ZETA | ZERO EMISSION TRANSPORTATION ASSOCIATION

June 16, 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–2022–0985
Greenhouse Gas Emissions Standards for Heavy-Duty Vehicles—Phase 3
Submitted via Rulemaking Portal: http://www.regulations.gov.

The Zero Emission Transportation Association (ZETA) is an industry-backed coalition of more than 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 Phase 3 greenhouse gas (GHG) emissions standards for model year (MY) 2027-2032 heavy-duty vehicles. ZETA appreciates the work that went into this proposal and we encourage the agency to finalize heavy-duty GHG standards that are more stringent than proposed and align with California's Advanced Clean Trucks (ACT) regulation. To meet the country's commitments under the Paris Climate Agreement and the National Blueprint for Transportation Decarbonization, more than 55% of total class 4-8 vehicle sales must be zero-emission by 2030. Without a quicker transition, older, more-polluting vehicles will remain on the roads well into the future.

Emission standards like these are critical to ensuring the supply chain has the necessary regulatory certainty in order to put the sector on a glide path to a zero-emission future. We urge EPA to finalize these standards before the end of calendar year 2023 to ensure they take effect as soon as permitted under the Clean Air Act as doing so would maximize the potential emissions reductions, consistent with Executive Order 14037. We also encourage EPA to support the EV supply chain by providing forums for coordination between the agency, large fleets, utilities, and

other stakeholders that will be needed to support the adoption of the electrification technologies necessary to meet these emissions reductions targets.

Frontline communities will benefit the most from heavy-duty vehicle (HDV) electrification. Members of these communities are disproportionately likely to live near highways, airports, and ports, and suffer from poor air quality as a result. Stringent heavy-duty GHG standards will promote HDV electrification and help protect these communities from harmful emissions. Stringent standards will also align with the environmental justice goals that the Biden-Harris Administration has placed a much-needed spotlight on.

Beyond the environmental, public health, and climate benefits, HDV electrification will help ensure the United States maintains its economic competitiveness with the rest of the world. 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 investment in the industry.

EVs are now available in all heavy-duty classes, with many models presenting fleet operators with a favorable total cost of ownership today. That should be expected to improve further over the timeframe covered by EPA's proposed standards, and continued innovation by industry will only increase product offerings and vehicle capabilities in the coming years.

As discussed in greater detail in the comments below, the entire EV supply chain is preparing today to meet the demand needs of tomorrow. The certainty that EPA provides in the form of emissions standards like these is critical to helping de-risk capital expenditures and providing future demand clarity. As domestic manufacturing capacity continues to grow, ZETA's members are leading the way to ensure the United States is well positioned to lead the EV revolution.

ZETA supports many of the provisions included in the proposed rule. We also believe there are a few key areas where EPA clarification could strengthen the rule to further protect public health and the environment. We expand upon these and many other points in detail 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 Phase 3 greenhouse gas (GHG) emission standards for model year (MY) 2027-2032 heavy-duty vehicles (HDVs). ZETA applauds EPA's ambition shown in these proposed standards; however, we believe there is solid justification for EPA to incentivize zero emission, heavy-duty vehicle deployment further. This proposed rulemaking offers an opportunity to phase out internal combustion engine (ICE) heavy-duty vehicles—thereby locking in significant GHG 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 goal of decarbonizing the transportation sector.[2]

The heavy-duty electric vehicle (HDEV) market is primed to grow in the coming years. As discussed further in these comments, hundreds of thousands of vehicles have already been ordered, the diversity of available models is growing exponentially, and battery prices are falling rapidly. Robust emission standards will provide the regulatory certainty needed to not only ensure manufacturers continue to invest in HDEV 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. To that end, we encourage EPA to support the supply chain by providing forums for coordination between the agency, large fleets, utilities, and other stakeholders that will be needed to meet these emissions reductions targets and the corresponding increases in HDEV deployments.

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 heavy-duty GHG standards can be improved and strengthened, which we discuss further below. Lastly, ZETA urges the agency to finalize these standards before the end of this calendar year to ensure they apply to vehicles as soon as permitted under the Clean Air Act.

2. HDV GHG Standards are Necessary to Protect Public Health and the Environment

When coupled with EPA's final rule setting multi-pollutant emission standards for HDVs,[3] this rule will drive investment in electric technologies that will lead to significant emissions reductions and improved health outcomes. With an average lifespan of over 15 years and increasing, most HDVs spend more time and miles on the road before retirement than light-duty

[1] *See* 88 FR 25926 (April 27, 2023)
[2] 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
[3] *See* 88 FR 4296 (January 24, 2023)

vehicles.[4] Therefore, failing to electrify these HDVs now means that fossil fuel-powered vehicles rolling off assembly lines today will remain on the road well beyond 2040, adding hundreds of thousands of vehicle miles and associated deadly emissions over the coming decades.

Electrification presents the strongest pathway to reducing pollution from our transportation sector and unlocking tangible environmental and public health benefits. Each year, more than 12.2 million HDVs across the U.S. travel 297 billion miles and consume 46 billion gallons of gasoline and diesel.[5] HDVs produce about a quarter of all emissions across the transportation sector, making them major contributors to U.S. emissions of particulate matter ($PM_{2.5}$), nitrogen oxides (NOx), volatile organic compounds (VOCs), and carbon dioxide (CO_2).[6] Such pollutants are directly linked to long-term respiratory, cognitive, and autoimmune impairment, and studies expect the rate of HDEV deployment to have a direct relationship with improved health outcomes, particularly for individuals living near high traffic areas.[7]

a. Reducing HDV Emissions Protects Public Health

Diesel fumes, in particular, pose a substantial risk to human health[8]—and an overwhelming majority of ICE-powered HDVs run on diesel.[9] On-road diesel emissions are responsible for poor air quality, impaired respiratory systems, and cardiovascular issues. Exposure to these toxins has both cancerous and noncancerous health risks, including potential neurological, cardiovascular, respiratory, reproductive, and immune system damage.[10]

A large portion of the U.S. population remains vulnerable to these dangers. 45 million people in the United States live within 300 feet of a major traffic facility or corridor.[11] Proximity to these roadways exposes residents to needless health risks and replacing older truck and bus fleets with

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[4] "Aging Trucks Create More Service Opportunities," accessed May 5, 2023 *https://www.ntea.com/NTEA/Member_benefits/Industry_leading_news/NTEANewsarticles/Aging_trucks_create_more_service_opportunities.aspx?fbclid=IwAR3mkimdcKilEbdqwvYYSwODX5Hop5g6odQWuQdIt9cJ37I30kwxgv209PU*

[5] "Colorado Medium- and Heavy-Duty (M/HD) Vehicle Study," Colorado Energy Office (September 2021) https://drive.google.com/file/d/1N8tQp0v1RPK86Kle08ZQ83rKsY4Ja5Tx/view

[6] "Federal Vehicle Standards," C2ES, accessed May 18, 2023 https://www.c2es.org/content/regulating-transportation-sector-carbon-emissions/

[7] "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

[8] "Diesel Exhaust," Occupational Safety and Health Administration, accessed May 15, 2023 https://www.osha.gov/diesel-exhaust#:~:text=Workers%20exposed%20to%20diesel%20exhaust,respiratory%20disease%20and%20lung%20cancer

[9] "Trucking," Diesel Technology Forum, accessed May 15, 2023 https://dieselforum.org/trucking#:~:text=More%20than%2015%20million%20commercial,are%20powered%20by%20diesel%20engines.

[10] *Id.* at Page 5

[11] "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.

electrified alternatives has the potential to yield significant public health benefits. According to the American Lung Association, the widespread transition to zero-emission transportation by 2050 can produce up to $72 billion in avoided health costs, save approximately 6,300 lives, and prevent more than 93,000 asthma attacks and 416,000 lost workdays each year.[12]

b. Reducing HDV Emissions Protects the Environment and the Climate

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.[13] In areas where diesel exhaust is present, a 2022 study found that there were 70% fewer pollinators and 90% fewer flower visits.[14] 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.[15]

While HDVs make up just 10 percent of vehicles on the road, they generate more than 25 percent of the total GHG emissions from the transportation sector.[16] As the nature of anthropogenic climate change is becoming increasingly evident,[17] the urgency needed in addressing its causes is becoming greater.[18] Electrification is the best path forward for reducing transportation emissions, and HDV electrification in particular presents an outsized opportunity for emissions reductions. In addition to emitting higher volumes of pollutants compared to other classes of vehicles, commercial HDVs also spend more time on roads.[19] The average Class 8 semi travels 63,000

[12] "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

[13] "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

[14] James M.W. Ryalls, Ben Langford, Neil J. Mullinger, Lisa M. Bromfield, Eiko Nemitz, Christian Pfrang, Robbie D. Girling, 'Anthropogenic air pollutants reduce insect-mediated pollination services', *Environmental Pollution*, Volume 297, 2022, 118847, ISSN 0269-7491, accessed May 24, 2023 https://doi.org/10.1016/j.envpol.2022.118847.

[15] 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/

[16] "How to Eliminate Pollution from Heavy-Duty Vehicles," Union of Concerned Scientists, (February 11, 2022), accessed May 15, 2023 https://www.ucsusa.org/resources/heavy-duty-vehicles-and-nox#:~:text=The%20problem%20with%20heavy%2Dduty%20vehicles&text=Carbon%20dioxide%2C%20methane%2C%20and%20nitrous,this%20sector%20continues%20to%20grow.

[17] 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

[18] "Carbon dioxide levels in atmosphere mark a near-record surge," Washington Post, (June 5, 2023) accessed June 6, 2023 https://www.washingtonpost.com/climate-environment/2023/06/05/carbon-dioxide-growing-climate-change/

[19] Katie Zehnder et al. "Ohio Freight Electrification," Ohio Department of Transportation (August 2021) https://drive.ohio.gov/wps/wcm/connect/gov/c6eb7b83-7d19-4f14-b430-761849a3de98/20210812_OhioFreightElec

miles every year—more than four times the vehicle miles traveled (VMT) of a single passenger vehicle.[20] All this additional time spent on the road means more GHG emissions over the life of a HDV meaning it is even more urgent to decarbonize this segment of the transportation sector.

c. HDV Emissions Disproportionately Impact Historically Underserved Communities

The positive health impacts associated with increased HDV electrification will be most significant among frontline communities, whose members are disproportionately likely to live near highways, warehouses, ports, and airports and suffer from poor air quality as a result.[21] This higher exposure burdens historically underserved residents and communities of color with negative health outcomes and higher healthcare costs.[22] Electrifying the HDV sector is also consistent with the goals of Executive Order 14096, *Revitalizing Our Nation's Commitment to Environmental Justice for All*.[23]

A recent report from the Environmental Defense Fund on U.S. warehouse proliferation shows that some 15 million people live within a half-mile of a warehouse in ten states across the country.[24] The report concludes that in many states, Black, Latino, Asian, and American Indian communities and areas of low wealth are disproportionately exposed to this pollution. Strong Phase 3 GHG standards that promote HDEVs are a key step in addressing the historic inequities in how communities are affected by air pollution emitted by HDVs.

