV sales will be zero-emissions by 2035, with an accompanying ban on ICE sales.[124]
- Korea: 50% of new sales to be ZEVs by 2025, and 80% by 2030.[125]
- China: "New energy vehicle" sales in key air pollution control regions to account for about 50% of new vehicle sales by 2030.[126]
- Japan: 100% of car sales to be electrified by 2035. [127]

Stringent LMDV multipollutant and GHG emissions standards will encourage more domestic investment and innovation to position the United States as a global leader in the electric vehicle space. The regulatory certainty of these standards will enable increased investment and the

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[117] "Fit for 55: zero CO2 emissions for new cars and vans in 2035," European Parliament, accessed June 18, 2023) https://www.europarl.europa.eu/news/en/press-room/20230210IPR74715/fit-for-55-zero-co2-emissions-for-new-cars-and-vans-in-2035

[118] "Annual update on the global transition to electric vehicles: 2022," International Council on Clean Transportation, (June 2023) https://theicct.org/wp-content/uploads/2023/06/Global-EV-sales-2022_FINAL.pdf

[119] "Switzerland - EV Adoption by Year," HEV-TCP, accessed June 18, 2023 https://ieahev.org/countries/switzerland/

[120] "Denmark embraces electric car revolution with petrol and diesel ban plan," Reuters, (October 2, 2018) https://www.reuters.com/article/us-denmark-autos/denmark-embraces-electric-car-revolution-with-petrol-and-diesel-ban-plan-idUSKCN1MC121

[121] "Supporting Governments With 100% ZEV Targets," ZEV Alliance and ICCT, (November 2021) https://zevalliance.org/wp-content/uploads/2021/11/support-governments-zev-targets-nov21.pdf

[122] "Transitioning to zero emission cars and vans: 2035 delivery plan," HM Government, accessed June 30, 2023 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1005301/transitioning-to-zero-emission-cars-vans-2035-delivery-plan.pdf

[123] "Proposed regulated sales targets for zero-emission vehicles," Government of Canada, (January 9, 2023) https://www.canada.ca/en/environment-climate-change/news/2022/12/proposed-regulated-sales-targets-for-zero-emission-vehicles.html

[124] "Chile to ban sale of light and medium internal combustion engines in 2035," Electrive, (October 18, 2021) https://www.electrive.com/2021/10/18/chila-to-ban-sale-of-internal-combustion-engines-in-2035/

[125] "Zero-Emission Vehicles Factbook," BloombergNEF, (November 2022) https://assets.bbhub.io/professional/sites/24/2022-COP27-ZEV-Transition_Factbook.pdf

[126] "Global EV Outlook 2023 - Policy developments," IEA, accessed June 20, 2023 https://www.iea.org/reports/global-ev-outlook-2023/policy-developments

[127] "Japan Transition to Electric Vehicles, U.S. International Trade Administration, (July 7, 2021) https://www.trade.gov/market-intelligence/japan-transition-electric-vehicles

continued build-out of a domestic supply chain. Without stringent LMDV emissions standards, the U.S. risks ceding this vast economic opportunity to other countries, disadvantaging American businesses and workers.

5. ZETA Comments on the Proposed Emission Standards for LDVs

ZETA and its member companies appreciate the opportunity to submit comments on EPA's proposed rule to set multipollutant and GHG emission standards for class 1-2a LDVs. We urge the agency to finalize standards more stringent than Alternative One for LDV GHG emissions and to finalize LDV multipollutant standards that are equally as stringent. For reasons discussed throughout these comments, we believe such stringency is feasible and finalizing such standards will ensure the supply chain has the regulatory certainty needed to protect the investments being made today that will put the sector on a glide path to a zero-emission future. Backtracking on the stringency of these proposed standards in the final rule will not only jeopardize the health, climate, and environmental benefits but would create regulatory uncertainty.

The case for emissions standards more stringent than Alternative One is even stronger when considering the agency's apparent omission of ZETA member Rivian from its analysis. Specifically, OMEGA's Manufacturers File, an input file listing vehicle producers considered as distinct entities for GHG compliance, does not list Rivian.[128] Even the agency's survey of manufacturer commitments, presented as Table 1 in the NPRM, does not include the company.[129] Omitting Rivian from the agency's analysis could affect EPA's analysis and proposal. EPA should update its model inputs to account for Rivian's sales and revise its evaluation of the alternatives accordingly.

We also encourage EPA to consider standards for MYs 2033-2035 that would result in the same level of emissions reductions as California's Advanced Clean Cars II regulation. In doing so, we urge the agency to undertake a separate final rulemaking under a different OMB Regulatory Information Number to ensure such standards are severable from these proposed standards for MYs 2027-2032. ZETA notes that there may be useful parallels between the ongoing transition to EVs and EPA's phaseout of leaded gasoline from 1973 to 1996[130] and we encourage the agency to apply any potential lessons learned from that phaseout, recognizing that reducing GHG emissions requires a similar sense of urgency to eliminating lead in gasoline.

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[128] Purpose and description of the Manufacturers File per https://omega2.readthedocs.io/en/2.1.0/index.html#document-1_overview. List of producers found in the "manufacturers.csv" in the OMEGA zip file.
[129] *See* 88 FR 29192 (May 5, 2023)
[130] "EPA History: Lead," U.S. Environmental Protection Agency, accessed June 20, 2023 https://www.epa.gov/history/epa-history-lead

ZETA supports the proposed revisions to the car and light truck footprint curves, including the flattening of each slope over the timeframe covered by the standards, and we encourage EPA to finalize the changes as proposed. As EVs continue to grow in market share, EPA emission standards should reflect the decreasing disparity in emissions from different sized vehicles within each vehicle segment. In other words, there are no tailpipe emissions from EVs and as they become the predominant vehicle technology in automakers' fleets, EPA standards should be designed to continue incentivizing zero-emission technologies rather than to encourage production of larger, higher-emitting ICEVs. To that same end, we support the proposed revisions to the footprint cutpoints as well and encourage EPA to finalize them as proposed.

We are concerned that EPA relies on MY 2019 as the base year fleet for its analysis[131] The auto industry is in a period of rapid change. For example, the EV sales share grew from just 1.7 percent in MY 2019 to 4.4 percent in MY 2021[132] Preliminary data show the sales share roughly doubling in MY 2022 to approximately 8 percent.[133] In previous regulatory actions, the agency stated that the vintage of the base year will "not normally have a significant impact" but that certain broad shifts in the market, such as the average vehicle power-to-weight ratio, can affect the incremental cost-effectiveness of technology application in the modeling.[134] The significant growth in the EV market in recent years—a trend not yet visible in the MY 2019 data—would seem to constitute a "broad market shift" with potential impacts on agency compliance modeling. For example, greater BEV volumes in the base year fleet could affect credit-trading and technology application decisions in the model. If nothing else, greater EV volumes in the base year fleet would imply greater growth potential and higher penetrations of this technology by the end of the timeframe covered by the proposed standards and could support greater stringency than the agency currently proposes. We encourage incorporation of the most recent base year data available for the final rule in accordance with typical practice.[135]

6. ZETA Comments on the Proposed Emission Standards for MDVs

In regards to the proposed GHG and multipollutant emission standards for class 2b-3 MDVs, we encourage EPA to finalize standards that are as stringent as possible. ZETA supports the proposed revisions to the work factor curves, including the cutpoints and slope changes over time, for the same reasons discussed above in the LDV footprint curve context. Ultimately, we believe EPA's proposed changes to the work factor curves will more accurately capture the

[131] *See* DRIA at 9-1
[132] "Explore Trends Detailed Data," U.S. Environmental Protection Agency, accessed June 30, 2023 https://www.epa.gov/automotive-trends/explore-automotive-trends-data#DetailedData
[133] *See* DRIA at 3-5
[134] Revised 2023 and Later Model Year Light-Duty Vehicle Greenhouse Gas Emissions Standards, 86 Fed. Reg. 151, 43,769 - 43,770 (Aug. 10, 2021)
[135] EPA "will often attempt to utilize the most recent base year data," per Revised 2023 and Later Model Year Light-Duty Vehicle Greenhouse Gas Emissions Standards, 86 Fed. Reg. 151, 43,769 (Aug. 10, 2021)

benefits of EVs and drive greater emissions reductions over the MY 2027-2032 time frame covered by these standards. We encourage EPA to finalize these changes as proposed.

We also encourage EPA to finalize MDV GHG and multipollutant emissions standards for MY 2033-2035 that align with the stringency of California's Advanced Clean Trucks regulations for class 2b-3 vehicles. In doing so, we urge the agency to undertake a separate final rulemaking under a different OMB Regulatory Information Number to ensure such standards are severable from these proposed standards for MYs 2027-2032. We recommend finalizing MY 2033-2035 emissions standards for both LDVs and MDVs in the same rulemaking.

ZETA notes that EPA's modeling appears to show a decline in BEV sales in the MD pickup segment in the early model years covered by these proposed standards.[136] EPA should establish standards stringent enough to drive increasing electrification across all MD vehicle categories. The technology can meet the needs of many duty cycles performed by MD pickups, including those involving towing, but the rapid uptake of BEVs in the van fleet coupled with credit multipliers in the early years of the program could pad credit banks and allow BEV development and sales in the MD pickup category to stall. EPA should evaluate the feasibility of even stricter emissions requirements.

As in the LDV segment, EPA's modeling appears to omit ZETA member Rivian. Yet, Rivian's order book includes 100,000 all-electric Class 2b-3 vans, several thousand of which already operate on U.S. roads. The agency should assess to what extent the addition of 100,000 BEV vans to the national fleet by MY 2030 could support a lower fleet average emissions target.

7. ZETA Comments on the Additional Proposed Regulatory Changes

Beyond the overall stringency of EPA's proposed GHG and multipollutant emissions standards for LMDVs, ZETA is providing the following comments on the various regulatory changes proposed in the rule.

ZETA supports EPA's proposed changes to the medium-duty passenger vehicle (MDPV) definition. As MDPVs become increasingly electrified, EPA regulations should reflect the increased weight associated with the onboard battery. MDPVs are predominantly used to transport people, rather than goods, and therefore should be subject to emissions standards whose stringency is consistent with non-work based applications.

While we appreciate EPA's intent behind making BEVs ineligible to generate AC efficiency credits, we would note that AC efficiency does affect the overall vehicle efficiency, regardless of

[136] *See* DRIA at 13-53

the fuel type of the vehicle. As such, EPA should maintain parity between ICE and BEVs in regards to AC efficiency credits in the final rule.

ZETA supports the proposal to continue omitting upstream emissions from electricity generation for purposes of BEV CO_2 g/mile calculations. As EPA notes, this is not currently done for ICE vehicles and there is a robust regulatory framework in place to reduce emissions from stationary sources. ZETA encourages EPA to finalize this policy of omitting upstream emissions from mobile source emissions control regulations.

The following comments relate to the proposed changes to credit generation:

- ZETA supports the phaseout of offcycle credit generation by MY 2031. While a useful policy tool to promote marginal technological improvements to vehicle efficiency, the urgency in needing to reduce emissions from LMDVs warrants removing such programs that enable more tailpipe emissions. We believe the urgent need to reduce GHG emissions and prevent the worst effects of climate change warrants EPA accelerating the timeline to end offcycle credit generation by MY 2027.
- ZETA supports the proposed accelerated phaseout of MDEV credit multipliers by MY 2027. EPA has recognized that multipliers present a tradeoff between driving emissions reductions and incentivizing new technology. Based on the technology available today, multipliers are no longer required to incentivize MDEV technology investments, and a more stringent GHG standard would most effectively drive MDEV adoption and, in turn, emissions reductions. As such, we encourage the agency to finalize the phaseout of MDEV credit multipliers as proposed and encourage EPA to consider the benefits of sunsetting multipliers for advanced technology vehicles in the MD category starting in MY 2025.
- ZETA supports the proposed changes to the PHEV fleet utility factor (FUF) to more accurately apportion the benefit of PHEVs' electric operation. Ensuring accurate compliance calculations is critical to preserving programmatic integrity and reducing emissions. As EPA notes, SAE J2841 was developed more than ten years ago during the early introduction of light-duty PHEVs and at the time was a reasonable approach. However, with the benefit of more real world data and information about actual vehicle operating characteristics, we support EPA revisiting the FUF curve at this time.

The following comments relate to the proposed requirements for battery durability:

- ZETA notes that EV batteries have a variety of potential non-propulsion applications that IC engines do not. As a result, these applications may cause the battery to go through wear cycles that are unrelated to reducing on road mobile source emissions. The proposed requirements for battery durability could disincentivize those applications and we

encourage EPA to consider ways to uphold the intent of the MPR without disincentivizing non-propulsionary battery applications, including the use of good engineering judgment in determining statistically relevant in-use battery degradation.

- ZETA recommends EPA remove the battery durability MPR of 80% at 5 years or 62,000 miles (midpoint) but retain the 70% at 8 years or 100,000 miles endpoint. Battery degradation may not be linear and depends on a large number of factors.[137] An MPR that assumes linear degradation could result in vehicles needing to be recalled despite still meeting the 70% at 8 years or 100,000 miles endpoint if they were allowed to continue operating.
- In regards to the GTR No. 22 "Part B" compliance test under the durability requirements, EPA notes in the proposed rule preamble that "In the case that a durability family fails the Part B durability performance requirement, manufacturers would have to adjust their credit balance to remove compliance credits previously earned by those vehicles."[138] ZETA supports this penalty, however, we request clarification that forfeited compliance credits include all relevant credits generated by vehicles within the applicable durability family, not just GHGs.

The following comments relate to the proposed requirements for emissions control device warranties:

- ZETA requests clarity on what vehicle components constitute "associated powertrain components." While the preamble to the proposed rule includes some discussion on what components may be included: "e.g., electric machines, inverters, and similar key electric powertrain components,"[139] a more exhaustive list would provide additional clarity for manufacturers and support a more thorough assessment of this aspect of the proposal.
- ZETA's member companies stand by the durability of their products and many of them have their own warranties. While we support EPA's proposed warranty requirements, we note that designating the electric battery and associated powertrain components as "specified major emission control components" under the Clean Air Act could subject these components to additional regulatory requirements and rules. Specifically, we are concerned about the uncertainty in how EPA's anti-tampering rules may apply to these components and request EPA clarification on how enforcement would be applied to different scenarios where work may need to be performed on these components.

[137] "Optimizing the operation of energy storage using a non-linear lithium-ion battery degradation model," Applied Energy, (March 1, 2020) https://www.sciencedirect.com/science/article/pii/S0306261919320471?via%3Dihub
[138] *See* 88 FR 29286 (May 5, 2023)
[139] *Id.* at footnote 138

8. The EV Supply Chain is Preparing to Support Increased Electrification

The widespread transition to electrified transportation is involving industries and companies that have not historically had a major role in supplying products to the transportation sector. Policies like EPA's proposed LMDV multipollutant emissions standards provide regulatory certainty for the entire supply chain supporting the transition to electrification.

As discussed further in this section, the supply chain is composed of discrete, yet interconnected segments that are continuing to scale up in capacity. Complementary policies in various stages of implementation today will lead to an even more robust and resilient supply chain over the MY 2027-2032 time frame covered by EPA's proposed standards.

Finalizing strong LMDV emissions standards is not only necessary for public health, climate, and economic reasons, but they are feasible for industry to implement and align with the planned and existing investments being made throughout the EV supply chain.[140,141] Through ZETA, the full scope of the U.S. EV supply chain is coalesced behind the goal of 100% EV sales.

a. Critical Minerals Development

As projected demand for critical minerals (lithium, nickel, cobalt, manganese, copper, graphite, and rare earth elements) for use in EV batteries continues to grow–due in large part to policies such as EPA's proposed multipollutant emission standards for LMDVs–the supply chain is preparing to meet that demand both through new extraction and processing and with additional support from recycling.

Beyond EPA emission standards, the section 30D New Clean Vehicle Tax Credit in the Inflation Reduction Act ensures that these critical minerals are sourced either in the United States or from free trade agreement countries. The credit is composed of two halves: qualifying vehicles will receive $3,750 for meeting each of the critical mineral and battery component sourcing requirements totaling up to $7,500.[142] The stringent ramp-up of the domestic sourcing requirements in the IRA over the coming years will lead to a robust supply chain capable of delivering domestically-sourced raw and refined materials.