3. The Economic Benefits of Electrifying HDVs

Beyond health improvements, HDV electrification will 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 investment in the industry.

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[20] *Id.*

[21] Park YM, Kwan MP. 'Understanding Racial Disparities in Exposure to Traffic-Related Air Pollution: Considering the Spatiotemporal Dynamics of Population Distribution.' *Int J Environ Res Public Health*. 2020 Feb 1;17(3):908. doi: 10.3390/ijerph17030908. PMID: 32024171; PMCID: PMC7037907. Accessed may 24, 2023

[22] "Black children are more likely to have asthma. A lot comes down to where they live," Associated Press, (May 24, 2023) https://apnews.com/article/black-children-asthma-investigation-8892ec059a4b192b93eb38ccb613fcb9

[23] *See* 88 FR 25251

[24] Aileen Nowlan, "Making the Invisible Visible - Shining a Light on Warehouse Truck Air Pollution," (April 2023) https://globalcleanair.org/files/2023/04/EDF-Proximity-Mapping-2023.pdf

The transition to EVs is already leading to new domestic manufacturing jobs, improved property values, and investment in communities.[25] This trend should not only be expected to continue, but indeed accelerate in the coming years. The burgeoning HDEV 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.

As EPA notes in the proposed rule, the Phase 3 HD GHG standards would reduce U.S. oil imports by 4.3 billion gallons through 2055, meaning American consumers would be more insulated from foreign geopolitical turmoil and associated oil price volatility. 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, stating that "every recession since World War II has been preceded by a jump in oil prices."[26] As discussed further below, reducing exposure to such volatility through freight sector electrification may have the additional effect of stabilizing consumer product costs, as these are often heavily affected by transportation fuel costs.[27]

a. HDV Electrification Will Create Good-Paying American Jobs

HDV electrification will require building out a domestic EV supply chain and charging capacity, both of which hold considerable economic potential. A study by ICF Climate Center found that, as a whole, truck electrification provides greater benefits to the economy than other fleet composition.[28] The study found that investment in HDEVs and charging infrastructure results in greater net employment, gross regional product, and industrial activity per dollar spent compared to natural gas vehicles and infrastructure.

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.[29] This is a result of the new jobs in charging infrastructure, the electricity sector, and maintenance. Additional estimates find that the 45W commercial clean vehicle tax

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[25] 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

[26] "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

[27] Melodia, Lauren; Karlsson, Kristina. 2022. 'Energy Price Stability: The Peril of Fossil Fuels and the Promise of Renewables.' Roosevelt Institute. Accessed May 24, 2023. https://rooseveltinstitute.org/wp-content/uploads/2022/05/RI_EnergyPriceStability_IssueBrief_202205.pdf

[28] "Comparison of Medium- and Heavy-Duty Technologies in California," ICF, (December 2019) https://caletc.com/assets/files/ICF-Truck-Report_Final_December-2019.pdf

[29] "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

credit could create more than 154,000 jobs in the U.S.[30] The manufacturing and installation of charging infrastructure alone is projected to create more than 29,000 jobs.[31] Heavy-duty charging infrastructure will demand even more jobs than the light-duty sector due to the large scale of these projects.[32] In general, jobs in the EV industry are high-quality, high-paying, and tech focused. As a result, the industry is attracting a new generation of workers, including individuals transitioning from other industries, who are eager to work in sustainable transportation.

Beyond the EV industry itself, electrification could encourage growth in the trucking industry. With the boom in e-commerce, the demand for heavy-duty trucks to transport goods across the country is steadily increasing. In 2020, U.S. e-commerce sales were up 32.4% from the previous year,[33] and estimates project the total VMT by MHDVs will grow 29% by 2050.[34] To meet the growing demand of goods being shipped across the country, fleet managers are deploying a greater number of commercial vehicles. With this VMT growth, electrification provides an efficiency and cost savings potential that can help meet this increased demand, while avoiding the emissions increases resulting from more trucks on the road.

Relatedly, the transportation industry is also experiencing considerable shortages of available truck drivers, and HDV electrification could alleviate this crisis. The trucking industry is an estimated 80,000 drivers short, with many long-term employees citing stress as a reason for quitting.[35] The American Trucking Association estimates the shortage could grow to 160,000 drivers by 2030.[36] Consumer reports consistently demonstrate higher satisfaction with the EV driving experience compared to fossil fuel-powered vehicles. EVs provide a smoother ride with minimal vibrations, less noise pollution, and a high-tech driving experience free from diesel exhaust fumes.[37] As a result, the health benefits associated with eliminating diesel fume

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[30] "Decarbonization Pathways: Full Study Results," Eurelectric, (May 2018) https://cdn.eurelectric.org/media/3558/decarbonisation-pathways-all-slideslinks-29112018-h4484BB0C.pdf

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

[32] "Electrification of mobility will create new and support existing well-paying jobs in Canada," ChargePoint, (February 16, 2023) https://www.chargepoint.com/blog/electrification-mobility-will-create-new-and-support-existing-well-paying-jobs-canada

[33] Fareeha Ali and Jessica Young, "US Ecommerce Grows 32.4% in 2020," Digital Commerce 360, (January 29, 2021) https://www.digitalcommerce360.com/article/usecommerce-sales/

[34] Dana Lowell and J. Culkin, "Medium- and Heavy-Duty Vehicles: Market Structure, Environmental impact, and EV readiness," Environmental Defense Fund, (July 2021) https://www.edf.org/sites/default/files/documents/EDFMHDVEVFeasibilityReport22jul21.pdf

[35] "The Biggest Kink in America's Supply Chain: Not Enough Truckers," New York Times, (November 9, 2021) https://www.nytimes.com/2021/11/09/us/politics/trucker-shortage-supply-chain.html

[36] "ATA Chief Economist Pegs Driver Shortage at Historic High," American Trucking Associations, (October 25, 2021) https://trucking.org/news-insights/ata-chief-economist-pegs-driver-shortage-historic-high

[37] "FAQ about electric trucks," Volvo Trucks, accessed May 15, 2023 https://www.volvotrucks.com/en-en/trucks/renewable-fuels/electric-trucks/faq.html

inhalation and improved experience from a quieter drivetrain may reduce healthcare costs and increase driver retention.[38]

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

HDEVs can offer substantial economic advantages to fleet operators. Fuel and maintenance costs, in particular, are areas with substantial cost reduction potential. In a survey of fleet managers, the most commonly cited motivation for electrifying their fleets was to meet sustainability goals (83%); lower total cost of ownership (TCO) was the second-most common reason (64%).[39]

Fleet managers are particularly sensitive to costs, and economics drive the majority of their business decisions. Currently, evaluating the upfront cost—rather than lifecycle—of vehicle acquisition is standard practice for both private and public fleet managers. When analyzed this way, fossil fuel-powered vehicles often outcompete HDEVs; however, TCO analyses regularly demonstrate that HDEVs are significantly cheaper than their ICE counterparts. Transitioning from an upfront cost-based decision-making model to one that considers the vehicle's entire lifespan—including purchase cost, depreciation, financing, fuel costs, insurance costs, maintenance costs, taxes, fees, and operational expenses—provides a more accurate picture of the true costs incurred via vehicle ownership. Under such considerations, HDEVs like transit buses, school buses, and vocational vehicles are already cost competitive with equivalent ICEVs.[40]

Even before the passage of the Inflation Reduction Act (IRA), the International Council on Clean Transportation (ICCT) found that HDEVs have a TCO advantage over ICEVs in some U.S. regions and they are expected to reach cost parity nationally by 2035.[41] That should be expected to accelerate with the passage of the IRA's 45W commercial clean vehicle tax credit, as discussed further below. ICCT also found that TCO savings hold even assuming lower-than-expected oil prices or higher electricity rates in the future. Even without the IRA tax credits, most classes of HDVs will have a payback period of less than 5 years by 2025. Considering most HDVs today have an average lifespan of 15 years, these cost savings make a strong economic case for fleet operators to make the switch to electric technologies.

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[38] J. Leung and J. Peace. "Insights on Electric Trucks for Retailers and Trucking Companies," C2ES, accessed May 15, 2023 https://www.c2es.org/wp-content/uploads/2020/02/Insights-On-Electric-Trucks-For-Retailers-And-Trucking-Companies.pdf

[39] Steven Nadel and P. Huether, "Electrifying Trucks: From Delivery Vans to Buses to 18-Wheelers," ACEEE, (June 2021) https://www.aceee.org/sites/default/files/pdfs/t2102.pdf

[40] *Id.*

[41] "Purchase Costs of Zero-Emission Trucks in the United States to Meet Future Phase 3 GHG Standards" ICCT, March 2023 https://theicct.org/publication/cost-zero-emission-trucks-us-phase-3-mar23/

These savings are expected to grow in the coming years. By 2030, an electric day cab is expected to lower the TCO by more than 31% for savings of $239,000 over a vehicle's lifetime.[42] Fleets that experience the highest fuel and maintenance costs from their diesel trucks would see the greatest cost reductions from an EV transition. Class 8 electric trucks with trips fewer than 500 miles will see the greatest TCO savings, largely when operating in environments with higher fuel prices and relatively low electricity prices.[43] Because the upfront cost is paid back via savings on operations mile-by-mile, fleets with higher VMT would see the greatest reductions, which bodes well for long-haul trucking.[44] See Figure 1 for a breakdown of the average yearly VMT by different HD vehicle classes.

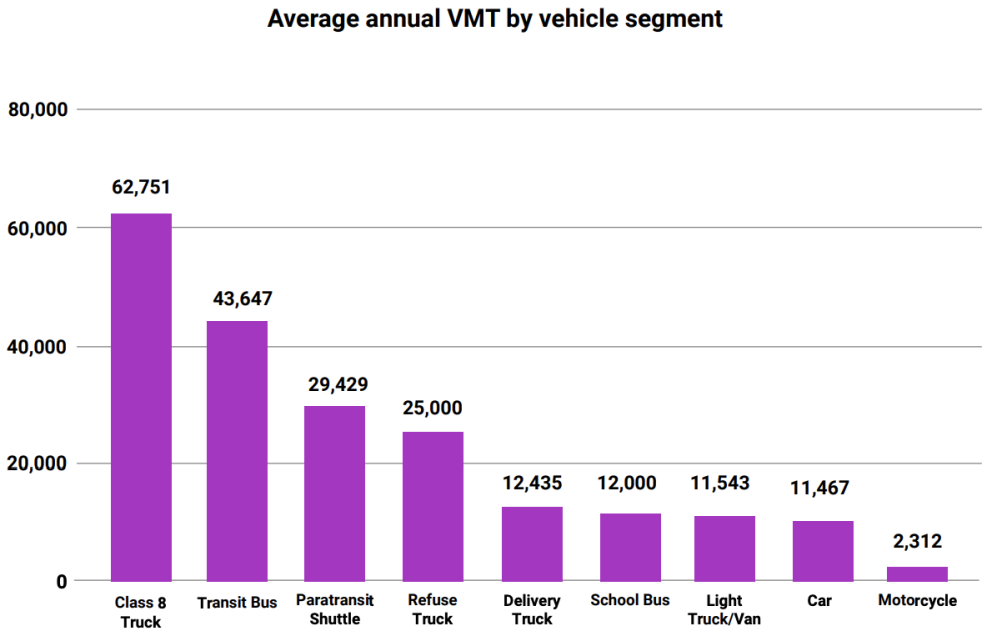

Figure 1: HDVs have higher annual VMTs, leading to massive amounts of fuel consumption. EVs would improve fuel efficiency and save fleet operators in fuel costs.[45]

[42] "Advanced Clean Fleets Total Cost of Ownership Discussion Document," California Air Resources Board, (September 9, 2021) https://ww2.arb.ca.gov/sites/default/files/2021-08/210909costdoc_ADA.pdf
[43] Chad Hunter et al. "Spatial and Temporal Analysis of the Total Cost of Ownership for Class 8 Tractors and Class 4 Parcel Delivery Trucks," National Renewable Energy Laboratory, (September 2021) https://www.nrel.gov/docs/fy21osti/71796.pdf
[44] Robert Prohaska, et al. "Medium-Duty Plug-in Electric Delivery Truck Fleet Evaluation," IEEE, (2016) https://doi.org/10.1109/ITEC.2016.7520262
[45] "Medium- and Heavy-Duty Electrification: Weighing the Opportunities and Barriers to Zero Emission Fleets," ZETA, (January 2022) https://fs.hubspotusercontent00.net/hubfs/8829857/ZETA-WP-MHDV-Electrification_Opportunities-and-Barriers_Final3.pdf

i. Fuel and maintenance costs

A key consideration for the cost savings of HDEVs is that electricity is considerably cheaper than diesel and gasoline. As of 2022, electricity was three to six times cheaper than diesel.[46] Electricity prices tend to be less volatile and subject to fewer supply shocks than oil prices.[47] In addition, most states and regional operators implement price controls on changes to electricity prices. Electricity can also be sourced from a wider array of resources, such as renewables like solar, wind, hydropower, and geothermal. This fuel source diversification further reduces electricity rate volatility and creates more predictability for HDEV fleet operators.

EVs have fewer moving parts than their ICE counterparts, which makes them simpler to maintain and reduces the probability of a major malfunction. Reduced maintenance saves both time and money, particularly for fleet managers operating on tight margins. School districts, in particular, tend to lack the economic and labor resources to make repairs to their existing vehicles, thus making EVs a more attractive alternative.

A Class 8 electric truck costs 4.7 cents less per mile to maintain compared to its diesel counterpart and these maintenance savings alone can equate to thousands of dollars over the vehicle's lifetime.[48] The EIA expects a 55% growth in total MHDV VMT between 2019 and 2050, largely driven by the rise of e-commerce.[49] Due to HDVs' higher VMT and lower fuel economy, they stand to see significant cost savings from increased efficiency and lower dollar-per-mile costs with electrification.

ii. Impact of the Inflation Reduction Act and Bipartisan Infrastructure Law

Despite the TCO savings, reaching near upfront cost parity to ICEVs is a preference for fleet owners. Once cost parity is reached, EV demand can be expected to rise rapidly. Purchase subsidies for HDEV acquisition offers one way to address the upfront cost differential, though the lower operating expenses still makes them attractive to fleet operators—even without incentives.

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[46] Fred Lambert, "Electric cars are now three to six times cheaper to drive in the US as gas prices rise," Electrek, (March 22, 2022) https://electrek.co/2022/03/22/electric-cars-3-to-6-times-cheaper-to-drive-us-high-gas-prices/
[47] Melodia, Lauren; Karlsson, Kristina. 2022. 'Energy Price Stability: The Peril of Fossil Fuels and the Promise of Renewables.' Roosevelt Institute. Accessed May 24, 2023. https://rooseveltinstitute.org/wp-content/uploads/2022/05/RI_EnergyPriceStability_IssueBrief_202205.pdf
[48] "Calculating TCO for EVs: Where to Find the Greatest Long-Term Cost Savings for Medium- and Heavy-Duty Vehicles." Advanced Clean Tech News. (August 26, 2020) www.act-news.com/news/calculating-tco-for-medium-and-heavy-duty-evs/
[49] "Annual Energy Outlook 2019," U.S. EIA, (2019) https://www.eia.gov/outlooks/aeo/

BloombergNEF projects electric delivery vehicles will reach price parity with diesel trucks around 2025.[50] Due to the IRA's 45W commercial clean vehicle tax credit of up to $40,000 and battery production incentives of $45/kWh, McKinsey analysts expect electric HDVs with a range of 400 miles to achieve parity by 2027.[51] Prior to the passage of the IRA, cost parity was not anticipated until much later.[52]

Beyond the tax credits created or modified by the IRA, the law's funding programs, coupled with those in the Bipartisan Infrastructure Law (BIL) of 2021, will help drive adoption of heavy-duty vehicle technologies in all sectors, including transit, school bus, and freight. EPA's Clean Heavy-Duty Vehicles program and Clean Ports program will incentivize a buildout of manufacturing capacity to meet the increased demand for these products. EPA's Clean School Bus program is already having a similar effect on the school bus sector. The Department of Transportation's Low or No Emission Vehicle Program is also supporting the transition to electric HDVs with millions of dollars already awarded to transit projects in recent years. The BIL provided an additional $5.5 billion over five years for the Low-No Program—more than six times greater than the previous five years of funding.[53]

c. HDV 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 to creating certainty and encouraging investment in the industry. If the U.S. does not move more aggressively on HDEV deployment, it risks ceding market share to other countries who are moving faster on EV deployment.

Complimentary incentives embedded in the IRA will facilitate onshoring of the EV supply chain but 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

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[50] Owen MacDonnell and Cristiano Façanha, "How Zero-Emission Heavy-Duty Trucks Can Be Part of the Climate Solution," CALSTART, (May 2021) https://calstart.org/wp-content/uploads/2021/05/How-Zero-Emission-Heavy-Duty-Trucks-Can-Be-Part-of-the-ClimateSolution.pdf

[51] "Why the economics of electrification make this decarbonization transition different," McKinsey & Company, (January 30, 2023) https://www.mckinsey.com/industries/automotive-and-assembly/our-insights/why-the-economics-of-electrification-make-this-decarbonization-transition-different

[52] "Decarbonizing Medium- & Heavy-Duty On-Road Vehicles: Zero-Emission Vehicles Cost Analysis," NREL, (March 2022) https://www.nrel.gov/docs/fy22osti/82081.pdf

[53] "Biden-Harris Administration Announces Over $1.6 Billion in Bipartisan Infrastructure Law Funding to Nearly Double the Number of Clean Transit Buses on America's Roads," U.S. Department of Transportation, (August 16, 2022) accessed June 4, 2023 https://www.transportation.gov/briefing-room/biden-harris-administration-announces-over-16-billion-bipartisan-infrastructure-law

supportive policies in other areas of the supply chain—most notably on critical minerals permitting reform—EPA emissions standards are crucial drivers of domestic EV supply.

Many countries have made commitments to accelerate HDEV development and deployment in their borders. China accounted for nearly 90% of global electric truck registrations in 2021.[54] In 2021, China also recorded 86,000 electric bus registrations, compared to 3,000 in Europe and 1,000 in the U.S.[55] With its own emissions targets, countries in Europe are sending strong signals about its future electric HDV fleet. With robust Phase 3 GHG standards, the U.S. would be encouraging quicker adoption of HDEV technology to ensure the country remains at the forefront of this global transition. Below is a list of regional and national goals for HD zero-emission vehicle deployment that further underscores the need for the United States to maintain pace with the rest of the world:

- Austria, Canada, Chile, Denmark, Finland, Luxembourg, Netherlands, New Zealand, Norway, Scotland, Switzerland, Turkey, United Kingdom, Uruguay, and Wales signed a Memorandum of Understanding (MOU) in 2021.[56] The MOU sets a target for ZEVs to account for 30% of new truck and bus sales by 2030, and 100% by 2040.
- In 2023, the European Union (EU) proposed more stringent standards for HDVs to reduce emissions by 45% by 2030, 65% by 2035 and 90% by 2040 from 2019 levels. The EU also proposed to make all new city buses zero-emission by 2030.[57]
- The EU's Clean Vehicles Directive sets national targets for ZEV public procurement by national governments, ranging from 15-65% depending on the vehicle segment.[58]
- Chile has a target for 100% of new public transportation to be ZEVs by 2035, and 100% by 2045 for freight transport and buses.[59]
- In July 2023, China will introduce more stringent emissions standards for heavy-duty vehicles.[60]

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[54] "Trends in electric heavy-duty vehicles," IEA, (2022) https://www.iea.org/reports/global-ev-outlook-2022/trends-in-electric-heavy-duty-vehicles

[55] *Id.*

[56] "Decarbonizing Bus Fleets: Global Overview of Targets for Phasing Out Combustion Engine Vehicles," ICCT, (December 9, 2021) https://theicct.org/decarbonizing-bus-fleets-global-overview-of-targets-for-phasing-out-combustion-engine-vehicles/

[57] "Reducing CO_2 emissions from heavy-duty vehicles," European Commission, accessed May 20, 2023 https://climate.ec.europa.eu/eu-action/transport-emissions/road-transport-reducing-co2-emissions-vehicles/reducing-co2-emissions-heavy-duty-vehicles_en