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[140] "US and Canada Electric Vehicle Supply Chain Map," Charged by the Book, accessed June 30, 2023 https://www.charged-the-book.com/na-ev-supply-chain-map

[141] FACT SHEET: Biden-Harris Administration Announces New Private and Public Sector Investments for Affordable Electric Vehicles (April 17, 2023) https://www.whitehouse.gov/briefing-room/statements-releases/2023/04/17/fact-sheet-biden-harris-administration-announces-new-private-and-public-sector-investments-for-affordable-electric-vehicles/

[142] "Overview and Analysis: March Treasury Guidance for Clean Car Tax Credit (30D)," ZETA, (April 2023) https://www.zeta2030.org/insights/overview-and-analysis-march-treasury-guidance-for-clean-car-tax-credit-30d

A key element to the success of the supply chain's ability to deliver the critical minerals necessary to support the transition to electrified transportation will be reforming the permitting processes for new extraction and processing operations. The Biden-Harris Administration has placed a much-needed focus on this area[143] and ZETA has consistently supported reforms[144] that ensure development projects are constructed quickly while meeting the strongest environmental standards.

The executive branch has been just as aggressive on increasing critical mineral capacity in the U.S. In March 2022, President Biden invoked the Defense Production Act (DPA). The DPA allows the Department of Defense (DOD) to fund feasibility and modernization projects for mining and processing facilities.[145] With funding from the DPA, DOD invested $120 million in a rare earths separation plant in Texas with Lynas Rare Earths.[146] In February 2023, President Biden further expanded this authority to allow for large, longer-term investments in critical mineral projects.

In 2022, the White House announced the American Battery Material Initiative to leverage Federal investments and activities to build both a domestic and international critical minerals supply chain in coordination with our allies.[147] This complements the signing of the Minerals Security Partnership (MSP) with Australia, Canada, Finland, France, Germany, Japan, the Republic of Korea, Sweden, the United Kingdom, the United States, and the European Commission.[148] This agreement outlines the ethics, environmental, and safety standards expected of critical mineral mining and processing and ensures stronger trade connections between nations. The MSP also encourages investments between governments for certain projects. This partnership may explore using loans from the Export-Import Bank of the United States to on-shore and friend-shore the supply chain.

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[143] "FACT SHEET: Biden-Harris Administration Outlines Priorities for Building America's Energy Infrastructure Faster, Safer, and Cleaner," (May 2023)
https://www.whitehouse.gov/briefing-room/statements-releases/2023/05/10/fact-sheet-biden-harris-administration-outlines-priorities-for-building-americas-energy-infrastructure-faster-safer-and-cleaner/

[144] "Critical Mineral Permitting Reform Framework," ZETA, (May 2023)
https://www.zeta2030.org/insights/critical-mineral-permitting-reform-framework

[145] "Defense Production Act Title III Presidential Determination for Critical Materials in Large-Capacity Batteries," U.S. Department of Defense, (April 5, 2022)
https://www.defense.gov/News/Releases/Release/Article/2989973/defense-production-act-title-iii-presidential-determination-for-critical-materi

[146] "Australia's Lynas gets $120 mln Pentagon contract for U.S. rare earths project," Reuters, (June 14, 2022)
https://www.reuters.com/markets/us/australias-lynas-secures-120-mln-pentagon-contract-us-rare-earths-facility-2022-06-14/

[147] "Biden-Harris Administration Awards $2.8 Billion to Supercharge U.S. Manufacturing of Batteries for Electric Vehicles and Electric Grid," U.S. Department of Energy, (October 19, 2022)
https://www.energy.gov/articles/biden-harris-administration-awards-28-billion-supercharge-us-manufacturing-batteries

[148] "Minerals Security Partnership," U.S. Department of State, (June 14, 2022)
https://www.state.gov/minerals-security-partnership/

Federal agencies are also making efforts to improve the critical mineral supply chain. Organized by the Department of Interior, the interagency working group on mining reform has gathered experts and stakeholders to discuss potential permitting reform to support a domestic industry.[149] Efforts by the working groups will include proposals to reform the Mining Law of 1872, form recommendations to bolster the supply chain, and provide community engagement best practices.

To ensure there is a trained workforce for the critical mineral industry, the DOE and Department of Labor created a workforce development strategy, funded by the BIL.[150] These efforts will include retraining in fossil-fuel and automotive communities and enhancing additional training programs across the country. All together, these actions incentivize manufacturers and developers to create an American supply of critical minerals. Since their announcement, investments in the critical mineral supply chain have dramatically expanded in the country.

As EPA accurately notes in the proposed rule, there is an important distinction between energy security and mineral security. Utilization of critical minerals is inherently different from the utilization of petroleum, in that petroleum is consumed as a fuel while minerals become a component of manufactured vehicles. Supply disruptions and fluctuating prices for critical minerals are felt differently and by different parties as opposed to petroleum which has an immediate impact on consumers through higher fuel prices, as discussed in section 3(b) of these comments. In contrast, supply disruptions or price fluctuations of minerals affect only the production and price of new vehicles.

Moreover, critical minerals are not a single commodity but a number of distinct commodities, each having its own supply and demand dynamics, and some being capable of substitution by other minerals. Further, while petroleum is consumed as a fuel and thus requires continuous supply, minerals become part of the vehicle and have the potential to be recovered and recycled, as discussed further in section 8(b)(ii) of these comments.

i. Projected Demand for Critical Minerals

Demand for critical minerals is expected to grow substantially in the coming years. Figure 5 IEA's projected demand scenarios by 2040 relative to a 2020 baseline.

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[149] "Interior Department Launches Interagency Working Group on Mining Reform," U.S. Department of the Interior, (February 22, 2022) https://www.doi.gov/pressreleases/interior-department-launches-interagency-working-group-mining-reform

[150] "DOE Announces $5 Million to Launch Lithium-Battery Workforce Initiative," U.S. Department of Energy, (March 18, 2022) https://www.energy.gov/articles/doe-announces-5-million-launch-lithium-battery-workforce-initiative

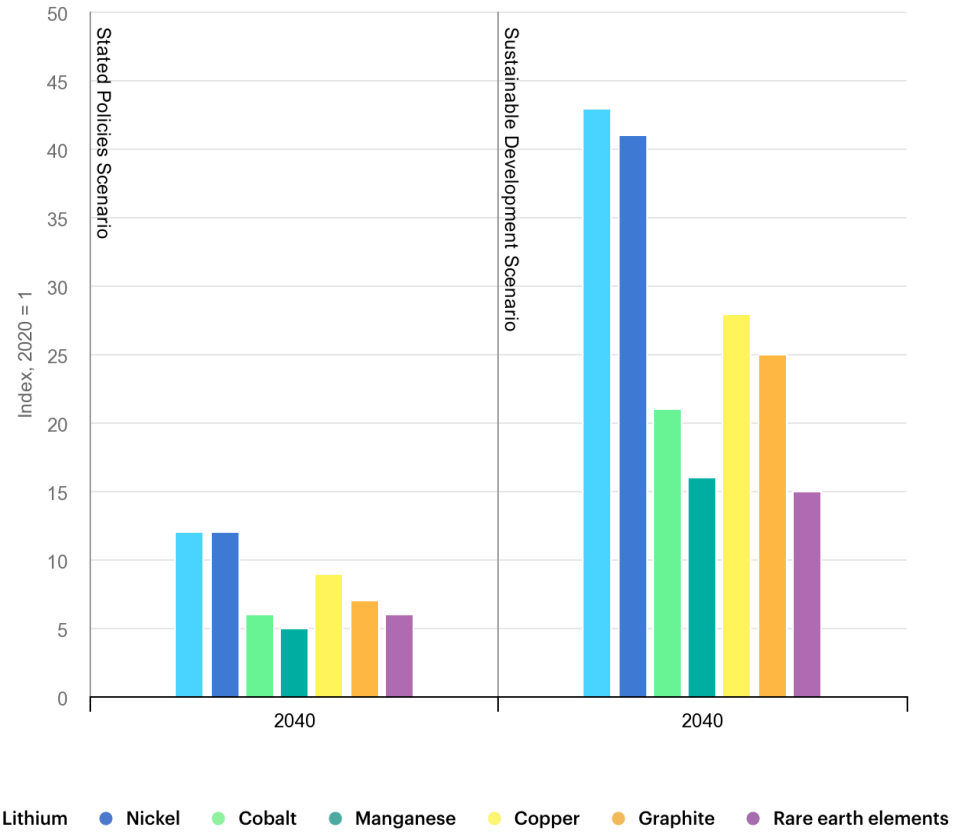

Figure 5. Mineral demand growth from new EV sales by scenario, 2040 relative to 2020[151]

In a scenario that meets the goals of the Paris Climate Agreement, the share of total demand for critical minerals rises significantly over the next two decades to over 40% for copper and rare earth elements, 60-70% for nickel and cobalt, and almost 90% for lithium.[152] EVs and battery storage have already displaced consumer electronics to become the largest consumer of lithium and are set to displace the stainless steel industry as the largest end user of nickel by 2040.

ii. Meeting the Forthcoming Demand for Critical Minerals

[151] "Mineral demand growth from new EV sales by scenario, 2040 compared to 2020," IEA, (October 26, 2022) https://www.iea.org/data-and-statistics/charts/mineral-demand-growth-from-new-ev-sales-by-scenario-2040-compared-to-2020

[152] "The Role of Critical Minerals in Clean Energy Transitions," IEA, (May 2021) https://www.iea.org/reports/the-role-of-critical-minerals-in-clean-energy-transitions

As demand for critical minerals is expected to grow rapidly, it is first necessary to evaluate the current state of global production. For most minerals, production has grown in the past decade.[153] However, while much of the production for certain minerals is concentrated in a handful of countries, there is reason to believe that most critical minerals demand can be met through extraction in democratic countries. According to the Carnegie Endowment for International Peace and as shown in Figure 6 below, nearly all critical mineral demand could be met through reserves in democratic countries.[154]

Critical Mineral	**2030 Global Demand 1.5ºC Scenario (kt)**	**Democratic Countries' Reserves (kt)**	**Surplus or Deficit (kt)**
Boron	5	79,000	78,995
Chromium	1,312	213,620	212,308
Cobalt	1,246	2,302	1,056
Copper	23,568	1,235,800	1,212,232
Graphite	30,181	75,200	45,019
Lithium	2,884	17,255	14,371
Manganese	3,205	1,338,000	1,334,795
Molybdenum	296	6,876	6,580
Nickel	10,914	60,000	49,086
Selenium	2	32	30
Silver	327	388	61
Tellurium	35	11	-24
Tin	2,210	2,330	120
Zinc	14,273	129,900	115,628

[153] "bp Statistical Review of World Energy," British Petroleum, (2022) https://www.bp.com/content/dam/bp/business-sites/en/global/corporate/pdfs/energy-economics/statistical-review/bp-stats-review-2022-full-report.pdf

[154] Democratic countries include: Argentina, Armenia, Australia, Austria, Belgium, Bhutan, Bolivia, Brazil, Bulgaria, Canada, Chile, Finland, France, Georgia, Germany, Ghana, Iceland, Indonesia, Japan, Mexico, Mongolia, Nigeria, Norway, Peru, Poland, Portugal, Senegal, Sierra Leone, South Africa, South Korea, Spain, Sri Lanka, Sweden, Ukraine, and the United States.

Figure 6. Critical Minerals Potential in All Democratic Countries[155]

The Net Zero Industrial Policy Lab at Johns Hopkins University finds that partnerships among democratic countries would be able to produce enough minerals to enable the world to limit warming to 1.5 degrees Celsius, the more ambitious target in the Paris Climate Agreement.[156] However, producing enough metals to meet these targets would require extraordinary technological and financial cooperation.

In regards to lithium, Benchmark Mineral Intelligence found that by the end of 2023, world supply of lithium will be more than double 2021's output and more than the total produced between 2015 and 2018.[157]

Given the national security implications of ensuring a stable supply of critical minerals, the Defense Advanced Research Projects Agency (DARPA) and the United States Geological Survey (USGS) have partnered to explore the potential of machine learning and artificial intelligence tools and techniques to enhance USGS critical mineral assessments.[158]

iii. Critical Mineral Production

ZETA members are scaling up capacity to meet the projected demand in the coming years. For example, Ioneer's Rhyolite Ridge project–located in Esmeralda County, NV–holds the largest known lithium and boron deposit in North America.[159] Ioneer recently announced a mineral resource update that found a 168% increase in estimated lithium at Rhyolite Ridge.[160]

ZETA member Albemarle Corp. recently announced it is aiming to spend between $1.25 billion and $1.5 billion to double its lithium hydroxide output in Australia to a volume that it estimates could power more than 2 million electric cars each year.[161] Albemarle plans to build two

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[155] "Friendshoring Critical Minerals: What Could the U.S. and Its Partners Produce?," Carnegie Endowment for International Peace (May 3, 2023) https://carnegieendowment.org/2023/05/03/friendshoring-critical-minerals-what-could-u.s.-and-its-partners-produce-pub-89659

[156] *Id.* at footnote 155

[157] "Global lithium supply forecast to hit 1 million tonnes for first time," Benchmark Mineral Intelligence, (April 28, 2023) https://source.benchmarkminerals.com/article/global-lithium-supply-forecast-to-hit-1-million-tonnes-for-first-time

[158] "Artificial Intelligence for Critical Mineral Assessment Competition," DARPA, https://criticalminerals.darpa.mil/

[159] Ioneer - Rhyolite Ridge, accessed May 16, 2023 https://rhyolite-ridge.ioneer.com/

[160] "New Ioneer Mineral Resource update finds 168% increase in estimated lithium at Rhyolite Ridge," BusinessWire, (April 26, 2023) https://www.businesswire.com/news/home/20230426005886/en/New-Ioneer-Mineral-Resource-update-finds-168-increase-in-estimated-lithium-at-Rhyolite-Ridge

[161] "Lithium giant Albemarle eyes $1.5B Australian expansion," E&E News, (May 4, 2023) https://subscriber.politicopro.com/article/eenews/2023/05/04/lithium-giant-albemarle-eyes-1-5b-australian-expansion-00095141

additional processing trains at its Kemerton plant south of Perth in Western Australia, which could boost its lithium hydroxide production by 50,000 tons annually. Albemarle recently announced that it achieved an IRMA 50 level of performance in an independent third-party assessment of its lithium brine extraction and concentration site in the Salar de Atacama, using the Initiative for Responsible Mining Assurance's (IRMA) comprehensive mining standard.[162]

Recently, ZETA member Lithium Americas provided an update on the status of its various projects around the world.[163] Lithium Americas' Caucharí-Olaroz project in Argentina is expected to begin producing lithium in June 2023. Production ramp up at the Caucharí-Olaroz project is expected to produce 40,000 tonnes per year of battery-quality lithium carbonate and is targeted to be complete in Q1 2024. Domestically, Lithium Americas recently announced the start of construction activities at Thacker Pass in Nevada following receipt of notice to proceed from the Bureau of Land Management.[164]

Snapshot of Key Domestic Lithium Production Projects		
Company	**Project/Location**	**Production Estimate**
ioneer *offtake agreement with Ford*	Rhyolite Ridge, Nevada	24,000 metric tons lithium carbonate /year
Lithium Americas *offtake with GM*	Thacker Pass, Nevada	80,000 metric tons lithium carbonate/year
Albemarle	North Carolina	100,000 tons lithium hydroxide /year (processing)
Livent *offtake with GM*	North Carolina	15,000 metric tons lithium hydroxide/year
Piedmont Lithium *offtake agreements with Tesla and LG*	Tennessee and North Carolina	60,000 metric tons lithium hydroxide / year

Figure 7. ZETA members key domestic lithium production projects.

With applications well beyond just EVs, ensuring a domestically-sourced supply of copper will be critical to ensuring a rapid transition to electrified transportation. In May 2023, the

[162] "Albemarle Becomes First Lithium Producer to Complete Independent Audit and Publich IRMA Report," Albemarle Newsroom, (June 20, 2023) https://www.albemarle.com/news/albemarle-becomes-first-lithium-producer-to-complete-independent-audit-and-publish-irma-report
[163] "Lithium Americas Reports First Quarter 2023 Results," Lithium Americas, (May 15, 2023) https://www.lithiumamericas.com/news/lithium-americas-reports-first-quarter-2023-results
[164] *Id.* at footnote 163

Department of Energy proposed to characterize copper as critical through its inclusion on the official DOE Critical Materials List.[165] In particular, DOE is recommending a designation for copper of "near-critical" in the medium term (2025-2035). To meet the forthcoming increases in demand for copper, a pair of domestic projects are currently in various stages of development: One major project that would help the U.S. with its growing demand for copper, molybdenum, silver and critical minerals is Resolution Copper in Arizona. This project has the potential to supply up to 25% of the nation's copper demand to power America's clean energy transition with $1 billion annually into Arizona's economy. The project currently employs 300 people, 80% of whom live locally in rural communities within 40 miles of the project. When the mine is fully operational, Resolution Copper expects to directly employ about 1,500 workers, paying around $134 million per year in total compensation. In total, the project is expected to support 3,700 direct and indirect jobs, many of them local building trades and U.S. Steel Workers union jobs.[166]

NewRange Copper Nickel is a 50:50 joint venture of Teck Resources Limited and PolyMet Mining Corp., holding the NorthMet and Mesaba deposits – two large, well defined resources in the established Iron Range mining region of Minnesota. The stand- alone company is creating a path to develop one of the world's largest and lowest cost copper-nickel-PGM producing districts, unlocking a new domestic supply of critical minerals for the low-carbon transition through responsible mining, and delivering significant, multi-generational economic and other benefits to the region and beyond.[167]

Anovian, which produces synthetic graphite anodes, is investing $800 million in Georgia to build a new manufacturing facility. The company's first large-scale facility is expected to produce 40,000 metric tons of synthetic graphite annually for lithium-ion batteries.[168]

Manganese miner Element 25 has signed a definitive agreement with automotive major General Motors to supply up to 32,500 t/y of battery-grade high-purity manganese sulfate to support GM's EV production in North America.[169]

iv. Refining and Processing

[165] "Critical Materials Assessment," U.S. Department of Energy, (May 2023) https://www.energy.gov/sites/default/files/2023-05/2023-critical-materials-assessment.pdf
[166] *See:* https://resolutioncopper.com/
[167] *See:* https://newrangecoppernickel.com/
[168] "Anovion Technologies to build $800M facility in Georgia," Manufacturing Dive, (May 22, 2023) https://www.manufacturingdive.com/news/anovion-technologies-800m-facility-in-georgia/650808
[169] "GM signs up to Element 25's Louisiana plans," Mining Weekly, (June 26, 2023) https://www.miningweekly.com/article/gm-signs-up-to-element-25s-louisiana-plans-2023-06-26

In March 2023, Albemarle announced a new lithium processing facility in South Carolina.[170] Albemarle expects the facility to annually produce approximately 50,000 metric tons of battery-grade lithium hydroxide from multiple sources, with the potential to expand up to 100,000 metric tons. Production at the facility would support the manufacturing of an estimated 2.4 million electric vehicles annually.

In March 2023, EVelution Energy announced a $200 million cobalt processing plant in Arizona to produce cobalt sulfate for up to 470,000 EVs per year by the time the facility is fully operational in 2026.[171]

In May 2023, Tesla announced a new lithium refinery in Southwest Texas which, when completed, is expected to produce enough lithium to build about 1 million EVs by 2025.[172]

b. Batteries

The U.S. battery manufacturing industry is quickly scaling to meet demand driven by transportation electrification. According to Argonne National Lab, between 2010 and 2021, $95 billion was invested in the U.S. battery manufacturing industry.[173] This number represents 160 new or expanded critical materials processing and manufacturing facilities, with enough capacity to provide batteries for 10 million EVs each year and create 70,000 new jobs.

The Bipartisan Infrastructure Law allocated $1.6 billion to the Department of Energy for the funding of "new commercial-scale domestic facilities to extract and process lithium, manufacture battery components, recycle batteries, and develop new technologies to increase U.S. lithium reserves."[174] In 2022, the Inflation Reduction Act 45X Advanced Manufacturing Production and Advanced Energy Project Tax Credit provided $35 per kWh in each battery cell, $10 per kWh in each battery module, 10% of the costs of production of the applicable critical materials incurred by the taxpayer. The Advanced Energy Project Tax Credit also appropriated a $10,000,000 fund

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[170] "Albemarle Corporation Announces New U.S. Lithium Mega-Flex Processing Facility in South Carolina," Albemarle Corporation, (March 22, 2023) https://www.albemarle.com/news/-albemarle-corporation-announces-new-us-lithium-megaflex-processing-facility-in-south-carolina–

[171] "EVelution Announces $200 Million Cobalt Production Facility in Yuma County, Arizona Commerce Authority, (March 29, 2023) https://www.azcommerce.com/news-events/news/2023/3/evelution-energy-announces-200-million-cobalt-production-facility-in-yuma-county

[172] "Elon Musk and Tesla break ground on massive Texas lithium refinery," Reuters, (May 8, 2023) https://www.reuters.com/business/autos-transportation/tesla-plans-produce-lithium-1-mln-vehicles-texas-refinery-elon-musk-2023-05-08/

[173] "A new look at the electric vehicle supply chain as battery-powered cars hit the roads en masse," Argonne National Laboratory, (May 4, 2023) https://www.anl.gov/article/a-new-look-at-the-electric-vehicle-supply-chain-as-batterypowered-cars-hit-the-roads-en-masse

[174] *See* Public Law 117-58

for tax credits to build clean technology manufacturing facilities, including those that process, refine, and recycle critical minerals.[175] Through the 45X credit, the IRA cuts nearly one third of the cost of producing batteries in the United States.[176] Together, these historic provisions will drive American battery innovation, ensuring that the sector is equipped to electrify all vehicle classes as EV deployments accelerate over the coming years.

i. Manufacturing

There is historic momentum around battery manufacturing as it ramps up to support transportation electrification. Over the past year, battery producers have rapidly invested in new battery capacity in anticipation of strong electric vehicle sales growth. A total of 1.4 terawatt hours (TWhs) of new battery capacity was announced in just the last six months, according to Benchmark's Gigafactory Assessment.[177] The number of plants being tracked more than doubled to 379 in April from 174 plants in November 2020, according to Benchmark. Since January 2021, the U.S. private sector has announced nearly $82 billion in battery manufacturing investments, translating to 96 new or expanded processing and manufacturing plants.[178]

Below is a list of recently-announced investments in EV battery manufacturing, all of which will help support the transition to an electrified transportation sector:

- In March 2023, ZETA member LG announced a $5.5 billion investment to construct a battery manufacturing complex in Queen Creek, Arizona. The complex will consist of two manufacturing facilities – one for cylindrical batteries for EVs and another for lithium iron phosphate (LFP) pouch-type batteries for energy storage systems (ESS). LG plans to invest $3.2 billion in building a cylindrical battery manufacturing facility with a capacity of 27GWh, and $2.3 billion in LFP pouch-type battery facility with the capacity of 16GWh. Both facilities, totaling 43 GWh, plan to break ground this year and will begin production in 2025 and 2026, respectively.[179] A more comprehensive list of LG's

[175] "Inflation Reduction Act: What it Is and What it Means for EV Adoption," ZETA, (2022) https://www.zeta2030.org/insights/the-inflation-reduction-act-what-it-is-and-what-it-means-for-ev-adoption
[176] "U.S.-Made EVs Could Get Massively Cheaper, Thanks to Battery Provisions in New Law," Car and Driver, (February 3, 2023) https://www.caranddriver.com/news/a42749754/us-electric-cars-could-get-cheaper-inflation-reduction-act-section-45x/
[177] "Battery gigafactory plans slow down in April after record 2022," Benchmark Minerals Intelligence, (April 26, 2023) https://source.benchmarkminerals.com/article/battery-gigafactory-plans-slow-down-in-april-after-record-2022?mc_cid=f82a9ac7a8&mc_eid=be723945d8
[178] New US Battery Manufacturing and Supply Chain Investments Announced Under President Biden, US Department of Energy, (February 13, 2023) https://www.energy.gov/sites/default/files/2023-02/Battery%20Supply%20Chains%20Investments%20Map.pdf
[179] "LG Energy Solution to Invest KRW 7.2 Trillion to Build Battery Manufacturing Complex in Arizona, Step Up EV and ESS Battery Production in North America," LG, (March 24, 2023) https://news.lgensol.com/company-news/press-releases/1613/

investments in domestic battery manufacturing can be found in Appendix figure A.1.

- In April 2023, Hyundai Motor Co. announced it had finalized a $5 billion EV battery joint venture with SK On, a battery unit of SK Innovation Co Ltd. The plant will be located in Georgia and is expected to start manufacturing battery cells in the second half of 2025 with an annual production capacity of 35 GWh.[180]
- In April 2023, General Motors and Samsung announced they will invest over $3 billion to build a joint venture EV battery manufacturing plant in the U.S. Expected to start production in 2026, the plant aims to have an annual production capacity of 30 GWh.[181]
- In May 2023, ZETA member Panasonic announced that it would expand its U.S. manufacturing capacity from 38 GWh today to 200 GWh by 2030, including Panasonic's $4 billion under-construction investment in Kansas.[182]
- In June 2023, the Ford/SK On joint venture BlueOval SK was awarded a $9.2 billion conditional loan from the Department of Energy's Loan Programs Office–the largest in the office's history. The loan will help the joint venture build two gigafactories in Kentucky and one in Tennessee. Together, the plants will enable more than 120 GWh of U.S. battery production annually and displace more than 455 million gallons of gasoline per year for the lifetime of the vehicles powered by these batteries. The project is expected to create a total of approximately 5,000 construction jobs in Tennessee and Kentucky, and 7,500 operations jobs once the plants are up and running.[183]

ii. Recycling

A key component for meeting the coming demand for EV batteries and critical minerals will be recycling existing batteries at their end-of-life (EOL). As shown in Figure 8, North American battery recycling capacity is growing rapidly and as it increases in the coming years, so too will available EOL battery feedstocks as EVs on the road today will approach the end of their useful life.

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[180] "Hyundai Motor bolsters US presence with $5 bln EV battery venture," Reuters, (April 25, 2023) https://www.reuters.com/business/autos-transportation/hyundai-motors-q1-net-profit-jumps-109-beating-expectations-2023-04-25/

[181] "GM, Samsung SDI to invest more than $3 bln to build joint EV battery plant in US," Reuters, (April 25, 2023) accessed May 17, 2023 https://www.reuters.com/business/autos-transportation/gm-samsung-sdi-plan-build-new-us-battery-plant-sources-2023-04-24/

[182] "Group Strategy Briefing," Panasonic Holdings Corporation, (May 18, 2023) https://holdings.panasonic/global/corporate/investors/pdf/20230518_groupstrategy_e.pdf

[183] "LPO Announces Conditional Commitment for Loan to BlueOval SK to Further Expand U.S. EV Battery Manufacturing Capacity," U.S. Department of Energy, (June 22, 2023) https://www.energy.gov/lpo/articles/lpo-announces-conditional-commitment-loan-blueoval-sk-further-expand-us-ev-battery

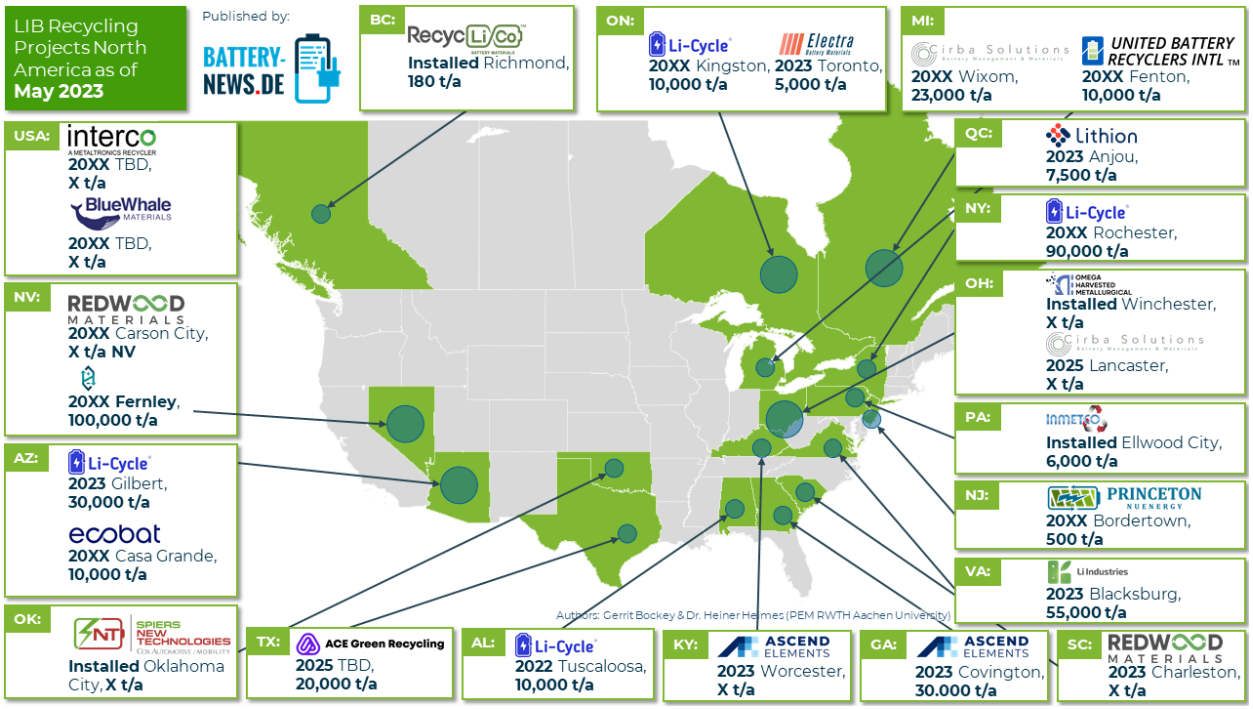

Figure 8. Battery recycling projects in North America (as of May 2023)[184]

In recognition of the potential solutions that battery recycling can provide, Congress required EPA under the Bipartisan Infrastructure Law to develop battery recycling best practices and battery labeling guidelines. Congress allocated $10 million and $15 million respectively to the agency to complete these tasks by September 30, 2026.[185] While there will likely be more work needed, potentially through voluntary consensus standards bodies, a framework is beginning to take shape to ensure increased recycling capacity is built out in the coming years.