[58] "Clean Vehicles Directive," European Commission, accessed May 20, 2023 https://transport.ec.europa.eu/transport-themes/clean-transport-urban-transport/clean-and-energy-efficient-vehicles/clean-vehicles-directive_en#:~:text=The%20revised%20Clean%20Vehicles%20Directive,targets%20for%20their%20public%20procurement

[59] "Global EV Outlook 2022 - Securing supplies for an electric future," IEA, (2022) https://iea.blob.core.windows.net/assets/e0d2081d-487d-4818-8c59-69b638969f9e/GlobalElectricVehicleOutlook2022.pdf

[60] *Id.*

- In March 2022, Canada set zero emissions targets for ZEV models to account for 35% of MHDVs by 2030 and 100% by 2040.[61]
- New Zealand has a goal to fully decarbonize its public bus fleet by 2035.[62]
- Pakistan aims for 90% of new heavy-duty truck sales to be electric by 2040.[63]
- Austria, Cape Verde, Chile, Colombia, Denmark, New Zealand, and the Netherlands have committed to a target of 100% ZEV buses in cities by 2030.[64]
- Austria also has a goal for 100% of smaller HDVs (<18 tonnes) to be ZEVs in 2030 and larger HDVs in 2035.[65]
- France plans to ban the sale of new HDVs that use fossil-fuels by 2040.[66]
- Norway is targeting 100% of new HDVs, 75% of buses and 50% of new trucks to be ZEVs by 2030.[67]
- The United Kingdom is phasing out large ICE truck sales (>26 tonnes) by 2040.[68]

Stringent Phase 3 GHG emission standards will encourage more domestic investment and innovation to position the United States as a global leader in the heavy-duty electric vehicle space. The regulatory certainty of these standards will allow for increased investment and the continued build-out of a domestic supply chain. Without stringent Phase 3 GHG standards, the U.S. risks ceding this vast economic opportunity to other countries, disadvantaging American businesses and workers.

4. ZETA Comments on the Proposed Phase 3 GHG Emission Standards for HDVs

ZETA and its member companies appreciate the opportunity to submit comments on EPA's proposed rule to set Phase 3 GHG emission standards for class 4-8 HDVs. We urge the agency to finalize standards consistent with California's Advanced Clean Truck (ACT) regulation through MY 2032. Doing so will ensure a rapid transition to a zero-emission and prevent a patchwork of regulatory stringencies across various states. We also urge the agency to finalize these standards by the end of calendar year 2023 to ensure they take effect as soon as possible under the Clean Air Act, consistent with Executive Order 14037.

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[61] *Id.*
[62] "Decarbonisation of bus fleets for a healthier Aotearoa." New Zealand Government, accessed May 24, 2023. https://www.nzta.govt.nz/media-releases/decarbonisation-of-bus-fleets-for-a-healthier-aotearoa/#:~:text=In%20January%202021%2C%20the%20Government,transport%20bus%20fleet%20by%202035.
[63] *Id.*
[64] *Id.*
[65] "Global Overview of Government Targets for Phasing Out Internal Combustion Engine Medium and Heavy Trucks," ICCT, (August 26, 2021) https://theicct.org/global-overview-of-government-targets-for-phasing-out-internal-combustion-engine-medium-and-heavy-trucks/
[66] *Id.*
[67] *Id.* at Page 15
[68] *Id.*

ZETA also encourages EPA to consider Phase 4 GHG emissions standards for MYs 2033-2035 that are consistent with California's ACT 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 GHG standards for MYs 2027-2032.[69]

5. ZETA Comments on the Additional Proposed Regulatory Changes

Beyond the overall stringency of EPA's proposed Phase 3 GHG emission standards for HDVs, ZETA is providing the following comments on the various regulatory changes proposed in the rule.

ZETA supports the proposed accelerated phaseout of HDEV credit multipliers by MY 2027. HDEV technology has progressed rapidly since the Phase 2 GHG emissions standards finalized in 2016. HDEVs will soon penetrate the market to a much greater degree than was previously anticipated. 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 HDEV technology investments, and a more stringent GHG standard would most effectively drive HDEV adoption and, in turn, emissions reductions. While we believe it is appropriate to phase out credit multipliers for HDEVs, we recognize that other zero-emission technologies, such as hydrogen fuel cell vehicles, are in a different stage of development and deployment. While we are not recommending phasing out credit multipliers for these technologies, we request EPA articulate clear guidelines for when it would be appropriate to do so.

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 powertrain as "emissions control equipment" 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.

Other commenters may recommend EPA adopt so-called regulatory "off-ramps" in an effort to undermine the stringency of the proposed standards. ZETA urges EPA not to adopt any regulatory changes that would create unnecessary and avoidable uncertainty in the HDEV supply chain. The private sector investments being made today will be critical in meeting the target EPA has created with these proposed standards and arbitrarily undermining them with counterproductive regulatory changes will only add additional risk to such investments.

[69] RIN 2060–AV50

6. The EV Supply Chain is Preparing to Support Increased Heavy-Duty 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 Phase 3 GHG emissions standards for heavy-duty vehicles provide regulatory certainty for the entire supply chain supporting the transition to electrification.

As discussed further below, 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.

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 Phase 3 HDV GHG emissions standards—the supply chain is preparing to meet that demand both through new extraction and processing and with additional support from recycling.

The section 30D New Clean Vehicle Tax Credit in the Inflation Reduction Act will ensure 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.[70] 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. While the 30D credit is only available for eligible light-duty vehicles, the incentive to onshore EV supply chains will have additional effects for HDEVs.

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[71] and ZETA has consistently supported reforms[72] that

[70] "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
[71] "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/
[72] "Critical Mineral Permitting Reform Framework," ZETA, (May 2023) https://www.zeta2030.org/insights/critical-mineral-permitting-reform-framework

ensure development projects are constructed quickly while meeting the strongest environmental standards.

i. Projected demand for critical minerals

Demand for critical minerals is expected to grow substantially in the coming years.[73] Figure 2 shows IEA's projected demand scenarios by 2040 relative to a 2020 baseline.

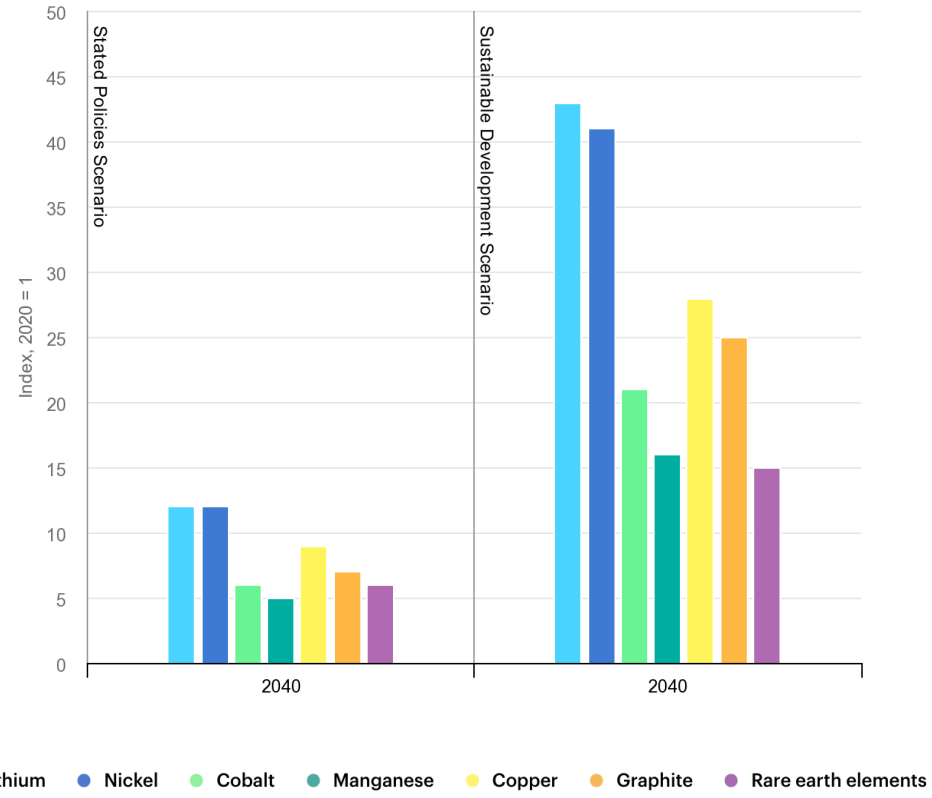

Figure 2. Mineral demand growth from new EV sales by scenario, 2040 relative to 2020.

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.[74] 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.

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[73] "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

[74] "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

ii. Meeting the forthcoming demand for critical minerals

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.[75] However, while much of the production for certain minerals is concentrated in a handful of countries, the Carnegie Endowment for International Peace and Figure 3 below demonstrate that the demand for most virgin critical minerals can be met through extraction in democratic countries.[76]

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

[75] "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

[76] 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 3. Critical Minerals Potential in All Democratic Countries[77]

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.[78] However, while producing enough metals to meet these targets would require extraordinary technological and financial cooperation, the substantial economic development opportunities create a strong incentive to do so.

In regards to lithium specifically, Benchmark Mineral Intelligence found that by the end of 2023, the world's supply of lithium will be more than double 2021's output and more than the total produced between 2015 and 2018.[79] Such rapid growth provides cause for optimism that supply will be able to keep pace with demand in the coming years. Separately, 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 domestic critical mineral assessments.[80]

iii. ZETA members' investments in 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.[81] Ioneer recently announced a mineral resource update that found a 168% increase in estimated lithium at Rhyolite Ridge.[82]

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

[77] "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
[78] *Id.*
[79] "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
[80] "Artificial Intelligence for Critical Mineral Assessment Competition," DARPA, https://criticalminerals.darpa.mil/
[81] Ioneer - Rhyolite Ridge, accessed May 16, 2023 https://rhyolite-ridge.ioneer.com/
[82] "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

more than 2 million electric cars a year.[83] Albemarle plans to build two 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.