The global market for EV battery recycling alone is estimated to reach $17.1 billion by 2030.[186] By 2025, Benchmark Minerals Intelligence forecasts that scrap will account for 78% of the pool of recyclable materials.[187] This growth is largely driven by the growing number of EVs

[184] "Battery Recycling in North America as of May 2023," Battery-News.de, (May 5, 2023) accessed June 26, 2023 https://battery-news.de/index.php/2023/05/05/batterie-recycling-in-nordamerika/
[185] *See* Public Law 117-58
[186] "Battery Recycling Market Size, Share & Trends Analysis Report By Chemistry (Lithium-ion, Lead Acid, Nickel), By Application (Transportation, Industrial), By Region (Europe, Asia Pacific, North America), And Segment Forecasts, 2023 - 2030," Grand View Research, (April 2023) https://www.grandviewresearch.com/industry-analysis/battery-recycling-market
[187] "Benchmark Minerals: Battery production scrap will be the main source of recyclable material this decade," (September 16, 2022) https://chargedevs.com/newswire/benchmark-minerals-battery-production-scrap-will-be-the-main-source-of-recyclable-material-this-decade/

approaching EOL. The volume of EOL batteries from EVs and large storage applications is less than 2 GWh today but could reach 100 GWh by 2030 and 1.3 TWh by 2040.[188]

Below is a list of recently-announced investments in EV battery recycling, all of which will help support the transition to an electrified transportation sector:

- In October 2022, ZETA member Princeton NuEnergy Inc. (PNE) opened a new 500 t/a plant capable of direct recycling lithium-ion consumer electronics and EV batteries with its strategic partner, Wistron GreenTech in McKinney, Texas.[189] This end-to-end facility ingests end of life batteries fully separating copper, aluminum, plastics, electrolyte, cathode and anode materials. Cathode materials are cleaned by surface etching with low-temperature plasma (LPAS™) and reformed into new cathode materials equivalent to OEM specifications that can be directly reused in battery production. The factory will be certified and commissioned in 2023. In April 2023, Princeton NuEnergy launched a US Department of Energy $12M R&D grant to expand and enhance PNE's battery recycling production processes through 'up-cycling' of legacy spent cathode chemistries into newer formulations, scaling processes for direct recycling of anode materials, and enhancing recycling/reuse of all other battery components.[190]
- In April 2023, ZETA member Redwood Materials announced a pair of partnerships to collect EOL battery feedstocks. This announcement builds on Redwood's announcement from November 2022 to recycle Panasonic's cell scrap and supply Panasonic with recycled copper foil and cathode active material.[191] Rad Power Bikes will provide Redwood with e-bike batteries when they reach the end of their lifespan.[192] Redwood and Volkswagen of America expanded their partnership to collect more EOL batteries from consumer electronics.[193] Both announcements come following a historic announcement from the Department of Energy of a $2 billion conditional loan to Redwood to support its McCarran, NV recycling facility.[194] At full production capacity, the McCarran project's

[188] "The Role of Critical Minerals in Clean Energy Transitions - Reliable supply of minerals," IEA, (2021) https://www.iea.org/reports/the-role-of-critical-minerals-in-clean-energy-transitions/reliable-supply-of-minerals
[189] "Update: Princeton NuEnergy launches end-to-end LIB recycling production line," RecyclingToday, (October 25, 2022) https://www.recyclingtoday.com/news/princeton-nuenergy-launching-end-to-end-lib-recycling-production-line/
[190] "Princeton Nuenergy teams up with scientists to improve its LIBs recycling technology," RecyclingToday, (April 3, 2023) https://recyclingtoday.com/news/princeton-nuenergy-teams-up-with-scientists-aided-by-doe-grant/
[191] https://news.panasonic.com/global/press/en221115-4
[192] "Rad Power Bikes links up with Redwood Materials for e-bike battery recycling," Verge, (April 24, 2023) https://www.theverge.com/2023/4/24/23695767/rad-power-bikes-redwood-materials-ebike-battery-recycle
[193] "VW and Redwood want to turn your old laptops into EV batteries," TechCrunch+, (April 4, 2023) https://techcrunch.com/2023/04/04/vw-and-redwood-want-to-turn-your-old-laptops-into-ev-batteries/
[194] "LPO Offers Conditional Commitment to Redwood Materials to Produce Critical Electric Vehicle Battery Components From Recycled Materials," U.S. Department of Energy, (February 9, 2023) https://www.energy.gov/lpo/articles/lpo-offers-conditional-commitment-redwood-materials-produce-critical-electric-vehicle

anode copper foil and cathode active material output is anticipated to support the production of more than 1 million EVs per year.

- In May 2023, ZETA member Li-Cycle announced a partnership with Glencore to build a battery recycling hub in Portovesme, Italy, with construction expected to commence in late 2026 to early 2027. Once completed, the Portovesme Hub is expected to have processing capacity of up to 50,000 to 70,000 tons of black mass annually, or the equivalent of up to 36 GWh of lithium-ion batteries.[195]

iii. Alternative Chemistries

As battery manufacturing and recycling capacity ramps up, so too does the development of innovative alternative battery chemistries that will transform the range, durability, and cost of EVs. Lithium Iron Phosphate (LFP) batteries do not require nickel or cobalt, leading to reduced costs.[196] Another potentially promising technology is sodium-ion batteries. Because they substitute lithium for sodium, sodium-ion batteries tend to be cheaper, and may have significant applications in lower-range EVs.[197]

Recent advancements in solid-state batteries have also recently been announced, most notably by Toyota which aims to commercialize the technology as soon as 2027, consistent with the MY 2027-2032 time frame covered by EPA's proposed LMDV emissions standards.[198] While there remain substantial challenges to mass adoption, solid-state batteries offer some promise in that they are more energy dense, highly stable, offer potentially faster charging times, and can be produced faster than lithium-ion batteries.[199] Benchmark Mineral Intelligence forecasts that solid-state battery production will exceed 30 GWh in 2026.[200]

As research and commercialization of alternative battery chemistries and technologies continues in the private sector, the Department of Energy's SLAC National Accelerator Laboratory[201] and

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[195] "Li-Cycle and Glencore unveil plans for recycling hub in Italy," Reuters, (May 9, 2023) https://www.reuters.com/business/sustainable-business/li-cycle-glencore-unveil-plans-recycling-hub-italy-2023-05-09/

[196] "Lithium iron phosphate comes to America," Chemical and Engineering News, (January 29, 2023) https://cen.acs.org/energy/energy-storage-/Lithium-iron-phosphate-comes-to-America/101/i4

[197] "What If Your Tesla Could Run on Sodium?" The Wall Street Journal, (April 19, 2023) https://www.wsj.com/articles/what-if-your-tesla-could-run-on-sodium-3c18df30

[198] "Japan's Toyota announces initiative for all-solid state battery as part of electric vehicles plan," AP News, (June 13, 2023) https://apnews.com/article/toyota-evs-hydrogen-battery-climate-cd7730dbb9c157cf1663d39a3b39778e

[199] "Solid State Battery Tech For EV Cars: Challenges Lie Ahead," MotorTrend, (March 10, 2023) https://www.motortrend.com/features/solid-state-ev-car-batteries-challenges/

[200] Benchmark Mineral Intelligence on LinkedIn, accessed June 21, 2023 https://www.linkedin.com/posts/benchmark-mineral-intelligence_solidstatebattery-solidstate-lithiummetal-activity-7075019101990989825-0DAG

[201] "SLAC National Accelerator Laboratory," DOE Office of Enterprise Assessments, accessed May 17, 2023 https://www.energy.gov/ea/slac-national-accelerator-laboratory

Stanford University recently announced the launch of a new joint battery center at SLAC.[202] It will bring together the resources and expertise of the national lab, the university, and Silicon Valley to accelerate the deployment of batteries and other energy storage solutions. Argonne National Laboratory is also researching emerging new battery technologies including lithium-air, which could offer much longer driving range compared with the lithium-ion battery,[203] and lithium-sulfur, which can hold more energy than traditional ion-based batteries.[204]

c. Electricity Generation and Grid Readiness

Transitioning to zero-emission transportation offers a unique challenge to the energy companies that will need to ensure they have ample electricity supply to match EV-driven demand. At minimum, this will require investments in the electricity distribution system to enable the deployment of electric vehicle charging equipment. In some instances, this may also require investing in new energy generation sources and associated distribution system infrastructure to accommodate high-use EV charging centers.

However, this is not the first time electricity providers have navigated increases in electricity demand brought on by new technologies: similar spikes accompanied the mass adoption of now-standard appliances like refrigerators and in-home air conditioners. Still, it will be important to ensure that providers and government agencies can work within their regulatory frameworks to test solutions and upgrade the grid to prepare for future demand increases accompanying greater EV adoption.

This section will discuss the growing energy demands of widespread EV adoption and new potential hotspots for energy demand. It will also use case studies to highlight how electricity providers are preparing for this transition. These case studies showcase solutions that have the potential to revolutionize energy consumption and highlight how electricity providers support customer EV adoption through incentive programs, building infrastructure, and other initiatives.

The grid's ability to handle millions of additional EVs hinges on utilities' proactive planning capacity. Granting utilities the flexibility to make proactive upgrades to the electrical grid and facilitate transportation electrification will require careful planning and coordination between regulators and stakeholders.

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[202] "New Battery Center Launches In USA," CleanTechnica, (April 13, 2023) https://cleantechnica.com/2023/04/13/new-battery-center-launches-in-usa/

[203] "New design for lithium-air battery could offer much longer driving range compared with the lithium-ion battery," Argonne National Laboratory, (February 22, 2023) https://www.anl.gov/article/new-design-for-lithiumair-battery-could-offer-much-longer-driving-range-compared-with-the-lithiumion

[204] "Lithium-sulfur batteries are one step closer to powering the future," Argonne National Laboratory, (January 6, 2023) https://www.anl.gov/article/lithiumsulfur-batteries-are-one-step-closer-to-powering-the-future

Regulatory certainty will allow utilities to make the investments necessary to facilitate a smooth EV transition. To invest proactively, rather than in response to firm load, energy providers will need clear insight into multi-year schedules for customer electrification, approval from regulators to recover costs, and/or flexibility to serve loads with non-wire alternatives.

Stringent EPA emissions standards will provide the regulatory certainty needed to not only ensure vehicle manufacturers continue to invest in EV technologies, but that the entire supply chain supporting the transition to electrification will have a clearer picture of how to plan capital expenditures today to meet the increased demand over the coming years.

i. Anticipated Impacts to the Electrical Grid from Increased EV Deployment

In 2021, the U.S. fleet of electric vehicles used 6.1 TWhs of electricity to travel 19.1 billion miles.[205] That accounted for just 0.15% of the total national energy generation that year.[206] In 2022, the United States produced 4,243 TWhs of electricity.[207] To meet the demand of transportation electrification, more generation will be needed to service EVs and electrified vehicle technologies. One estimate suggests it would take roughly 800 to 1,900 TWh of electricity to power all vehicles if they were electric.[208] It is important to remember, however, that this new demand will not occur all at once but rather more gradually as EVs continue to displace ICEVs. While achievable, meeting this increase in electricity demand will require significant strategy as electric providers transition to renewable, carbon free resources.

The key to meeting these energy requirements will be the expansion of renewable energy resources but also the addition of new, zero-emission and low-emission load-following resources like advanced nuclear, carbon capture, long-term energy storage, and green hydrogen. In 2022, electricity generated from renewable sources surpassed coal for the first time in U.S. history.[209] At the same time, electricity providers are looking at ways to add low-cost energy storage to increase the availability of non-dispatchable renewable generation such as solar and wind. Currently, renewable energy generates about 20% of all electricity production in the U.S, and renewable sources like solar and wind are expected to account for the majority of new

[205] "Assessment of Light-Duty Plug-in Electric Vehicles in the United States, 2010–2021," Argonne National Laboratory, (November 2022) https://publications.anl.gov/anlpubs/2022/11/178584.pdf
[206] "Monthly Energy Review May 2023," EIA, https://www.eia.gov/totalenergy/data/monthly/pdf/sec7_3.pdf
[207] *Id.* at footnote 206
[208] "How much electricity would it take to power all cars if they were electric?," USAFacts, (May 15, 2023) https://usafacts.org/articles/how-much-electricity-would-it-take-to-power-all-cars-if-they-were-electric/
[209] "U.S. renewable electricity surpassed coal in 2022," Associated Press, (March 28, 2023) https://apnews.com/article/renewable-energy-coal-nuclear-climate-change-dd4a0b168fe057f430e37398615155a0

utility-scale electricity generation going forward.[210,211] Already, available renewable energy resources in the U.S. are estimated to amount to more than 100 times the nation's current electricity needs.[212]

Power generation is only one of the considerations when preparing for 100% transportation electrification. In particular, the industry needs to develop its ability to precisely manage demand in real time, including by accurately predicting when and where increases in demand will occur.

It is important to note that energy demand is not constant. Instead, it consists of relatively predictable peaks and troughs throughout the day. High demand consistently occurs between 5:00 PM and 8:00 PM each day, as customers return home, turn up their climate control systems, begin cooking dinner, and turn on other devices.[213] System demand peak is typically between 5:00-6:00 PM during the summer, and 7:00-8:00 AM in the winter. As such, EV charging poses minimal impacts to the winter peak hours but could increase summer peaks without managed charging. As discussed further below, electricity providers are looking at ways to reduce the impact of EV charging on these spikes in energy demand by studying the energy needs of their customers.

ii. Utility-Specific Planning Underway

The following collection of case studies demonstrates how electricity providers in ZETA's membership are preparing for the EV transition and highlights some of their groundbreaking initiatives to support EV adoption in the United States. It should be noted that each provider operates within a regulatory framework that is unique to the state in which it serves. The cases outlined below do not represent the entire portfolio of EV-related products and services offered by these providers.

These examples include programs that exist across the EV supply chain, with earlier examples covering infrastructure planning programs and later examples focusing on programs to engage with EV drivers on their charging needs.

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[210] "Renewable Energy," U.S. Department of Energy, accessed June 4, 2023 https://www.energy.gov/eere/renewable-energy

[211] "Solar power will account for nearly half of new U.S. electric generating capacity in 2022," EIA, (January 10, 2022) https://www.eia.gov/todayinenergy/detail.php?id=50818

[212] "Renewable Energy Resource Assessment Information for the United States," U.S. Department of Energy, accessed June 4, 2023 https://www.energy.gov/eere/analysis/renewable-energy-resource-assessment-information-united-states

[213] "Yes, the grid can handle EV charging, even when demand spikes," Yale Climate Connections, (March 23, 2023) https://yaleclimateconnections.org/2023/03/yes-the-grid-can-handle-ev-charging-even-when-demand-spikes/

1. Pacific Gas & Electric

As California's largest electric provider, PG&E continues to play an important role in advancing electric vehicle adoption in support of the state's broad climate goals. PG&E works in collaboration with the California Energy Commission and California Public Utilities Commission to plan and approve grid infrastructure upgrades to support this shift to zero-emission transportation.

With nearly 500,000 EVs sold in its service area—one in every seven of all EVs on the road throughout the nation—expansion of PG&E's EV charging network in Northern and Central California is critical to support the State's transition to a clean transportation future. Over the last half-decade, the provider has deployed more than 5,000 EV charging ports across its service area. Additionally, it offers a variety of resources to help accelerate EV adoption among customers, and PG&E is working collaboratively with vehicle manufacturers to develop vehicle grid-integration technologies.

Grid planning requires precise forecasts to ensure electric infrastructure is available to support future demand. Pre-existing electricity demand (load) forecasts did not provide the geographical granularity needed to best plan for grid investments. PG&E could allocate the load to residential charging locations; however, larger charging loads that are often not associated with existing service points—such as public charging systems—lacked a methodology to be accounted for in long-term forecasting efforts. Without the ability to identify future EV demand with geographic and temporal accuracy, PG&E was limited in its ability to plan future grid capacity.

Lacking a long-term geospatial forecasting methodology, PG&E was primarily dependent on customer requests for service to inform where EV load would materialize. This reliance on customer requests led PG&E to reactively develop capacity solutions to serve load requests. Given the long lead times often associated with capacity projects and the relatively fast pace at which customers wish to build EV charging infrastructure, there would be instances where energization timelines exceeded the requested energization date from customers. This can occur with large load applications associated with public DCFC charging stations or large fleets, which have the potential to exceed the maximum capacity of existing electrical infrastructure in those areas.

Identifying a need for a more proactive approach, PG&E set out to improve its forecasting abilities to increase the clarity of where and when EV loading is most likely to materialize. This enables PG&E to build capacity in advance of service applications being received. Although research indicates that customer preference for EVs is increasing, and there are many regulations and incentives which further support the transition to EVs, there are still uncertainties around the pace of adoption. This impacts how the EV load will manifest on the electric grid. For this

reason, a solution capable of supporting a variety of forecast scenarios was necessary for success. PG&E commissioned a multi-faceted project focused on three common categories of EV charging load: 1) public DCFC & Level 2 charging stations, 2) residential EV charging, and 3) fleet charging.

Detailed analysis and machine learning modeling and testing were applied to each of these focus areas to predict where EV charging is most likely to occur. These analyses were performed at the premise level and resulted in over 5 million potential growth points across PG&E's service territory that were integrated into existing distribution planning software. This created a dynamic tool that can adapt to a variety of forecast inputs, such as system-level adoption forecasts, EV charging behaviors, and charging infrastructure assumptions. These scenarios can be integrated into PG&E's distribution planning processes.

Developing a solution that was easily integrated into existing distribution planning processes and software was critical for successful implementation. Involving PG&E forecasting and asset planning teams in the development of the EV forecasting tool, as well as reviewing and approval of the major inputs and assumptions used to develop forecast scenarios, ensured alignment in the scenarios generated.

Using varying EV forecast scenarios, PG&E was able to assess the localized grid impacts from high EV adoption scenarios that are better aligned with state transportation electrification goals and policies. PG&E assessed how various levels of EV adoption, as well as the impacts that changing charging behaviors (such as on vs. off-peak charging), can have on grid needs. Early analysis has indicated that off-peak charging can reduce near-term grid constraints. In the future, this may lead to new circuit peaks and capacity constraints that must be addressed.

Results from these analyses were helpful in advocating for approval of higher transportation electrification forecasts with regulators and the state energy commission, which are ultimately used for electric grid planning. PG&E has also used these forecasts to produce directional assessments of the resources needed to support capacity investments included in their long-term capital planning. PG&E continues to work to improve its forecasting and planning capabilities. Still, the solutions implemented to date have enabled a more robust approach that will allow PG&E to continue to support its customers' electrification transition.

PG&E's plan for a high electrification future also includes the following measures:[214]

[214] "Answers to Administrative Law Judge's Ruling Seeking Additional Information on the Distribution Planning Process by Pacific Gas and Electric Company," PG&E, (April 10, 2023) https://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M505/K839/505839889.PDF

- Working diligently to plan and develop capacity infrastructure to ensure electricity is available where peak demand is expected to increase as zero-emission vehicle adoption continues to grow. Efforts include close collaboration with state agencies, technology partnerships, EV charging developers, vehicle original equipment manufacturers, and adopters of zero-emission vehicles to proactively prepare electric capacity in high demand areas in ways that consider economic development and customer electricity rates.
- Proactive discussions with customers and municipalities to understand their individual plans for electrification load growth to better include them in PG&E forecasting and planning.
- In addition to using customer TE plans to inform longer-term load forecasts and planning, PG&E is also using these customer plans to inform our near-term priority proactive upgrades.
- Working with state agencies and regulators to increase the load forecasts that are used for utility planning, enabling a faster build out of additional capacity infrastructure (as described earlier).

2. Vistra

Electricity generators are making the transition to low- and no-carbon-emitting sources of energy as quickly as possible in response to investor, regulator, policymaker, and customer expectations. This transition is backed by a strong business case for doing so, as renewables and battery storage systems are able to compete effectively with fossil fuel generation and provide benefits to the power grid. The International Energy Agency expects renewable energy resources to provide 18% of the world's power by 2030, up from 11.2% in 2019.[215] However, certain renewable energy sources—such as solar and offshore/onshore wind—are dependent on weather conditions and the time of day. This means deploying these resources at scale will require accompanying battery technology to ensure electric grid reliability.

Energy storage allows for the integration of more intermittent resources by storing electricity until it is needed. It also augments existing energy generation by allowing excess energy to be produced when low demand is stored until demand peaks. Energy storage can provide benefits beyond emissions reduction, including cost-savings for consumers, reliability, and backup and startup power during extreme events.

Vistra operates the Moss Landing Energy Storage Facility in California, the largest of its kind in the world, and is pursuing an expansion that will bring 750 MW online in the second quarter of

[215] "Modern renewables," IEA, accessed June 4, 2023 https://www.iea.org/reports/sdg7-data-and-projections/modern-renewables

2023.[216] This facility is particularly valuable in California, where the swift transition to renewable energy, paired with a constantly growing demand for electricity, illustrates the need for reliability in the electric grid and the role energy storage can play. As of 2021, non-hydroelectric renewables provide approximately 35% of California's electricity, and electricity demand has increased due to a variety of factors, including severe weather events, widespread electrification, and electric vehicle deployment.[217] This combination was put to the test in September 2022, when the state faced its most extreme September heat event in recorded history. This weather event put unprecedented strain on the electric grid and set records for electricity demand. To the surprise of many, the lights stayed on. During that event, batteries, including Vistra's Moss Landing facility, provided about 4% of supply—over 3,360 MW, more than the Diablo Canyon nuclear power plant (the state's largest electricity generator)—during the peak demand, averting rolling blackouts. A report from the California Independent System Operation (CAISO) following the September 2022 event specifically highlighted the increase in energy storage resources as a key factor that supported the grid's reliability.[218] As a comparison, the August 2020 heat wave, which occurred when California's energy storage resources were few and far between, resulted in rolling blackouts over multiple days.

Recognizing that the replacement of fossil fuel-powered assets with zero-carbon resources is not a one-to-one exchange, Vistra is working to maintain reliability by using energy storage and installing zero-carbon investments on the sites of retired or soon-to-be-retired fossil fuel plants. This also ensures that communities do not lose key energy supplies or ongoing tax revenue. Vistra is also focused on ensuring that existing zero-carbon generation remains online, such as the Comanche Peak Nuclear Power Plant in Texas, which is currently going through the Nuclear Regulatory Commission's relicensing process to continue operations through 2053. This high-performing plant is able to produce power—rain, snow, or shine—increasing grid reliability for Texans and making it a keystone generator for the Electric Reliability Council of Texas (ERCOT) grid. Alongside the transition to cleaner generation resources, Vistra has been able to maintain reliability for its consumers and ensure that individuals and businesses are able to keep their lights on, even during extreme weather events. During Winter Storm Uri in Texas in 2021, Vistra's plants produced between 25-30% of the power on the grid during the storm, far beyond its ~18% market share.

As the energy supply mix shifts toward low- and zero-carbon resources, energy storage will fill the reliability gap and allow that mix to evolve more reliably and flexibly. The Inflation

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[216] "Vistra Announces Expansion of World's Largest Battery Energy Storage Facility," Vistra, (January 24, 2022) https://investor.vistracorp.com/2022-01-24-Vistra-Announces-Expansion-of-Worlds-Largest-Battery-Energy-Storage-Facility

[217] "2021 Total System Electric Generation," California Energy Commission, accessed June 5, 2023 https://www.energy.ca.gov/data-reports/energy-almanac/california-electricity-data/2021-total-system-electric-generation

[218] "California ISO posts analysis of September heat wave," California ISO, accessed June 5, 2023 http://www.caiso.com/Documents/california-iso-posts-analysis-of-september-heat-wave.pdf

Reduction Act provides new tax incentives for investment in energy storage technologies and resources to support the R&D of advanced and long-duration energy storage technologies. These investments will enable the deployment of utility-scale energy storage and add reliability to the grid, no matter what the future energy generation mix looks like. It is crucial that the United States continues to make the transition to a carbon-neutral economy and electric grid in a way that ensures the continued reliability of the grid at a reasonable cost to consumers.

3. Southern California Edison

About 40% of the nation's electric vehicles, more than 1.3 million, have been sold in the state of California. More than 430,000 of those are in SCE's service area alone. Many have expressed doubts that the grid is ready for the energy demand created by the need to charge so many EVs, but electric power companies, including SCE, are keeping up with increasing levels of adoption. In anticipation of growing EV demand in Southern California, SCE is continuously taking the steps to upgrade the grid and promote customers' transition to electric transportation and proactively solve near-term issues, while also undertaking long-term investments to ensure the grid is ready for all levels of anticipated electrification adoption.

Solving near-term challenges

One way SCE is addressing the near-term issues is its Power Service Availability (PSA) initiative for Transportation Electric service.

- SCE is focusing on (1) improving its internal processes to streamline interconnection, (2) engaging fleet operators to better understand their plans for electrification, (3) improving its ability to forecast and assess the impacts of transportation electrification (TE) growth, and (4) leveraging new technologies as grid infrastructure solutions
- Because some projects require more time than others to build, SCE is encouraging fleet owners to engage with the utility early in the process so that SCE can better understand and plan for the fleets' needs.

SCE is also improving how we partner with customers to meet their needs.

- This includes streamlining buildout, developing deeper customer engagements that include rate planning and load management education, and right-sizing grid solutions to meet the expected charging demand growth in both the near and long term. These efforts will provide more innovative and customer-focused solutions.

In addition to customer project deployment, SCE has also pushed to accelerate EV adoption through customer-side infrastructure programs such as Charge Ready for light-duty vehicles.

- Through its Charge Ready program, SCE installs, maintains, and covers installation costs for charging infrastructure while participants own, operate, and maintain the charging stations. For those ready to invest in EV charging for medium- and heavy-duty vehicles, SCE's Charge Ready Transport program similarly offers low- to no-cost site upgrades to support the installation. The program provides funding to help electrify semi-trucks, buses, and delivery vehicles, among others. Through its Charge Ready programs, SCE has installed more than 3,000 charging ports throughout its service area and is targeting 30,000 charging ports by 2026.

SCE's Transportation Electrification Advisory Services program is also available for commercial customers considering electric transportation options.

- On top of offering educational webinars and workshops, the program also offers to develop site-specific EV-readiness studies to help determine the feasibility of proposed projects and grant writing assistance to help customers secure zero-emission vehicle grants.

Long-term Planning and investing in the grid for TE

SCE is improving the value of EV adoption forecasts used for grid planning by assessing where, when, and how much EVs are likely to charge.

- SCE led the West Coast Clean Transit Corridor Initiative, composed of nine other electric utilities and two agencies representing more than two dozen municipal utilities, to conduct a multi-phase and multi-year research study to forecast EV truck populations and determine the proper number and size of highway charging sites. Subsequent phases of this initiative are supporting internal planning operations across the participating utilities.
- SCE developed an augmented forecasting approach to capture accelerated load growth due to Medium-Duty / Heavy Duty (MDHD) vehicles as well as the direct current fast charging (DCFC) for Light-Duty vehicles and port electrification for the recent General Rate Case (GRC) Application.
    - Because MDHD electrification is still nascent, current forecasting methodologies that are based (in part) on historical adoption are insufficient
    - For the GRC, SCE's augmented forecasting methodology leverages MDHD fleet industry data to more accurately predict MDHD electrification adoption and corresponding grid needs
    - The augmented forecasting approach also included added load from DCFC charging plazas for Light-Duty vehicles.
    - SCE (and the IOUs) are collaborating with CPUC on a new "Freight Infrastructure Planning" (FIP) Framework to further address planning for MDHD

- SCE is working to expand the current distribution planning forecast window from 10 years to 20 years. Developing and implementing an interagency-sponsored forecast that spans 20 years for distribution will bring benefits, such as:
    - Identifying long lead time projects that are needed beyond the 10-year horizon
    - Identifying important land acquisition needs
    - Informing how the development of infrastructure may need to be levelized to practically achieve the scale of development required by achieving state ZEV policies and GHG targets.
- SCE has proposed robust investments in its GRC application to support TE adoption and load growth.
    - The investments proposed are designed to ensure long-lead infrastructure projects (such as substation expansion or new substations) will be completed when load growth arrives. The plan especially focuses on high TE locations: freight corridors, fleet hubs, Port of Long Beach, etc.
    - Specific TE-focused projects include:

Project Type	Count	Cost ($M)*
New A Substations	4	535
A-Bank Upgrades	4	116
New B Substations	5	122
B-Bank Upgrades	6	9
New Distribution Circuits	33	183

*Cost reflects spend in GRC window (2023-2028)

4. Con Edison

Con Edison is helping to accelerate New York State's transition to clean transportation and EV adoption through grid and customer investments that support buildout of a widespread charging network. The Company's PowerReady Program provides incentives to connect thousands of new public and private charging stations to the electric grid. Authorized by the New York State Public Service Commission's July 2020 Order Establishing Electric Vehicle Infrastructure Make-Ready Program and Other Programs, the program offsets the electric infrastructure costs associated with installing chargers for light-duty EVs, including cars and small vans. To date, nearly 4,000 Level 2 and 175 DCFC chargers have been installed under the program, with the goal of installing

18,539 Level 2 and 457 DCFC chargers by 2025, with the potential for significant expansion of the program budget and goals as recently recommended by the New York State Department of Public Service Staff. The Company provides a similar pilot program for medium- and heavy-duty (MHD) vehicles, and a full-scale program is being considered in the recently launched New York State proceeding to address barriers to MHD charging infrastructure (MHD Proceeding).

Along with these infrastructure incentive programs, Con Edison also offers the SmartCharge New York managed charging program that provides incentives for personal drivers to charge outside of grid peak periods and the Company is launching a commercial managed charging program later this year including eligibility for all fleets, public stations, and multi-unit dwellings. SmartCharge New York is discussed below as an example of how managed charging can help mitigate the impact of EV charging on the grid.

An essential step in EV charger buildout is interconnection with the grid. Con Edison has developed dedicated teams that support the growing number of EV charging interconnections, including those that provide load evaluation, engineering review, project queue management, and incentive deployments. The Company is implementing multiple efforts to improve the customer experience and speed interconnection timelines and will continue to identify and implement efficiencies and improvements. For example, the Company provides pre-application advisory services for fleets and other customers to evaluate site feasibility and understand electric fueling costs, automates internal processes such as service rulings for smaller stations, and is coordinating with permitting agencies to identify and resolve challenges. Con Edison provides load-serving capacity maps to help those seeking to install EV charging infrastructure identify suitable sites with adequate grid capacity.

While Con Edison is supporting installation of increasing numbers of EV chargers under its programs today, the Company is also working to evolve its robust planning processes to prepare for the ramp in clean transportation loads. These loads are expected to drive significant grid impacts in New York State and ambitious emissions regulations will further accelerate an already rapidly growing EV market, with the exact timing in the inflection point unknown. The timeline to install EV chargers is relatively short compared to that of other new customer infrastructure, such as a new building, while the buildout of utility-side grid infrastructure to meet the significant increase in demand from EV chargers requires longer timelines, sometimes of 5 to 7 years. A proactive grid planning process to meet near-term needs and build out the grid in advance to support long-term growth in the deployment of EVs is being considered in the New York State MHD Proceeding. Con Edison, along with other NY State Utilities, filed comments proposing a proactive utility infrastructure planning framework to prepare the grid in advance of future transportation electrification needs.

SmartCharge New York Managed Charging Case Study

In 2017, Con Edison launched SmartCharge New York program with the goal of instilling grid-beneficial charging behavior in parallel with the upswing in electric vehicle adoption. The goal was to influence driver behavior at the inflection point of transitioning from combustion-engine fueling to electric battery charging and have drivers default to grid-optimizing charging activity. Program participants received a free cellular-enabled device that plugs into the vehicle's diagnostic port that allowed Con Edison to track time, energy, and power consumed when charging in the utility's service territory. Incentives encourage drivers to 1) avoid charging during the system peak (2 PM to 6 PM) during summer weekdays from June to September, and 2) charge overnight from 12 AM to 8 AM. Incentives were initially paid off-bill through gift cards to the customer's business of choice, such as Amazon, Starbucks, or Home Depot.

As electric vehicle adoption continues to rise, managing charging behavior will grow increasingly important in maintaining a healthy and reliable grid. Since its inception, the SmartCharge New York program has evolved to meet customer needs and program objectives. Starting in 2023 for example, the program was overhauled to allow participation through a mobile application and payments are now issued through Venmo or Paypal, in line with participant feedback. This shift also changed the way the program collects data, favoring more cost-effective vehicle onboard telematics or networked electric vehicle supply equipment such as a Wi-Fi-enabled charger or charging cable. This enables the program to scale efficiently with the market and give a greater number of drivers insight into their behavior and how that activity translates to incentive earnings.

In light of the EPA announcement of its heavy-duty and light/medium-duty proposed emissions standards, Con Edison released the following statement:

> "Con Edison applauds the Environmental Protection Agency's efforts to rev up the market for electric vehicles, which will improve the air in the communities we serve and help in the fight against climate change.
>
> A rapid shift to mass EV adoption looks more achievable all the time, with vehicle options expanding and new charging stations being built across New York City and Westchester County, including locations that serve the needs of disadvantaged communities.
>
> Con Edison will continue to support the EV market's development through investment in the grid and by offering a range of programs, from incenting new

chargers to managing the grid impact by rewarding drivers for charging overnight."[219]

5. SRP

When EVs were still in the early stages of adoption, SRP recognized the importance of exploring ways to identify EV households and analyze their charging behavior in order to help prepare for greater EV uptake in the future. It was also important to begin engaging customers who were EV drivers in order to understand their interests and their charging patterns and assess ways to influence charging behaviors.

In 2014, SRP launched "EV Community" (EVC)—a program that offers customers a $50 bill credit for each EV they register (up to two vehicles per household)—as a means to incentivize EV drivers to identify themselves and engage with SRP. Participants provide basic information about the electric vehicle and the type of charger they use. This provides a way for SRP to learn more about EV customers and their charging behavior and needs while offering them an incentive to help support EV growth in the region. There are currently more than 7,500 customers enrolled in the program.

While EVC members only account for a small number of total EV households, they are a fair overall representation of the EV customer base since all price plans are included, as well as households with one vs. two EVs. The program offers SRP a good platform for analysis, including the type of cars they drive (PHEV, BEV, brand, etc.) and the charge levels they use. In addition, SRP found that EVC members are willing to share information and are eager to participate in future pilot programs.