Recently, Lithium Americas provided an update on the status of its various projects around the world.[84] 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 of battery-quality lithium carbonate per year; the company expects to complete this expansion 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.[85]

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 4. 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 Department of Energy proposed to characterize copper as critical through its inclusion on the

[83] "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
[84] "Lithium Americas Reports First Quarter 2023 Results," Lithium Americas, (May 15, 2023) https://www.lithiumamericas.com/news/lithium-americas-reports-first-quarter-2023-results
[85] *Id.*

official DOE Critical Materials List.[86] 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:

Resolution Copper, 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 $1B annually into Arizona's economy. The project currently employs 300 people, 80% who 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.[87]

NewRange Copper Nickel: This project 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.[88]

iv. Refining and processing

Beyond extraction, ZETA members have recently announced projects to process and refine raw critical minerals:

- In March 2023, Albemarle announced a new lithium processing facility in South Carolina.[89] 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 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.[90]

[86] "Critical Materials Assessment," U.S. Department of Energy, (May 2023) https://www.energy.gov/sites/default/files/2023-05/2023-critical-materials-assessment.pdf
[87] *See:* https://resolutioncopper.com/
[88] *See:* https://newrangecoppernickel.com/
[89] "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–
[90] "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/

b. Batteries

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 battery manufacturing investments, translating to 96 new or expanded processing and manufacturing plants.[91] According to Argonne National Lab, between 2010 and 2021, the private and public sector invested $95 billion in the U.S. battery manufacturing industry.[92] 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."[93] In 2022, the Inflation Reduction Act 45X Advanced Manufacturing Production and Advanced Energy Project Tax Credit provides $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 for tax credits to build clean technology manufacturing facilities, including those that process, refine, and recycle critical minerals.[94] Through the 45X credit, the IRA cuts nearly one third of the cost of producing batteries in the United States.[95] Together, these historic provisions will drive American battery innovation, ensuring that the sector is equipped to electrify all electric vehicle classes 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

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[91] 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

[92] "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

[93] Public Law 117-58

[94] "Inflation Reduction Act: What it Is and What it Means for EV Adoption." Zero Emission Transportation Association, (2022) https://www.zeta2030.org/insights/the-inflation-reduction-act-what-it-is-and-what-it-means-for-ev-adoption

[95] "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/

battery capacity in anticipation of strong electric vehicle sales growth. Benchmark's Gigafactory Assessment suggests that a total of 1.4 terawatt hours of new battery capacity was announced in just the last six months and the number of Benchmark-tracked plants more than doubled—from 174 in November 2020 to 379 in April 2023.[96]

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. 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.[97] A more comprehensive list of LG's 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.[98]
- In April 2023, General Motors and Samsung announced they will invest over $3 billion to build a joint venture EV battery manufacturing plant in St. Joseph County, Indiana. Expected to start production in 2026, the plant aims to have an annual production capacity of 30 GWh.[99]

ii. Recycling

[96] "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

[97] "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/

[98] "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/

[99] "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/

A key element of 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 5, North American battery recycling capacity is growing rapidly. Available EOL battery feedstocks are projected to increase in tandem as EVs on the road today approach the end of their useful life.

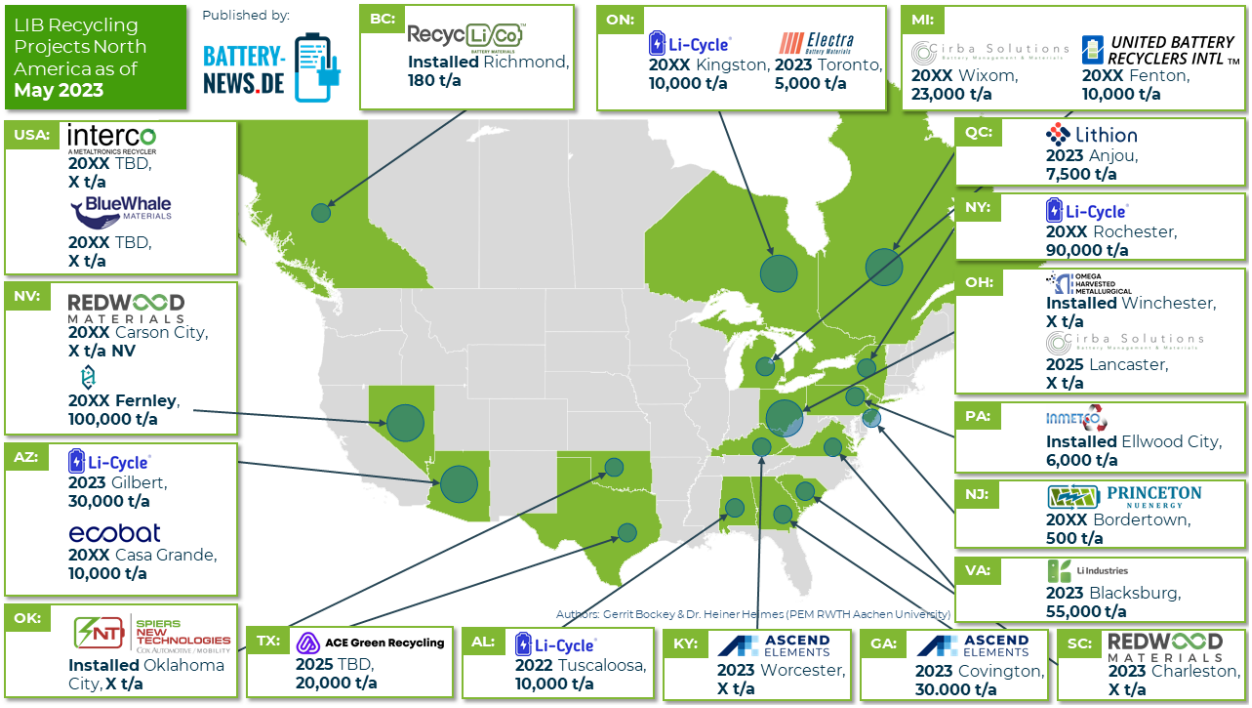

Figure 5. Battery recycling projects in North America (as of May 2023)[100]

In recognition of the potential solutions that battery recycling can provide, the Bipartisan Infrastructure Law requires EPA to develop battery recycling best practices and battery labeling guidelines by September 30, 2026. Congress allocated $10 million and $15 million to each issue respectively.[101] 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.[102] By 2025, Benchmark Minerals Intelligence forecasts that scrap will account for 78% of the pool

[100] "Battery Recycling in North America as of May 2023," Battery-News.de, (May 5, 2023) accessed May 17, 2023 https://battery-news.de/index.php/2023/05/05/batterie-recycling-in-nordamerika/
[101] Public Law 117-58
[102] "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?utm_source=prnewswire&utm_medium=referral&utm_campaign=CMFE_10-April-23&utm_term=battery_recycling_market&utm_content=rd

of recyclable materials.[103] This growth is largely driven by the growing number of EVs 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.[104]

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.[105] 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, PNE launched a US Department of Energy $12MM 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.[106]
- In April 2023, ZETA member Redwood Materials announced a pair of partnerships to collect EOL battery feedstocks. Rad Power Bikes will provide Redwood with e-bike batteries when they reach the end of their lifespan.[107] Redwood and Volkswagen of America expanded their partnership to collect more EOL batteries from consumer electronics.[108] Both announcements come following a historic announcement of a $2 billion conditional loan from the Department of Energy to support Redwood's McCarran, NV recycling facility.[109] At full production capacity, the McCarran project's anode copper

[103] "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/

[104] "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

[105] "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/

[106] "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/

[107] "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

[108] "VW and Redwood want to turn your old laptops into EV batteries," TechCrunch+, (April 4, 2023) accessed May 17, 2023 https://techcrunch.com/2023/04/04/vw-and-redwood-want-to-turn-your-old-laptops-into-ev-batteries/

[109] "LPO Offers Conditional Commitment to Redwood Materials to Produce Critical Electric Vehicle Battery Components From Recycled Materials," Department of Energy, (February 9, 2023) https://www.energy.gov/lpo/articles/lpo-offers-conditional-commitment-redwood-materials-produce-critical-electric-vehicle

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 between late 2026 and early 2027. Once completed, the Portovesme Hub is expected to have a 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.[110]

There is also a substantial effort to construct new copper recycling facilities, which often require different sources of feedstocks beyond EOL batteries, as demand for copper is expected to increase with increased deployment of EVs. A complete list of existing recycling projects can be found in Appendix Figure A.2.

iii. Alternative chemistries

As battery manufacturing and recycling ramps up, so too does the development of innovative alternative battery chemistries that will transform the range, durability, and cost of HDEVs. One chemistry with particular promise is that of lithium iron phosphate (LFP) batteries, touted for its potential application in MHD contexts.[111] LFP batteries do not require nickel or cobalt, reducing cost, and reportedly generate 15% less emissions during manufacturing.[112] Importantly, LFP batteries have twice as many charge cycles in their useful vehicle life.[113]

Another potentially promising technology is sodium-ion batteries. In April 2023, Contemporary Amperex Technology Co. Limited (CATL)—the world's largest battery producer—said its first sodium-ion battery would power electric vehicles built by Chinese brand Chery.[114] Because they substitute lithium for sodium, sodium-ion batteries tend to be cheaper and may have significant applications for lower-range EVs. However, their commercial viability will likely be determined by lithium prices going forward.

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[110] "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/

[111] "Driving Sustainability with Evolving Battery Chemistries," Chris Nevers, accessed May 18, 2023 https://www.zeta2030.org/insights/driving-sustainability-with-evolving-battery-chemistries

[112] *Id.*

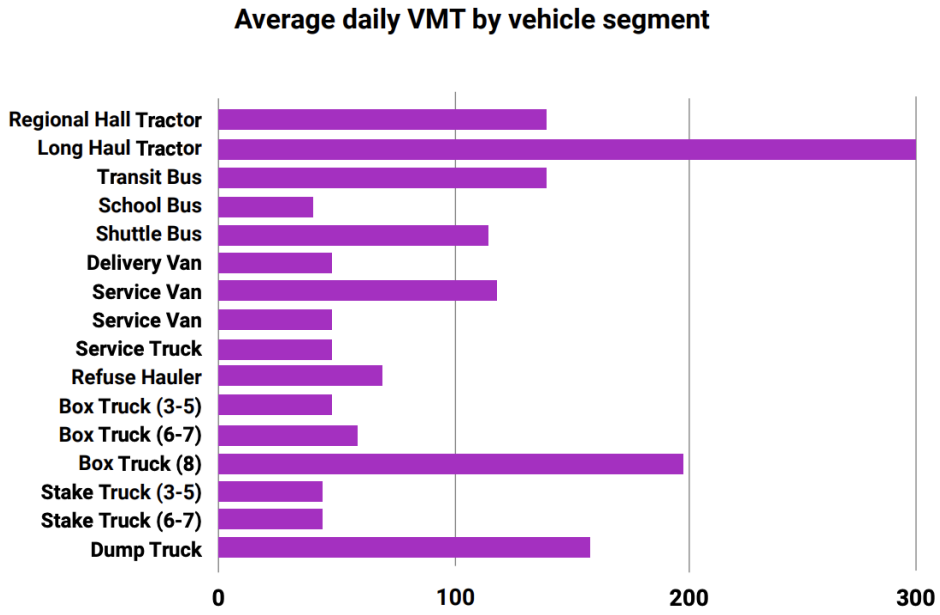
[113] *Id.*

[114] "What If Your Tesla Could Run on Sodium?" Wall Street Journal, (April 19, 2023) accessed May 17, 2023 https://www.wsj.com/articles/what-if-your-tesla-could-run-on-sodium-3c18df30