The EVC program also provides SRP with a method and channel to promote their Electric Vehicle Price Plan, a special time-of-use pricing plan which offers EV drivers the most opportunity to save on EV charging costs by charging during super off-peak times (between 11 PM and 5 AM). Load research has shown that this program has been highly effective at shifting EV charging loads away from peak periods.

The EVC program has helped SRP plan and prepare the grid for widespread EV adoption by enabling them to:

[219] "Con Edison Supports Effort to Encourage Electric Vehicle Adoption," Con Edison Media Relations, (April 12, 2023) https://www.coned.com/en/about-us/media-center/news/2023/04-12/con-edison-supports-effort-to-encourage-electric-vehicle-adoption

- Anticipate load growth. A pilot study with EVC members that monitors their EV driving and charging behavior through data telematics devices enables SRP to estimate typical consumption and charging load profiles per EV.
- Understand the impacts of EV charging on the grid. EVC data is used to model the impacts of EV charging on the electric grid, identify when transformers and wires may need to be upgraded, and understand when and how customers need to charge.
- Recruit for Managed Charging pilot programs. The EVC program and channel have enabled SRP to recruit participants for additional Managed Charging pilot programs to test other active control technologies to control EV charging load on the grid.
- Survey participants for insights. EVC members are surveyed regularly to get more data on their charging behaviors, including their use of home, workplace, and public charging and their satisfaction with EVs overall.
- Engagement. EVC participants receive regular newsletters and other communications with EV-related information.

6. Duke Energy

Electric fleet commitments are increasing as companies with ambitious sustainability goals work to decarbonize operations. Fleet owners are also seeking ways to take advantage of the cost savings available by transitioning to EVs. However, programs for fleet electrification and managed charging options are still limited to date.

When transitioning to an electric fleet, it is important that fleet managers understand the full scope of charging multiple vehicles while maintaining fleet operations and that larger MHDVs bring with them additional factors to consider. Fleet owners who have electrified fleets without consulting experts or an electric provider have likely been experiencing avoidable operational and technological issues. Long-term energy cost and performance risk are also potential issues for fleets and can hinder mainstream fleet electrification technology development if not managed correctly.

Duke Energy's significant experience and large customer base make it well-positioned to design and implement fleet electrification and charging programs. Duke Energy is building a first-of-its-kind performance center that will model and accelerate the development, testing, and deployment of zero-emission light-, medium-, and heavy-duty commercial electric vehicle EV fleets. The site will be located in North Carolina at Duke Energy's Mount Holly Technology and Innovation Center and incorporate microgrid integration.

The fleet electrification center will provide a commercial-grade charging experience for fleet customers evaluating or launching electrification strategies—reinforcing reliability, clean power,

and optimization by integrating solar, storage, and microgrid controls software applications. The center will be connected to both the Duke Energy grid—charging from the bulk electric system—and to 100% carbon-free resources through the microgrid located at Mount Holly. This project is the first electric fleet depot to offer a microgrid charging option.

In addition to fleet charging, the site will also function as an innovation hub, allowing Duke Energy to collect data around charger use, performance, management, and energy integration with various generation resources. It will also allow for the development of managed charging algorithms for fleets connected to the bulk power system or integrated with renewables and storage—which can be utilized to minimize the upgrades needed to the distribution system, easing the transition to electrifying fleets. Identifying EV charging technologies and how they may be used to power any type of fleet with vehicles (ranging from class 1) will help develop a model to show the industry a clear, integrated, and cost-effective path to fleet electrification.

Duke Energy is teaming up with Daimler Truck North America and Electrada on this important work. Electrada, an electric fuel solutions company, is providing funding for research and demonstration efforts. For fleets seeking to electrify, Electrada invests all required capital "behind the meter" and delivers reliable charging to the fleet's electric vehicles through a performance contract, eliminating the complexity and risk that fleets face in transitioning to this new source of fuel. Electrada's investment in the depot allows Duke Energy to focus on programs that simplify adoption for electric fleet customers and distribution system performance to support the predictable addition of electric load over time.

By the end of 2023, fleet operators will be able to experience a best-in-class, commercial-grade fleet depot integrated with energy storage, solar, and optimization software. Moving to zero-emission vehicles in this sector allows North Carolina to seize the large economic potential of the transition and generate billions in net benefits for the state. Projects like Duke Energy's fleet performance center will be key for fleet owners across the state to take advantage of the cost savings of transitioning to electric vehicles. That said, fleet owners exploring electrification should engage their electricity provider early and often to identify and address site-specific considerations. As fleet electrification accelerates, it will be important for electricity providers and policymakers to identify best practices to proactively plan for fleet electrification, including readying the distribution grid.

7. Xcel Energy

Xcel Energy is committed to electrifying all of its light-duty fleet and 30% of its medium- and heavy-duty fleet by 2030, equating to over 2,500 EVs. It's part of their vision to be a net-zero energy provider by 2050 and enable one out of five vehicles to be electric in the areas they serve

by 2030. This will save customers $1 billion annually on fuel by 2030 and deliver cleaner air for everyone.

With a fleet that includes iconic bucket trucks, all-terrain service vehicles, and a host of pickup trucks and pool cars across eight states, achieving these goals will be no small feat, but an important one. There are notable hurdles, yet evolving technology presents solutions.

Electrifying the Marquee Fleet Vehicle

Xcel Energy is the first electric provider in the nation to add an all-electric bucket truck to its fleet. The truck features two electric sources: one for the drivetrain and one for the lift mechanism. It has a 135-mile driving range and can operate the bucket for an entire workday on a single charge. Crews are collecting data from real working conditions in Minnesota and Colorado that will be used to inform further improvement to the vehicle's technology and operation.

Optimizing Charging to Minimize Grid Impacts

To support a growing electric fleet, over 1,200 EV chargers must be brought into service by 2030, which will result in an electric load increase of 71 megawatts. Charge management techniques enable low-cost charging for this growing electric fleet. It's a sophisticated approach to optimize charging times by using time-of-day and grid demand efficiencies and builds on the expertise Xcel Energy has developed through offering managed charging programs to customers in multiple states.

For fleets, overnight charging schedules make the most sense. Demand and rates are lower, and renewable wind sources are ample at that time. Yet, fast charging outside of these time periods may be required to help larger vehicles make it through a workday. This is when charging schedules need to be customized and highly specific.

Enabling Cleaner Service Calls Through Bucket Truck Technology

Xcel is also taking immediate action on other high-impact emission reduction opportunities, using technologies such as electric power take-off, idle mitigation, and solar systems to power jobsite tools.

- Electric power take-off (ePTO) - An ePTO system is a device that uses battery power. It's similar to an EV, but instead of moving the vehicle down the road, it powers equipment and tools to avoid engine idling at the job site. These devices are recharged by plugging into the same chargers that EVs use.

- Idle mitigation - An idling truck can consume 1.5 gallons of gas each hour. Idle mitigation on Xcel Energy's utility bucket trucks works by automatically shutting down the gas-powered engine when the vehicle is not in use or when the engine is idling for too long. This helps to reduce emissions and conserve fuel.

Fleet Electrification Solutions for Customers

Xcel Energy's experience and expertise with fleet electrification doesn't stop with their own fleet. They have developed a mix of customer programs across service areas to support fleet electrification for businesses and communities. These customer-centric solutions enable sophisticated planning, lower upfront costs with various rebates and incentives, and minimize impacts to the grid.

Xcel's approach for commercial EV fleet development includes:

- Advisory services: Xcel offers a "white-glove service" to meet customers where they are on their electrification journey by guiding them through customized planning for their infrastructure needs. For fleet operators, this includes a free assessment to help them determine the best path to electrify their fleet and advise them on future electric fleet considerations such as charging best practices.
- Infrastructure installation: Xcel designs and builds EV supply infrastructure to support charging station installations at minimal to no cost to customers.
- Equipment recommendations and rental options: Xcel also provides recommendations for charging equipment and offers customers the option to purchase their own qualifying vehicle chargers or rent them at a monthly fee that includes installation and maintenance.
- Grid continuity: Xcel designs long-term clean energy resource and distribution plans to consider the future impact of new EV load to ensure ongoing grid stability, reliability and affordability.
- Equitable opportunities: Xcel supports EV adoption in higher emissions communities and income-qualified neighborhoods through rebates and incentives. This includes facilitating the electrification of carshare, refuse trucks, school buses, paratransit vehicles, and other fleets operating in these disproportionately impacted communities.

Fleet electrification is a key component of Xcel Energy's larger vision, which includes enabling zero-carbon transportation by 2050 across our eight-state service footprint. This long-term strategy balances affordability with sustainability across the entire grid. It's why Xcel is dedicated to assisting fleet managers across the ecosystem in providing fleet electrification solutions that empower and inspire a clean energy future while also leading by example.

iii. Transmission

A critical part of ensuring a smooth transition to an electrified transportation sector will be a robust build out of high-voltage transmission lines. Doing so will also enable increased penetration of renewables into the grid mix, helping to further improve the environmental benefits of electric vehicles. While progress in this space has historically been slow and bogged down by procedural delays, there are some signs of progress. In April 2023, the U.S. Bureau of Land Management approved a 732-mile transmission line, which will carry wind energy from Wyoming through to Nevada.[220] Also in April 2023, a Maine court granted approval to restart work on the 145-mile New England Clean Energy Connect project, which will carry hydropower from Canada to New England.[221] The line is expected to carry up to 1,200 megawatts of power.

Electricity transmission is also a key focus of the Biden-Harris Administration. In May 2023, the administration published its plan to decrease permitting timelines for new transmission projects, among other key items.[222] Also in May 2023, the U.S. Department of Energy proposed a rule on designating National Interest Electric Transmission Corridors.[223] There will also be a role for Congress to play in improving transmission permitting times and this is a policy area where some bipartisan support exists.

d. Charging Infrastructure

Although the majority of charging needs will be ultimately met through at-home or near-home charging, a fully electrified transportation system will also require a robust public charging network—one which the sector is already deploying. As of June 2023, there were 140,000 individual Level 2 and DC fast charging ports across 54,000 public EV charging stations in the U.S.[224] A 2022 study by McKinsey & Company projected that the U.S. will need 1.2 million public EV charging stations to accommodate forecasted EV deployments by 2030.[225] A more

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[220] "US approves $3bn Wyoming-Nevada power line," Power Technology, (April 12, 2023) https://www.power-technology.com/news/us-approves-3bn-wyoming-nevada-power-line

[221] "Maine court greenlights embattled $1B transmission line," E&E News, (April 17, 2023) https://subscriber.politicopro.com/article/eenews/2023/04/21/maine-court-greenlights-embattled-1b-transmission-line-00093087

[222] "FACT SHEET: Biden-Harris Administration Outlines Priorities for Building America's Energy Infrastructure Faster, Safer, and Cleaner," (May 2023) https://www.whitehouse.gov/briefing-room/statements-releases/2023/05/10/fact-sheet-biden-harris-administration-outlines-priorities-for-building-americas-energy-infrastructure-faster-safer-and-cleaner/

[223] *See* 88 FR 30956

[224] U.S. Department of Energy's Alternative Fuels Data Center, accessed June 23, 2023 https://afdc.energy.gov/fuels/electricity_locations.html#/analyze?fuel=ELEC

[225] "Building the electric-vehicle charging infrastructure America needs," McKinsey & Company, (April 18, 2022) https://www.mckinsey.com/industries/public-and-social-sector/our-insights/building-the-electric-vehicle-charging-infrastructure-america-needs

recent June 2023 NREL study[226] analyzed U.S. progress towards building out an accessible network of public EV chargers and found that:

- The United States is on track to install a network of 1.2 million public chargers by 2030, keeping up with rapidly growing demand for EVs.
- Of the 1.2 million charging ports, about 1 million are expected to be Level 2 charging, providing convenient, low-cost charging to meet a variety of daily needs, with the remaining charging ports being DC fast chargers that are critical to driver confidence and longer distance travel.
- Building out a public charging network will require between $31 and $55 billion of cumulative public and private capital investment and will help unlock hundreds of billions of dollars of consumer savings from reduced fuel and maintenance costs.

As discussed further below, industry is continuing to rapidly build out EV charging capacity both as a result of private investment and with support from billions of dollars in federal funding. Strong EPA LMDV emissions standards that encourage vehicle manufacturers to transition to EVs sends market signals to the charging industry that provide the certainty needed to make proactive infrastructure and manufacturing investments.

i. EVSE Manufacturer and Operator Statements on EPA Standards

As discussed, robust LMDV emissions standards encourage vehicle manufacturers to transition to EVs, which in turn sends market signals to the charging industry that provide the certainty needed to make proactive infrastructure and manufacturing investments. A clearer picture of future electric vehicle supply equipment (EVSE) demand enables manufacturers and network operators to plan and allocate capital accordingly. Below are statements by ZETA's EVSE providers in response to EPA's announcement of these proposed standards:

- **"EVgo** applauds the EPA for proposing ambitious tailpipe emissions standards. These standards would accelerate the transition to electric vehicles and result in cleaner air, healthier communities, and create jobs across the country. More EVs demands more EV charging and we will continue to expand our fast charging network to provide the infrastructure to support the growing EV market."[227]
- **ChargePoint** on EPA emissions standards: "This proposal, in addition to state and federal funding programs like NEVI, will undoubtedly lead to more investment in EVs

[226] "The 2030 National Charging Network: Estimating U.S. Light-Duty Demand for Electric Vehicle Charging Infrastructure," National Renewable Energy Laboratory, (June 2023) https://driveelectric.gov/files/2030-charging-network.pdf

[227] EVGo on LinkedIn, accessed May 10, 2023 https://www.linkedin.com/posts/evgo_biden-administration-proposes-toughest-auto-activity-7054487813681025024-gCc0/

and chargers. Over our 15 year history, we have ensured charging infrastructure deployment kept pace with EV adoption, and we are well-positioned to meet the increased demand these standards will generate."[228]

- **ChargePoint** on EPA emissions standards: "As EV charging infrastructure buildout continues, more EV models become available and regulatory efforts ramp up, EV adoption will continue to grow rapidly and ChargePoint will be there to support drivers who need a charge. We see ambitious regulations like these as an opportunity, not a barrier, to sustainable business growth, and we will continue working with policymakers to ensure that policy helps individuals, businesses and the environment alike."[229]

ii. Impacts to EVSE Deployment from BIL and IRA Programs

With over $7.5 billion available across multiple programs, the Bipartisan Infrastructure Law represents the nation's largest ever investment in increasing Americans' access to EV chargers. Through the BIL's $5 billion National Electric Vehicle Infrastructure (NEVI) Formula Program, the federal government is partnering with private industry to build out a national charging network along key highway corridors. As of September 2022, the Federal Highway Administration approved formal plans submitted by all 50 States, the District of Columbia, and Puerto Rico and as of June 2023, multiple states had released requests for proposals from organizations seeking access to NEVI funds. The design of these state application processes through the NEVI Formula Program will help drive EVSE standardization, which will in turn improve reliability and consistency in the consumer-facing charging experience. Separately, the BIL's Charging and Fueling Infrastructure (CFI) Discretionary Grant Program allocates another $2.5 billion towards installing EV chargers in communities where people live and work.

As charging deployment continues to increase, the distribution of this network, not just its size, risks limiting electrification—especially in rural areas. In response, the Biden-Harris Administration has taken a comprehensive approach to EVSE build-out, recognizing the diverse demographics, landscapes, and types of communities throughout the United States. Ubitquity and visibility are important components of a national EVSE network deployment. The Department of Transportation has put together separate toolkits to guide EVSE deployment in both urban[230] and

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[228] ChargePoint on LinkedIn, accessed June 26, 2023 https://www.linkedin.com/posts/chargepoint_biden-harris-administration-proposes-strongest-ever-activity-7052288757399441408-xX54/

[229] "New EPA vehicle emissions regulations to accelerate EV production, adoption and infrastructure," ChargePoint, (May 18, 2023) https://chargepoint.com/blog/new-epa-vehicle-emissions-regulations-accelerate-ev-production-adoption-and-infrastructure

[230] "Charging Forward: A Toolkit for Planning and Funding Urban Electric Mobility Infrastructure," U.S. Department of Transportation, (June 2023) https://www.transportation.gov/urban-e-mobility-toolkit

rural[231] areas. Both toolkits go through an explanation of electric mobility basics, as well as the benefits and challenges that are specific to individuals, communities, and transit operators in their respective region types. Both expand on public-private partnership opportunities, as well as best practices for early planning and financing. With respect to EVSE, DOT has identified three levels of EVSE planning: community, corridor, and site. These toolkits are intended to guide private, state, and local entities as they implement federal funding and engage in other equitable, thorough EVSE deployment strategies.