The Department of Energy's SLAC National Accelerator Laboratory[115] and Stanford University recently announced the launch of a new joint battery center at SLAC.[116] 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.

iv. Range and durability

A common misconception is that range anxiety continues to pose a significant barrier to adoption across all vehicle classes. This concern is particularly acute for HDEV operators, as the average MHDV travels over 100 miles per day.[117] Likewise, trucks with the longest routes drive a maximum of 600 miles but average closer to 300 miles per day.[118] Figure 6 provides the average range of various vehicle classes; as many EV models have a similar range, the MHDV models currently available can meet up to 60% of operational needs.[119] Trucks capable of traveling longer distances (370 miles) are being produced today and those with ranges greater than 620 miles are expected after 2023.[120]



[115] "SLAC National Accelerator Laboratory," DOE Office of Enterprise Assessments, accessed May 17, 2023 https://www.energy.gov/ea/slac-national-accelerator-laboratory
[116] "New Battery Center Launches In USA," CleanTechnica, (April 13, 2023) https://cleantechnica.com/2023/04/13/new-battery-center-launches-in-usa/
[117] "Medium- & Heavy-Duty Vehicles: Market structure, Environmental Impact, and EV Readiness," EDF, (July 2021) http://www.edf.org/sites/default/files/documents/EDFMHDVEVFeasibilityReport22jul21.pdf
[118] *Id.*
[119] *Id.*
[120] How Zero-Emission Heavy-Duty Trucks Can Be Part of the Climate Solution," CALSTART, (May 2021) https://calstart.org/wp-content/uploads/2021/05/How-Zero-Emission-Heavy-Duty-Trucks-Can-Be-Part-of-the-Climate-Solution.pdf

Figure 6. Average VMT by MHDV Segment[121]

In the LDV segment, a recent study found that a majority of EVs retain at least 90 percent of their original range capacity left even after driving more than 100,000 miles—a testament to battery durability.[122] While HDVs operate under different duty cycles and applications, there is good reason to believe advances in LDV battery technologies and durabilities will extend into other vehicle classes. CATL—recently announced a new "condensed" battery with 500 Wh/kg. CATL expects to start mass production of the model in 2023,[123] and such an increase in battery capacity will benefit HDEVs in an outsized way. Bloomberg recently reported that the average range for a U.S. EV in the U.S. has quadrupled since 2011. In 2022, it stood at 291 miles and today is a third higher than the global average.[124] Policies such as EPA's emissions standards are critical to helping maintain the U.S.'s position as a global leader.

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 major EV centers like heavy-duty vehicle depots or co-locate other necessary amenities.

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

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[121] *Id.* at Page 12
[122] "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
[123] "World's largest battery maker announces major breakthrough in energy density," TheDriven, (April 21, 2023) https://thedriven.io/2023/04/21/worlds-largest-battery-maker-announces-major-breakthrough-in-battery-density
[124] "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

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.

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.

Robust EPA emission 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 electricity providers from increased EV deployment

In 2021, the U.S. fleet of electric vehicles used 6.1 terawatt hours (TWhs) of electricity to travel 19.1 billion miles.[125] That accounted for just 0.15% of the total national energy generation that year.[126] In 2022, the United States produced 4,243 TWhs of electricity.[127] 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.[128] 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,

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[125] "Assessment of Light-Duty Plug-in Electric Vehicles in the United States, 2010–2021," Argonne National Lab, November 2022 https://publications.anl.gov/anlpubs/2022/11/178584.pdf
[126] "Monthly Energy Review May 2023," EIA, https://www.eia.gov/totalenergy/data/monthly/pdf/sec7_3.pdf
[127] *Id.*
[128] "How much electricity would it take to power all cars if they were electric?," USAFacts, (May 15, 2023) accessed June 13, 2023
https://usafacts.org/articles/how-much-electricity-would-it-take-to-power-all-cars-if-they-were-electric/

electricity generated from renewable sources surpassed coal for the first time in U.S. history.[129] 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 utility-scale electricity generation going forward.[130,131] Already, available renewable energy resources in the U.S. are estimated to amount to more than 100 times the nation's current electricity needs.[132]

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.[133] 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.

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[129] "U.S. renewable electricity surpassed coal in 2022," Associated Press, (March 28, 2023), accessed June 4, 2023 https://apnews.com/article/renewable-energy-coal-nuclear-climate-change-dd4a0b168fe057f430e37398615155a0

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

[131] "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

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

[133] "Yes, the grid can handle EV charging, even when demand spikes," Yale Climate Connections, (March 23, 2023) accessed June 4, 2023 https://yaleclimateconnections.org/2023/03/yes-the-grid-can-handle-ev-charging-even-when-demand-spikes/

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.

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.

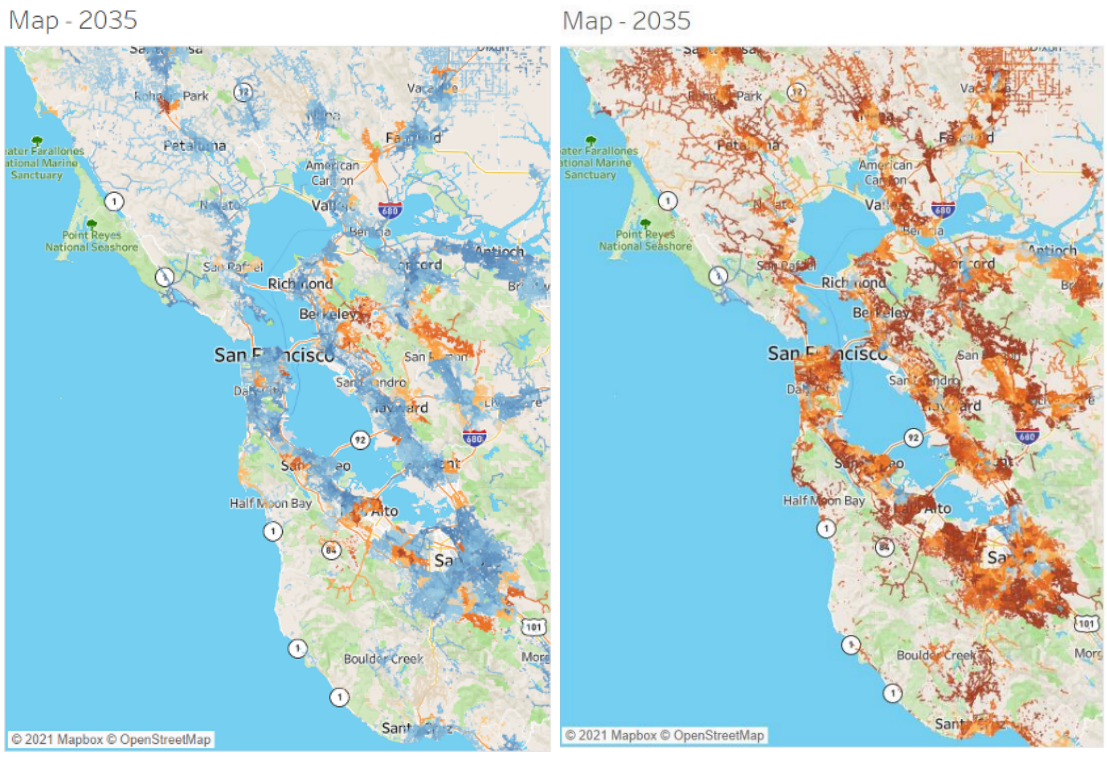
Lacking a long-term geospatial forecasting methodology, PG&E was primarily dependent on customer requests for service to inform where EV load would materialize. This reliance on customer requests led PG&E to reactively develop capacity solutions to serve load requests. Given the long lead times often 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.



2020 CEC IEPR Mid (2035) CARB MSS (2035)

Figure 7. 2035 Load scenarios in the San Francisco Bay Area based on different EV adoption forecasts.

In figure 7 above, the difference in magnitude of localized EV load in the year 2035 can be seen in a relatively low EV adoption scenario (2020 California Energy Commission (CEC) Integrated Energy Policy Report (IEPR Mid)) and a higher policy-based scenario based on the California Air Resources Board (CARB) Multiple Source Strategy (MSS) forecast. Grid planners can use this tool to investigate and solve for circuit level impacts of EV load growth.

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.

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.[134] 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 2023.[135] 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.[136] 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

[134] "Modern renewables," IEA, accessed June 4, 2023 https://www.iea.org/reports/sdg7-data-and-projections/modern-renewables
[135] "Vistra Announces Expansion of World's Largest Battery Energy Storage Facility," Vistra, accessed June 4, 2023 https://investor.vistracorp.com/2022-01-24-Vistra-Announces-Expansion-of-Worlds-Largest-Battery-Energy-Storage-Facility
[136] "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

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.[137] 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 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: Preparing the Grid for EV Adoption

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.

[137] "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

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 a new forecasting approach for Medium-Duty / Heavy Duty (MDHD) vehicles 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 new forecasting methodology leverages MDHD fleet industry data to more accurately predict MDHD electrification adoption and corresponding grid needs
    - 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 new or expanded 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."[138]

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.