The tax credits provided in the Inflation Reduction Act , specifically the Alternative Fuel Vehicle Refueling Property Tax Credit[232] are critical to helping ensure the continued availability of products necessary for a fully-electrified transportation sector. By targeting investments toward rural and lower-income residents, the credit incentivizes individuals and commercial operators to install charging stations at their homes and private entities. Retailers, local businesses, or commercial fleet operators can also utilize the credit to offset the costs of installing charging infrastructure on their property, enabling them to attract and retain customers.

Taken together, the funding in the NEVI and CFI programs under the BIL and the Alternative Fuel Vehicle Refueling Property Tax Credit in the IRA will lead to significant buildout of EV charging in communities, at homes and businesses, and along high-traffic highway corridors.

iii. Recent Trends in Public EVSE Deployment

The number of chargers in the U.S.—public, private, and residential— is on track for rapid growth in the next several years. To meet the Administration's goal of deploying 500,000 chargers by 2030, the U.S. Department of Energy's Alternative Fuels Data Center (AFDC) notes that the deployment rate will have to significantly increase. As discussed, public funding is helping to spur deployments, while private investment in public EV charging has increased considerably in the last five years rising from under $200 million in 2017 to nearly $13 billion by early 2023.[233] As the national EVSE network expands, growth tracked by the AFDC found that between 2015 and 2020, the number of EVSE ports in the U.S. more than doubled and in 2021 the number of ports grew 55% year-over-year.[234] This is growth that occurred before the impacts of both the IRA and BIL took effect.

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[231] "Charging Forward: A Toolkit for Planning and Funding Rural Electric Mobility Infrastructure," U.S. Department of Transportation, (June 2023) https://www.transportation.gov/rural/ev/toolkit
[232] *See* 26 U.S.C. § 30C
[233] "Investment in Publicly Accessible EV Charging in the United States," (2023) Atlas Public Policy https://atlaspolicy.com/wp-content/uploads/2023/05/Investment-in-Publicly-Accessible-EV-Charging.pdf
[234] "Electric Vehicle Charging Infrastructure Trends," Alternative Fuels Data Center, https://afdc.energy.gov/fuels/electricity_infrastructure_trends.html

Even without incentives, EV charging has generally kept pace with the rollout of EV deployment, as shown in Figure 9 below.

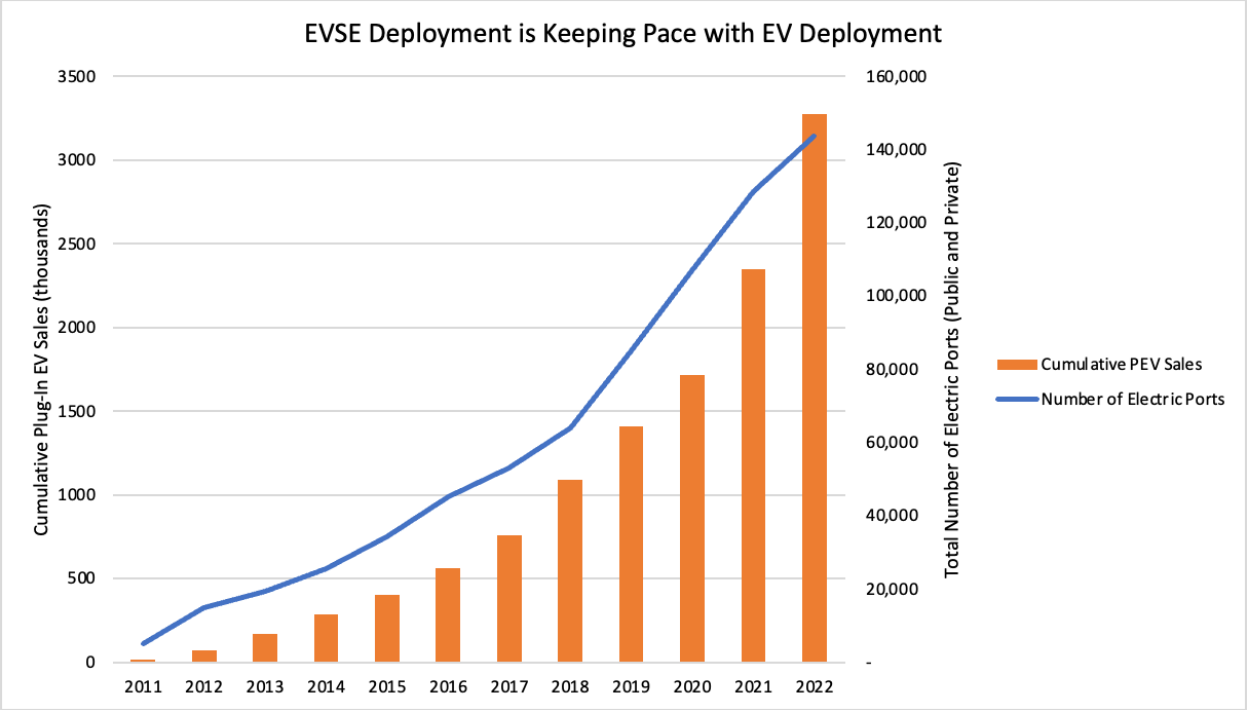

Figure 9. Trends in Light-Duty EV Deployment vs. Public Charging Infrastructure Deployment[235,236]

Deployments of both LDEVs and charging infrastructure have followed an upward growth trajectory in recent years. Deployments of both products are well correlated with a value of 0.982 between light-duty vehicles and EVSE ports. As such, recent trends suggest that charging infrastructure should not be a limiting factor in expanded EV deployment.

As a national public charging network continues to take shape, there are multiple efforts underway to help EV drivers locate and access charging infrastructure. As mentioned previously, the AFDC maintains a database of public charging stations with route-planning functionality embedded in the tool.[237] NREL recently announced the launch of an interactive map showing EV

[235] "LDV Total Sales of PEV and HEV by Month (updated through March 2023)," Argonne National Laboratory, (March 2023) https://www.anl.gov/sites/www/files/2023-04/Total%20Sales%20for%20Website_March2023_0.pdf
[236] U.S. Department of Energy Alternative Fuels Data Center, accessed May 2, 2023 https://afdc.energy.gov/data/10964
[237] U.S. Department of Energy Alternative Fuels Data Center, accessed May 2, 2023 https://afdc.energy.gov/fuels/electricity_locations.html#/find/nearest?fuel=ELEC

charging locations near national parks.[238] ZETA member Rivian is incorporating EV charging locations into their vehicles' onboard display.[239] Google Maps will now suggest charging stops on shorter trips, include a 'very fast' filter for charging station searches, and will show users in search results when a location has a charging station on-site.[240]

iv. Future State of EVSE Deployment

EVSE manufacturers and operators are regularly announcing investments to build out charger manufacturing capacity to ensure customers can meet their residential charging needs as well as publicly-accessible chargers for longer-duration trips. While many are detailed in the White House EV Accelerator Challenge fact sheet,[241] the ZETA members below have made the following announcements:

- In January 2023, ZETA member ABB e-Mobility announced manufacturing operations in Columbia, South Carolina. This will significantly reduce delivery and lead times for DC fast-chargers in the U.S., enabling charging developers, owners, and operators to deploy reliable chargers more quickly. Since 2010, ABB has invested $14 billion in the U.S. with plant expansions, operational improvements, state-of-the-art equipment, products, and people, making it the company's largest market. With approximately 20,000 employees in more than 40 manufacturing and distribution facilities, ABB is investing, growing, and serving across America through industries that create jobs, encourage innovation, and achieve a more productive, sustainable future.[242]
- In April 2023, ZETA member Enel announced plans to add at least two million chargers, including home systems, in North America by 2030.[243]
- In April 2023, ZETA member Siemens announced the opening of its latest EV charger manufacturing facility where the company will manufacture EV chargers specifically

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[238] "New Interactive Map Shows EV Charging Stations Near National Parks," National Renewable Energy Laboratory, (April 2023) https://www.nrel.gov/news/program/2023/new-interactive-map-shows-ev-charging-stations-near-national-parks.html

[239] Rivian on LinkedIn, accessed June 26, 2023 https://www.linkedin.com/posts/rivian_rivian-adventurousforever-careersintech-activity-7077710678597238784-YifP

[240] Google is adding some new features for EVs with built-in Google Maps," The Verge, (February 8, 2023) https://www.theverge.com/2023/2/8/23589724/google-maps-ev-charging-built-in-features

[241] Fact Sheet: Biden-Harris Administration Announces New Private and Public Sector Investments for Affordable Electric Vehicles (April 17, 2023) https://www.whitehouse.gov/briefing-room/statements-releases/2023/04/17/fact-sheet-biden-harris-administration-announces-new-private-and-public-sector-investments-for-affordable-electric-vehicles/

[242] "ABB E-mobility begins production of EV chargers in South Carolina," ABB E-Mobility, (January 20, 2023) https://new.abb.com/news/detail/99073/abb-e-mobility-begins-production-of-ev-chargers-in-south-carolina

[243] "Fast EV Chargers to Nearly Double on U.S. Highways Under Expansion Plan," The Wall Street Journal, (April 13, 2023) https://www.wsj.com/articles/italian-company-plans-10-000-fast-chargers-across-u-s-to-meet-ev-demand-959fd135?mod=panda_wsj_author_alert

designed to serve the U.S. market. The facility is the company's second U.S. EV charging manufacturing hub and will contribute to the company's goal to build 1 million EV chargers for the U.S. market. The new facility will support the creation of 100 new jobs at the site and across its regional supply chain footprint. It will also be operated in part by Wyntron, an existing partner in Siemens eMobility's manufacturing ecosystem.[244]

- In April 2023, ZETA member FLO opened its first U.S. manufacturing facility in Auburn Hills, Michigan. Available starting in 2024, the FLO Ultra charging stations can charge most EVs to 80% in 15 minutes, depending on vehicle type, and are built to meet both NEVI and Buy America requirements. FLO's Level 2 CoRe+ and CoRe+ MAX chargers are currently being assembled at the facility as preparations for the production of FLO Ultra chargers are underway. The chargers produced in Auburn Hills will contribute to the 250,000 chargers FLO plans to bring to the U.S. market by 2028. In that time span, FLO expects the facility to create and support 730 jobs.[245]
- In June 2023, SK Signet launched a new $15 million facility in Texas to expand EVSE manufacturing. The factory is expected to produce ultra-fast chargers for over 10,000 EVs per year, generating up to 183 jobs by 2026.[246]

From national retailers to local businesses, organizations are announcing their intent to host charging infrastructure on their property, enabling them to attract and retain customers. In some instances, these chargers could supplant at-home or curbside charging for certain individuals where such chargers may be less accessible. The following announcements from recent months indicate the benefits retailers see in becoming an EVSE site host:

- In January 2023, TravelCenters of America announced it would be purchasing 1,000 Electrify America DC fast charging stations and plans to install them at 200 travel stops over the next five years.[247]
- In February 2023, bp announced plans to invest $1 billion in EV charging across the U.S. by 2030, helping to meet demand from Hertz's expanding EV rentals.[248]

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[244] "Siemens opens newest electric vehicle charging manufacturing hub in Carrollton, Texas," Siemens eMobility, (April 24, 2023) https://new.siemens.com/us/en/company/press/press-releases/smart-infrastructure/newest-siemens-electric-vehicle-mfg-charging-hub-carrollton-texas.html

[245] "FLO, Governor Whitmer Announce New EV Charger Production at Auburn Hills Facility," FLO Charging, (April 26, 2023) https://www.flo.com/news/flo-governor-whitmer-announce-new-ev-charger-production-at-auburn-hills-facility/

[246] "SK Signet's New EV Charger Manufacturing Facility Opens in Plano, Texas," The EV Report, (June 8, 2023) https://theevreport.com/sk-signets-new-ev-charger-manufacturing-facility-opens-in-plano-texas

[247] "More Electrify America EV chargers are coming, this time at TravelAmerica rest stops," The Verge, (January 30, 2023) https://www.theverge.com/2023/1/30/23577696/electrify-america-travelcenters-petro-ev-dc-fast-chargers

[248] "bp plans to invest $1 billion in EV charging across US by 2030, helping to meet demand from Hertz's expanding EV rentals," Hertz Newsroom, (February 15, 2023) https://newsroom.hertz.com/news-releases/news-release-details/bp-plans-invest-1-billion-ev-charging-across-us-2030-helping

- In February 2023, fast casual sandwich shop Subway announced plans to assist their franchise owners with installing multiple stand alone fast charge stations for their customers at multiple locations.[249]
- In March 2023, ZETA member Uber and bp Pulse announced a new global mobility agreement which will see the companies work together to help accelerate Uber's commitment to become a zero-tailpipe emissions mobility platform in the US, Canada and Europe by 2030 and globally by 2040. Under the terms of the agreement, bp intends to offer bespoke deals to drivers on the Uber platform that are tailored to each market, including providing incentives for them to charge with bp pulse. The two companies will also explore working together on convenience and fuel offers. bp has a global network of almost 21,000 branded retail sites that offer fuel as well as food for now and for later with retail partners, and facilities such as toilets.[250]
- In March 2023, the convenience store 7-eleven launched its own EV fast charging network of DC chargers called 7charge. Consumers who use 7charge will pay rates based on the energy they consume or time spent charging, based on specific local regulations.[251] Currently the company's chargers are in Colorado, Florida, Texas, and California. The company is also planning to launch a Maryland location soon.
- In April 2023, Walmart announced plans to install new EV fast-charging stations at thousands of Walmart and Sam's Club locations across the country. This would be in addition to the almost 1,300 DC fast-charging stations already available at more than 280 U.S. facilities. With a store or club located within 10 miles of approximately 90% of Americans, the company is uniquely positioned to deliver a charging option that will help make EV ownership possible whether people live in rural, suburban or urban areas.[252]
- In May 2023, Boston based LNG Electric, an EV charging technology company, announced its plans to install Level 2 and DC charging stations at more than 13,000 hotels across the U.S.[253] The company intends to develop this infrastructure over the next five to six years with the first chargers going in this past May. Ultimately, LNG Electric aims to create a charging network that covers 10-15% of the US hospitality market. The company's first set of chargers will be deployed at Hilton and Marriott hotels in Florida, Ohio, and Illinois.

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[249] "The next hot fast food menu item? Electric car charging," Axios, (March 22, 2023) https://www.axios.com/2023/03/22/electric-vehicle-charging-subway-7-eleven

[250] "bp pulse and Uber team up on driver charging as EV momentum builds," Uber Newsroom, (March 31, 2023) https://www.uber.com/newsroom/uber-bp-charging-ahead/

[251] "Introducing 7charge," 7-Eleven, accessed June 28, 2023 https://www.7-eleven.com/7charge

[252] "Leading the Charge: Walmart Announces Plan To Expand Electric Vehicle Charging Network," Walmart Newsroom, (April 6, 2023) https://corporate.walmart.com/newsroom/2023/04/06/leading-the-charge-walmart-announces-plan-to-expand-electric-vehicle-charging-network

[253] "13,000+ hotels across the US are about to get EV charging stations," Electrek, (May 16, 2023) https://electrek.co/2023/05/16/lng-electric-ev-charging-stations-hotels/

e. EV Production and New Model Availability

EVs are now available in all light- and medium-duty classes, with many presenting owners with a favorable total cost of ownership today. That should be expected to further improve over the MY 2027-2032 time frame covered by these proposed emissions standards and continued innovation by industry will only increase product offerings and vehicle capabilities in the coming years.

While EV manufacturing investments in the U.S. have been ramping up over the past decade, the passage of the BIL and IRA have supercharged investment. Before the passage of these bills, several automakers had already committed to electrify large portions or all of their vehicle offerings. These targets were in recognition of the need to meet environmental goals and a result of the market's movement towards EVs. As EPA notes in the proposed rule, several major automakers set ambitious goals for a 100% electrified fleet. To meet these targets, they have significantly expanded their EV model offerings alongside manufacturing capability.

i. Impacts to EV Production from BIL and IRA Programs

Policies in the BIL and IRA are driving demand for EVs both for personal and commercial use. As discussed previously in these comments, customers are increasingly choosing to electrify and OEMs are better incentivized to meet this demand through the build out of additional domestic manufacturing capacity. As a result, EV production and model availability is rapidly expanding.

Analysis by the Environmental Defense Fund found that announced EV manufacturing investments from 2015 to 2023 total $31.4 billion and would lead to at least 55,800 new jobs and result in automakers being capable of producing more than 4.3 million EVs per year in 2026.[254] Figure 10 below illustrates the ramp up in EV manufacturing capacity through 2026, with major manufacturing capacity additions following BIL and IRA passage. As additional announcements are made, domestic EV manufacturing capacity will continue to grow, leading to a secure domestic supply chain and thousands of new jobs.

[254] "U.S. Electric Vehicle Manufacturing Investments and Jobs Characterizing the Impacts of the Inflation Reduction Act After 6 Months," Environmental Defense Fund, (June 2023) https://blogs.edf.org/climate411/files/2023/03/State-Electric-Vehicle-Policy-Landscape.pdf

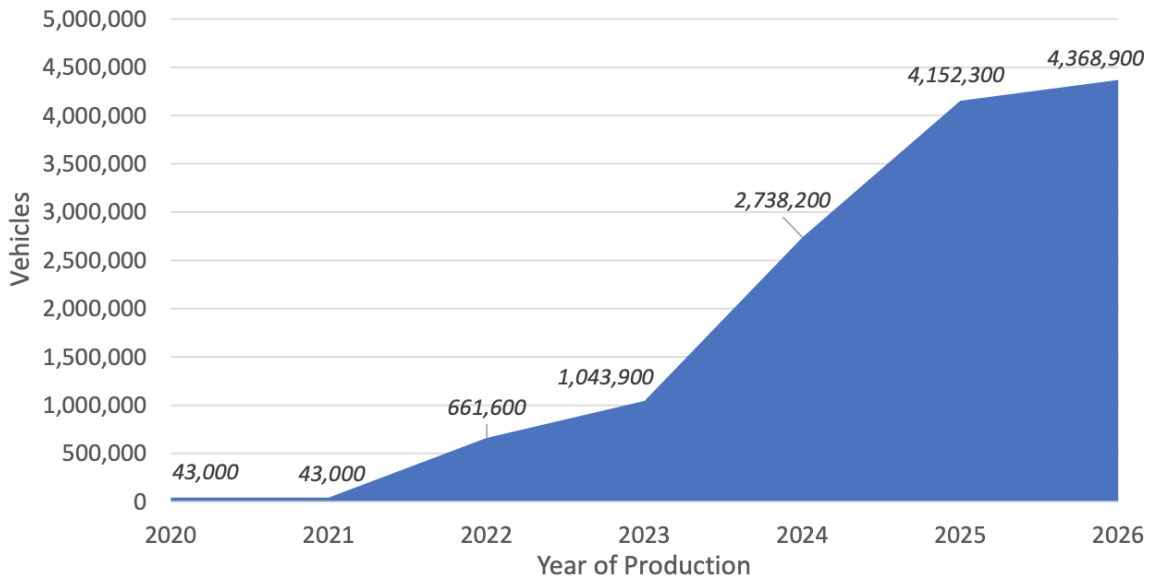

Figure 10. Estimated EV manufacturing capacity following passage of the IRA and BIL, 2020-2026.[255]

ii. OEM Investments in EV Manufacturing

With ambitious electrification goals, OEMs are investing heavily in domestic EV manufacturing. By 2026, announced facilities alone will be able to produce about 4.3 million new electric cars and passenger trucks each year. For reference, that equals about one-third of all new vehicles sold in the U.S. in 2022.[256]

Here are just a few of the recent major investments that have been announced in 2023:

- ZETA member Tesla announced a second manufacturing plant in Nevada. The $3.6 billion facility will be focused on building their electric semi truck as well as 100GWh of battery manufacturing.[257]

[255] *Id.* at footnote 253
[256] "Report Finds Investments in U.S. Electric Vehicle Manufacturing Reach $120 Billion, Create 143,000 New Jobs," Environmental Defense Fund, (March 14, 2023) https://www.edf.org/media/report-finds-investments-us-electric-vehicle-manufacturing-reach-120-billion-create-143000
[257] "Tesla to build $3.6 billion battery, electric semi truck manufacturing facility in Northern Nevada," Reno Gazette Journal, (January 25, 2023) https://www.rgj.com/story/news/money/business/2023/01/24/tesla-to-build-3-6b-battery-electric-nevada-semi-truck-manufacturing-facility/69837346007/

- Tesla also plans to spend upward of $770 million to expand its manufacturing facilities in Austin, Texas. The expansion will include for battery cell testing and manufacturing on-site.[258]
- Ford plans to build 500,000 electric pickup trucks at its new $5.6 billion BlueOval City facility in Tennessee.[259] The complex will also produce 40 GWh of battery cells–capable of supplying 500,000 vehicles.
- Ford plans to invest $1.3 billion in its Ontario plant to transition the facility to build their next-generation EVs. The facility will also assemble battery packs using cells from Ford's Kentucky battery plant.[260]
- Toyota is investing $7.4 billion in EVs through the end of the decade.[261] This includes a $2.1 billion battery plant expansion in North Carolina and an expansion of its EV assembly facility in Kentucky.[262]
- Stellantis is planning a $155 million expansion of its three Indiana plants to produce EV drive-trains.[263] This is in addition to the previously announced $3 billion in EV investment by Stellantis in the state.
- ZETA member Rivian is undergoing a $10 million expansion to its existing manufacturing facility in Kentucky.[264]
- Volkswagen's Scout EV manufacturing facility in South Carolina will undergo a $2 billion investment and will be capable of producing up to 200,000 EVs each year.[265]
- Hyundai raised its total EV investment to $28 billion over the next decade in an effort to meet its 2 million EV per year sales goal by 2030.[266]

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[258] "Tesla plans to spend more than $770 million on Texas factory expansion," CNBC, (January 10, 2023) https://www.cnbc.com/2023/01/10/tesla-plans-to-spend-more-than-770-million-on-texas-factory-expansion.html
[259] "Ford's new Tennessee plant aims to build 500,000 electric trucks a year," Reuters, (March 24, 2023) https://www.reuters.com/business/autos-transportation/fords-new-tennessee-plant-aims-build-500000-electric-trucks-year-2023-03-24/
[260] "Ford to invest $1.3 billion to build EV manufacturing hub in Canada," CNBC, (April 11, 2023) https://www.cnbc.com/2023/04/11/ford-to-build-ev-manufacturing-hub-in-canada.html
[261] "Toyota Accelerates Its EV Changes With Extra $7 Billion Investment," The Wall Street Journal, (May 10, 2023) https://www.wsj.com/articles/toyota-accelerates-ev-revamp-with-extra-7-billion-investment-b323eb1c
[262] "Toyota Ramps Up Commitment to Electrification with U.S. BEV Production and Additional Battery Plant Investment," Toyota Pressroom, (May 31, 2023) https://pressroom.toyota.com/toyota-ramps-up-commitment-to-electrification-with-u-s-bev-production-and-additional-battery-plant-investment/
[263] "Stellantis Announces $155 Million Investment in Three Indiana Plants to Support North American Electrification Goals," Stellantis Media, (February 28, 2023) https://www.stellantis.com/en/news/press-releases/2023/february/stellantis-announces-155-million-investment-in-three-indiana-plants-to-support-north-american-electrification-goals
[264] "Bullitt County welcomes $10M investment for electric vehicle manufacturing, 200+ jobs," Louisville Courier Journal, (May 1, 2023) https://www.courier-journal.com/story/money/companies/2023/05/01/rivian-ev-manufacturer-expands-in-kentucky-with-10-million-investment/70164153007/
[265] "VW-backed Scout Motors to build $2B factory in South Carolina," TechCrunch, (March 3, 2023) https://techcrunch.com/2023/03/03/vw-backed-scout-motors-to-build-2b-factory-in-south-carolina/
[266] "Hyundai raises EV investment to $28 billion, to reduce China operations," Reuters, (June 20, 2023) https://www.reuters.com/business/autos-transportation/hyundai-motor-invest-8541-billion-by-2032-accelerate-ev-plans-2023-06-20/

- ZETA member Canoo, a start-up electric vehicle manufacturer, invested $34.27 million to purchase the former Terex plant in Oklahoma City where it plans to begin EV production later this year.[267]
- Scout Motors announced its $2 billion investment to establish its first EV manufacturing plant in South Carolina. At full capacity, more than 200,000 all-electric, next-generation trucks and rugged SUVs may be produced annually at the facility.[268]
- GM plans to install more than 1 million units of annual EV capacity in North America in 2025 and accelerate from there. This is fueled by a $3 billion investment[269] for an EV battery cell plant in Indiana and a $64 million investment[270] in Rochester, New York and Defiance, Ohio for castings and components to support EV production.

As a result of these investments, more EVs are already being produced domestically. In the first quarter of 2023, American factories produced 39% more EVs than the same period the year before.[271] Tesla led the pack, producing more than half of the nation's EVs.

iii. Recent New EV Model Announcements

In 2022, the number of available EV models worldwide reached 500, up from below 450 in 2021 and more than doubling relative to 2018-2019.[272] In particular, OEMs are expanding their SUV and pickup truck offerings in line with consumer demand. Consumer Reports has compiled a noncomprehensive list of at least 30 new EVs in a variety of makes and models that are expected in the U.S. by the end of 2024.[273] In addition to new models from legacy automakers, there are a number of new entrants expected in 2024 including Fisker, Indi, Polestar, and VinFast.

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[267] "EV manufacturer Canoo to open production facility in OKC. Here's where it will be," The Oklahoman, (November 11, 2022) https://www.oklahoman.com/story/business/2022/11/10/electric-vehicle-manufacturer-canoo-repurposing-okc-facility-into-plant/69636856007/

[268] "Scout Motors selects South Carolina for production site; plans to create 4,000 jobs," Governor of South Carolina, (March 3, 2023) https://governor.sc.gov/news/2023-03/scout-motors-selects-south-carolina-production-site-plans-create-4000-jobs

[269] *Id.* at footnote 181

[270] "GM Investing $918 Million in Four U.S. Facilities for V-8 Engine Production, EV Components," GM Newsroom, accessed June 30, 2023 https://news.gm.com/newsroom.detail.html/Pages/news/us/en/2023/jan/0120-investment.html

[271] "Five New EV Models Drive Up North American Factory Production," Bloomberg, (May 10, 2023) https://www.bloomberg.com/news/articles/2023-05-10/five-new-ev-models-drive-up-north-american-factory-production#xj4y7vzkg

[272] *Id.* at footnote 27

[273] "Hot, New Electric Cars That Are Coming Soon," Consumer Reports, (June 9, 2023) https://www.consumerreports.org/hybrids-evs/hot-new-electric-cars-are-coming-soon-a1000197429/

In the United States, there were fewer than 100 models available in 2022, but twice as many as before the pandemic.[274] EV model availability has been growing quickly, at a compound annual growth rate of 30% over the 2016-2022 period. Such growth is to be expected in a nascent market with a large number of new entrants bringing innovative products to the market, and as incumbents diversify their portfolios. Even companies that had previously urged caution on EV commitments are shifting towards greater electrification. Toyota plans to release at least 10 EV models by 2026. It is also restructuring to create a unit solely dedicated to electric vehicles.[275]

In the future, the number of models can be expected to continue to increase quickly, as major carmakers expand their EV portfolios and new entrants strengthen their positions, particularly in emerging markets and developing economies.[276]

9. Conclusion

The EV supply chain is making investments today that will lead us to a decarbonized and zero-emission transportation system. Transportation electrification offers a litany of benefits, from improving public health by reducing carbon emissions to creating jobs and preserving American economic competitiveness.

We again thank EPA for the opportunity to comment on its notice of proposed rulemaking to set multipollutant emission standards for model years 2027 and later light- and medium-duty vehicles. ZETA encourages the agency to finalize more stringent standards than Alternative One for light-duty greenhouse gas emissions and finalize light-duty multipollutant standards that are equally as stringent. We also encourage the agency to finalize medium-duty GHG and multipollutant standards that are as stringent as possible. We believe such stringency is feasible and finalizing such standards will ensure the supply chain has the regulatory certainty needed to protect the investments being made today that will put the sector on a glide path to a zero-emission future.

Thank you for your consideration.

[274] "Global EV Outlook 2023 Catching up with climate ambitions," IEA, (2023) https://iea.blob.core.windows.net/assets/dacf14d2-eabc-498a-8263-9f97fd5dc327/GEVO2023.pdf
[275] *Id.* at footnote 261
[276] *Id.* at footnote 27

Appendix

Figure A.1: List of ZETA member LG's investments in domestic EV battery manufacturing.

Company	Product	City	State	Date	Investment	Jobs	Notes	Link
LG Energy Solution	EV Battery Plant	Holland	MI	2010	$600M	1,400	Original investment	
LG Energy Solution	EV Battery Plant	Holland	MI	March 2022	$1.7B	1,200	Expansion Investment from original 2010 $600M investment	https://www.michiganbusiness.org/press-releases/2022/03/whitmer-announces-1200-new-jobs-from-lg-energy-solutions-$1.7-billion-investment-expansion-holland/
Ultium Cells	EV Battery Plant	Warren	OH	Dec 2019	$2.3B	1,500	JV with GM	https://news.gm.com/newsroom.detail.html/Pages/news/us/en/2019/dec/1205-lgchem.html
Ultium Cells	EV Battery Plant	Spring Hill	TN	Apr 2021	$2.75B	1,700	JV with GM	https://www.ultiumcell.com/newsroom/News/2022/12/02/Ultium-Cells-LLC-Announces-Plans-to-Produce-More-Battery-Cells-Faster
Ultium Cells	EV Battery Plant	Lansing	MI	Jan 2022	$2.6B	1,700	JV with GM	https://www.ultiumcell.com/newsroom/News/2022/09/07/Ultium-Cells-Begins-Steel-Construction-in-Lansing
LG Energy Solution	EV Battery Plant	Fayette County	OH	Oct 2022	$4.4B	2,200	JV with Honda	https://www.prnewswire.com/news-releases/honda-and-lg-energy-solution-announce-ohio-as-home-to-joint-venture-ev-battery-plant-301646147.html
LG Energy Solution	EV Battery Plant + ESS	Queen Creek	AZ	March 2023	$5.5B	3,000		
LG Energy Solution	EV Battery Plant	Savannah	GA	May 2023	$4.3B	~3,000	JV with Hyundai	https://news.lgensol.com/company-news/press-releases/1780/
LG Chem	Cathode Plant	Clarksville	TN	Nov 2022	$3.2B	850		https://www.reuters.com/business/lg-chem-invest-more-than-3-bln-build-battery-cathode-plant-us-2022-11-21/
LG Chem & LG Energy Solution	Battery Recycling			May 2022	$50M		Investment in Li-Cycle Battery Recycling	https://www.businesswire.com/news/home/20220512005236/en/Li-Cycle-Announces-Completion-of-50-Million-Investment-from-LG-Energy-Solution-and-LG-Chem

Figure A.2: List of existing or planned investments in domestic copper recycling.

	Ames Copper Group	Aurubis Richmond	Wieland Shelbyville
Location	Shelby, NC	Richmond, GA	Shelbyville, KY
Raw Material and Input Capacity	High grade (No. 1 and No. 2) 54 kt/yr.	Low grade / e-scrap 180 kt/yr.	High grade (No.1 and No. 2) and alloys 100 kt/yr.
Output	50 kt/yr. anodes	70 kt/yr. blister to be initially exported to E.U. for refining	70 kt/yr. fire refined products/ingots
Technology	180 t tilting furnace by SMS	TBRC, PbSn alloy furnace by SMS	120 t fire refining furnace by Properzi
Production start	Q4 2022 (operational now)	H1 2024	H2 2023
Website	https://bit.ly/3XUAH3z	https://bit.ly/3YCIfsE	https://bit.ly/3YWvIQD