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[138] "Con Edison Supports Effort to Encourage Electric Vehicle Adoption," Con Edison Media Relations, (April 12, 2023) accessed June 5, 2023 https://www.coned.com/en/about-us/media-center/news/2023/04-12/con-edison-supports-effort-to-encourage-electric-vehicle-adoption

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:

- 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 heavy-duty 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 and climate 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.[139] 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.[140] 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.[141] Also in May 2023, the U.S. Department of Energy proposed a rule on designating National Interest Electric Transmission Corridors.[142] There will also be a role for

[139] "US approves $3bn Wyoming-Nevada power line," (April 12, 2023) accessed May 15, 2023 https://www.power-technology.com/news/us-approves-3bn-wyoming-nevada-power-line/#:~:text=The%20US%20BLM%20has%20given,blustery%20Wyoming%20through%20to%20Nevada.&text=US%20officials%20on%20Tuesday%20gave,running%20from%20Wyoming%20to%20Nevada

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

[141] "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/

[142] 88 FR 30956

Congress to play in improving transmission permitting times and this is a policy area where some bipartisan support exists.

d. HDEV Charging Infrastructure

A commonly cited barrier to HDEV adoption is the lack of available charging infrastructure. It is important to note that charging needs for fleet-owned HDEVs can be much different than consumer-owned LMDEVs. HDEVs tend to have higher capacity batteries requiring faster charging rates or longer charge times, or a combination of both. While most electric HD fleet vehicles have shorter, scheduled routes and can rely primarily on depot charging overnight, some fleets may require on-route charging to supplement longer trips. While a public HDEV charging network is still in the early stages of deployment, electric vehicle supply equipment (EVSE) manufacturers and operators are already investing the necessary resources to ensure multiple methods of charging are available and reliable for the 2027-2032 model years affected by these emissions standards.

75% of fleet owners surveyed cite concerns about the cost of installing HDEV-specific charging as one of the greatest barriers to adoption.[143] Indeed, an ultra-fast charger capable of 350kW can cost up to $140,000.[144] However, the amount of power needed is not the same across all classes of vehicles and smart charging software can optimize power distribution among vehicles according to their charging capabilities and needs. To ensure upfront capital is spent on the appropriate equipment, installation projects will benefit from a customized analysis of a fleet's charging needs based on fleet size and type, average VMT, duty cycles, and time of charging. While the investment in charging infrastructure will be returned via lower lifetime operating costs associated with EV ownership, the upfront investment presents a real but surmountable barrier.

As discussed previously, the need for increased HDEV charging also creates significant economic opportunities. The charging infrastructure necessary to accommodate the transition to an electrified HD fleet has the potential to create more than 29,000 jobs.[145] Considering the Bipartisan Infrastructure Law's Buy America Build America requirements for light-duty charging infrastructure under the NEVI Formula Program[146] and CFI Discretionary Grant

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[143] *Id.* at Page 10
[144] Michael Nicholas, "Estimating Electric Vehicle Charging Infrastructure Costs across Major U.S. Metropolitan Areas," The International Council on Clean Transportation (August 2019) https://theicct.org/sites/default/files/publications/ICCT_EV_Charging_Cost_20190813.pdf
[145] The Commanding Heights of Global Transportation - Quantifying the Employment Effects (March 2021) https://safe2020.wpenginepowered.com/wp-content/uploads/2021/03/The-Commanding-Heights-Of-Global-Transportation-Quantifying-The-Employment-Effects.pdf
[146] National Electric Vehicle Infrastructure Formula Program, US Department of Transportation, accessed May 12, 2023. https://www.fhwa.dot.gov/bipartisan-infrastructure-law/nevi_formula_program.cfm

Program,[147] it is reasonable to expect that many of the high-quality jobs in HD EVSE manufacturing will be domestic as manufacturers build increasingly robust domestic supply chains.

While the buildout of HDEV charging infrastructure is still in the nascent stages, so too is HDEV deployment. It is also important to remember that just as HDEV deployment will not occur all at once, neither will HD EVSE deployment. Initial strategic buildout of depot-based charging in high-priority areas will help ensure EVSE manufacturing capacity can scale while continuing to support a more rapid HDEV transition. This is already under way at certain locations[148, 149] and HD EVSE product offerings are increasing rapidly.[150,151,152]

i. EVSE operator statements on EPA emissions standards

As discussed previously, EPA's proposed rule setting GHG emissions standards for heavy-duty vehicles provides much needed certainty throughout the supply chain, including EVSE manufacturers and operators. A clearer picture of future EVSE demand enables manufacturers and operators to plan and allocate capital accordingly. The statements mentioned below by ZETA's EVSE manufacturers and operators in response to EPA's announcement of these standards indicate as much:

- **"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."[153]

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[147] Charging and Fueling Infrastructure Discretionary Grant Program, US Department of Transportation, accessed May 12, 2023. https://www.fhwa.dot.gov/environment/cfi/

[148] "Electric Island: First US Charging Station for Electric Semis is Ready for Megawatt Fast-Charging," Green Car Reports, (April 22, 2021) accessed May 24, 2023 https://www.greencarreports.com/news/1132019_first-charging-station-electric-semis-megawatt-fast-charging

[149] "WattEV breaks ground on nation's first electric truck stop charging station in Bakersfield," KGET.com, (December 17, 2023) accessed May 24, 2023 https://www.kget.com/news/business/wattev-breaks-ground-on-nations-first-electric-truck-stop-charging-station-in-bakersfield/

[150] "Siemens Unveils Fast and Flexible Charging Solution for Electric Buses, Trucks, and Heavy-Duty Vehicles at ACT Expo," Siemens e-Mobility, (August 31, 2021) accessed June 8, 2023 https://www.siemens.com/us/en/company/press/press-releases/smart-infrastructure/siemens-launches-sicharge-uc-in-the-united-states.html

[151] "ChargePoint Express Plus," Chargepoint, accessed June 8, 2023 https://www.chargepoint.com/fleet/stations/express-plus

[152] "EVgo Fleet Charging Solutions," EVgo, accessed June 8, 2023 https://www.evgo.com/charging-solutions/evgo-fleet-solutions/

[153] EVgo on LinkedIn, accessed May 10, 2023 https://www.linkedin.com/posts/evgo_biden-administration-proposes-toughest-auto-activity-7054487813681025024-gCc0/?utm_source=share&utm_medium=member_android

- "**ChargePoint** is pleased to see USEPA's tailpipe emission proposal, which will shift the electric mobility revolution into high gear. These rules will undoubtedly lead to more investment in heavy-duty EVs. We are actively building a national network of charging infrastructure to support the increased adoption of EVs, including heavy-duty vehicles, and deploying the hardware and software needed to effectively support heavy-duty vehicle charging in depots. 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."[154]

ii. Depot-based applications will satisfy the majority of HDEV charging needs

As studied by the International Council on Clean Transportation, the majority of class 4-8 HDEV charging will occur at depots, with the exception of single unit long-haul trucks.[155] Depot charging is ideal for minimizing cost and maximizing battery health, whereas on-route charging prioritizes convenience.

Depot charging stations are structures where charging infrastructure is co-located with off-duty HDEV storage facilities. Often located at warehouses, logistic hubs, or public stations in industrial areas, fleet owners and operators typically own the charging infrastructure and can use it for overnight charging of vehicles.[156] Deploying this method saves fleet operators money: they install the chargers at a pre-existing facility, charge their vehicles during scheduled downtime (which means they do not have to stop during typical hours spent on the road), and pay less for the electricity that they use (per-mile public charging rates are often higher).[157]

Given its centralized nature, depot charging is also well-suited for electricity load management. Depots can allow for easier coordination with grid operators to distribute charging activity to off-peak load times and facilitate tracking up-time fleet charging metrics. In an analysis conducted by Atlas Public Policy, more than 98% of cost-competitive scenarios for HDEV fleets included depot charging.[158]

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[154] Chargepoint on LinkedIn, accessed June 14, 2023 https://www.linkedin.com/posts/chargepoint_epa-proposes-ground-breaking-new-vehicle-activity-7074468492602667008-0G5F/

[155] Near-Term Infrastructure Deployment to Support Zero-Emission Medium- and Heavy-Duty Vehicles in the United States, International Council on Clean Transportation, (May 2023) https://theicct.org/wp-content/uploads/2023/05/infrastructure-deployment-mhdv-may23.pdf

[156] Alana Aamodt, Karlynn Cory, & Kamyria Coney, "Electrifying Transit: A Guidebook for Implementing Battery Electric Buses," National Renewable Energy Laboratory (April 2021) https://www.nrel.gov/docs/fy21osti/76932.pdf

[157] Charles Satterfield and Nick Nigro, "Assessing Financial Barriers to Adoption of Electric Trucks," Atlas Public Policy (February 2020) http://atlaspolicy.com/wp-content/uploads/2020/02/Assessing-Financial-Barriers-to-Adoption-of-Electric-Trucks.pdf

[158] *Id.*

Companies may also look into bulk charging negotiations through purchase agreements. Fleets that traditionally run short-haul delivery operations may be attuned to applied charging strategies to flatten the load profile and save money through off-peak charging incentives. Further opportunities for cost-savings may overlap with retail energy designs and could align charging with cheaper renewable energy sources.[159]

iii. Ensuring strategic HD EVSE buildout

While depot charging will be suitable for most HDEV applications, a national highway freight network (NHFN) will be necessary to ensure adequate charging access for long-haul trucking applications. A typical highway site will eventually need more than 20 fast-chargers to serve expected traffic.[160]

Setting targets for charging station deployment along key NHFN corridors can accommodate up to 85% of long-haul charging needs by 2030.[161] As discussed in ICCT's May 2023 white paper on MHDV infrastructure deployment, 844 charging stations will be needed along the Federal Highway Administration's Alternative Fuel Corridors to accommodate 50-mile spacing intervals between chargers along the entire length of the NHFN.[162]

Under federal regulations, the number of hours drivers can travel per day is limited, with drivers required to take a 30-minute break within an eight-hour driving period and restricting drivers to a limit of 11 hours of driving per day, after which they are required a 10-hour rest break.[163] During these mandatory rest times, drivers may be able to charge at individual stations or charging depots.

Work is already underway to install HD EVSE at high-traffic freight locations,[164,165] and NREL is working to electrify four key freight corridors across the United States:[166]

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[159] Brennan Borlaug, et al. "Heavy-duty truck electrification and the impacts of depot charging on electricity distribution systems," Natural Energy (June 21, 2021) https://doi.org/10.1038/s41560-021-00855-0
[160] "Electric Highways: Accelerating and Optimizing Fast-Charging Deployment for Carbon-Free Transportation," National Grid, (November 2022) https://www.nationalgrid.com/document/148616/download
[161] *Id.* at Page 45
[162] *Id.* at Page 45
[163] *Id.* at Page 8
[164] California installs first battery charger for heavy trucks, (March 28, 2023), accessed May 12, 2023 https://www.ccjdigital.com/alternative-power/battery-electric/article/15380695/california-installs-first-battery-charger-for-heavy-trucks
[165] "EV Charging Hub in Riverside Will Power 40 Sysco Trucks," The Press Enterprise, (April 20, 2023) accessed May 17, 2023 https://www.pressenterprise.com/2023/04/20/sysco-building-a-massive-ev-charging-hub-for-its-fleet-trucks-in-riverside/
[166] NREL Tapped To Help Electrify 4 Major Freight Corridors, (April 18, 2023), accessed May 12, 2023 https://www.nrel.gov/news/program/2023/nrel-tapped-to-help-electrify-4-major-freight-corridors.html

- In collaboration with CALSTART, NREL researchers will launch an intensive planning effort to develop infrastructure deployment plans for zero-emission medium- and heavy-duty vehicles along the I-95 freight corridor, which stretches from Savannah, Georgia, to Newark, New Jersey.
- Led by a Cummins Inc. team, NREL researchers will help develop extensive plans for battery-electric charging and hydrogen fueling stations along the stretch of I-80 that crosses Illinois, Indiana, and Ohio.
- In collaboration with a Utah State University team, NREL researchers will assist in developing a community-, state-, and industry-supported action plan for corridor electrification along Utah's Wasatch Front.
- Led by a National Grid team, NREL researchers will help create a detailed model of truck operations along New England's freight corridors and then use that data to simulate future electric truck operations, ideal charging locations, and the amount of energy those charging stations will use. The project will examine freight corridors in Maine, Massachusetts, New Hampshire, Vermont, Rhode Island, Connecticut, New York, Pennsylvania, and New Jersey, with a goal of informing a blueprint for future commercial EV charging.

Despite both the public and private sector investments to build out HDEV charging capacity, more support will be needed in the coming years to ensure the expected growth of HDEVs is complemented with adequate charging infrastructure. Policies such as EPA's proposed GHG emissions standards for heavy-duty vehicles provide the regulatory certainty needed to support those investments by creating more clarity on expected HD EVSE demand. The lead time provided by the standards' MY 2027-2032 time frame also aids in ensuring HDEV charging infrastructure manufacturers and operators can make the investments necessary today to meet anticipated charging needs of tomorrow.

e. HDEV Manufacturing and New Model Availability

The increase in electric vehicle manufacturing spurred by more stringent Phase 3 GHG emission standards will drive down the upfront cost of production through economies of scale. This shift will drive demand for production of component parts, chargers, and battery packs. The increased demand will drive down the cost of EVSE and batteries necessary for long-haul electrification, will boost EV growth in other vehicle segments, and will inform electrification strategies for other vehicle classes.

Among trucks, the shorter-haul vehicle segment is currently more cost-competitive to electrify than long-haul trucking—although technological improvements are accelerating the timeline for the latter. At present, transit buses, delivery vans, and school buses are well suited to electrification: they travel shorter distances, regular routes, and benefit from return-to-base

operations ideal for depot charging. Increasing the proportion of EVs in this vehicle segment will demonstrate the viability of this technology, increasing consumer confidence and paving the road for larger scale electrification.

With a growing number of fleet operators intending to decarbonize their fleets, HDV OEMs have begun ramping up their electric model production. HDEV sales have begun to rise rapidly in recent years, largely driven by a growth in available models, in addition to the growing policy support, improving technology, and cost-savings of electric trucks. More than 300 commercial EV models are available globally and this number is expected to double in the coming years.[167]

Major HDV manufacturers have made commitments to increase their zero-emission vehicle offerings. Company commitments range from 50%–67% of MHDV sales by 2030 to 100% of sales by 2040.[168]

- Paccar, which comprises 30% of U.S. HDV market share, has committed to be 100% zero-emission by 2040.[169]
- In 2020, Volvo committed to 35% ZEVs by 2030 and to be 100% net-zero emissions by 2040.[170] Volvo has a market share of more than 10% of heavy-duty trucks in North America.[171]
- In 2021, Daimler announced their goal for 60% ZEV sales by 2030. Today, they sell over 500,000 trucks and buses per year with a 40% market share in North America.[172]
- Navistar set their ambitions on a goal for 50% ZEV sales by 2030 and 100% by 2040.[173] They comprise 40% of school buses on the roads of North America and more than 12% of Class 8 trucks.
- Swedish-based Scania committed to make 30% of global sales ZEVs by 2030 and 90% by 2040.[174]

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[167] "Zero-Emission Technology Inventory," Global Commercial Vehicle Drive To Zero, CALSTART, 2021, https://globaldrivetozero.org/tools/zero-emission-technologyinventory/
[168] *Id.* at Page 5
[169] *Id.* at Page 51
[170] Letter from Volvo Group North America to David S Kim dated May 21, 2021 https://calsta.ca.gov/-/media/calsta-media/documents/volvo-group-2021-05-21-comments-capti-final.pdf
[171] "Record year for Volvo Trucks in 2022 – all-time high volumes and market share increase in 41 countries," Volvo Trucks, (February 6, 2023) accessed June 5, 2023 https://www.volvotrucks.com/en-en/news-stories/press-releases/2023/feb/record-year-for-volvo-trucks-in-2022.html#:~:text=The%20global%20truck%20manufacturer%20delivered,when%20122%2C525%20trucks%20were%20delivered
[172] "Daimler Truck sets out ambitions as an independent company," PR Newswire, (May 20, 2021) accessed June 5, 2023 https://www.prnewswire.com/news-releases/daimler-truck-sets-out-ambitions-as-an-independent-company-301295906.html
[173] Navistar, accessed June 5, 2023 https://www.navistar.com/en/sustainability/our-commitments
[174] "Scania's commitment to electrification – our initiatives so far," Scania, (December 21, 2021) accessed June 5, 2023 https://www.scania.com/group/en/home/newsroom/news/2021/Scanias_commitment_to_electrification_our_initiatives_so_far.html

In addition to the conventional HD manufacturers, there is an ever-growing list of EV manufacturers in North America committed to increasing model availability, including:

- Arrival
- BYD
- GreenPower Motor Company
- Lightning eMotors
- Lion Electric Company
- Nikola Corporation
- Proterra
- SEA Electric
- TransPower
- Volta Trucks
- Workhorse

In North America, there are 97 heavy-duty models available today, up from 75 in 2021.[175] The models span vehicle types including HD tractors, transit, coaches, school buses, and more. HD trucks alone have 27 available models in 2023, making them one of the fastest growing segments. See Appendix Figure A.3 for a list of the available HD models in North America for model years 2021-2023.

Transit buses have seen the greatest growth in EV adoption as a result of policy incentives and strong economics. These examples of early adoption can assist with building up economies of scale to drive down costs and build out supply chains in the U.S. In addition, exposing consumers to these vehicles increases overall trust and familiarity with the new, electric drivetrains.[176]

Today, there are fourteen heavy-duty Class 7 and 8 electric trucks and an additional eight electric heavy-duty yard tractors on the market in the U.S. Buses have seen some of the greatest model availability, with eighteen electric school bus models available for sale in the U.S. These numbers are comparable to diesel truck models, with the vast majority being sold by three major manufacturers (Daimler, Paccar, and Navistar).[177]

From 2021 to the end of 2022, electric HD truck model availability grew 88%—from 57 models to 107. This does not include electric transit buses, which had 285 available models at the close

[175] "Zero-Emission Technology Inventory (ZETI) Data Explorer," Global Commercial Drive to Zero, accessed June 5, 2023 https://globaldrivetozero.org/tools/zeti-data-explorer/
[176] *Id.* at Page 14
[177] "ATD Truck Beat: Commercial Truck Sales Increase 3.8% in 2022 over 2021," National Automobile Dealers Association, accessed June 5, 2023 https://www.nada.org/atd/research/truck-beat

of 2022.[178] Out of all the vehicle segments, heavy-duty trucks have seen the greatest growth in model availability every year, shown in Figure 8.

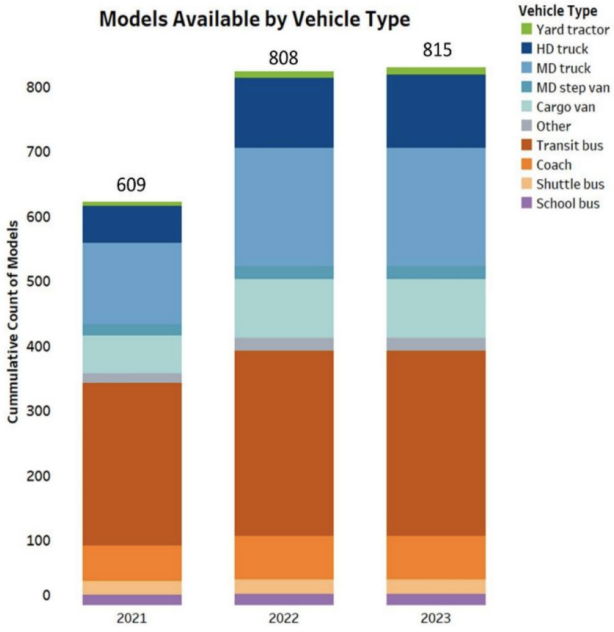

Figure 8. Global model availability growth from 2021-2023.[179]

Even without robust incentives and regulatory certainty, OEMs have dramatically scaled their HDEV offerings. With more stringent emissions standards, incentives from the Bipartisan Infrastructure Law and the Inflation Reduction Act, and acceleration of corporate sustainability commitments, the stock of EV models should be reasonably expected to grow substantially over the next few years before Phase 3 GHG standards take effect.

i. ZETA members' HDEV manufacturing announcements

The Inflation Reduction Act helps bolster HDEV supply and demand. Production tax credits for the construction of vehicles and charging infrastructure are coupled with funding to build new facilities or retool existing locations into EV manufacturing plants. This includes $60 million to reduce diesel emissions, $2 billion in grants to upgrade facilities, and $20 billion for the construction of new EV manufacturing facilities. These funds spur new manufacturing and build market confidence.

[178] "Zero-Emission Truck and Bus Market Update," CALSTART; Global Commercial Drive to Zero, accessed June 5, 2023 https://globaldrivetozero.org/site/wp-content/uploads/2022/10/ZE_TruckBus_update.pdf
[179] *Id.* at Page 52

ZETA member Proterra announced a new $76 million battery facility in South Carolina near its existing Greenville bus facility capable of producing 400 buses annually.[180] Lion Electric, a ZETA member and manufacturer of medium and heavy-duty EVs, has factories in Illinois and Quebec with production capacity expected to reach 22,500 electric trucks and buses per year.[181] Arrival is planning to build several U.S. based "microfactories," with the first being a $46 million investment in South Carolina.[182] Their second facility will be a $41 million investment near Charlotte, North Carolina.[183] GreenPower's bus manufacturing plant is expected to have an economic impact of $500 million per year for the state of West Virginia.[184] Finally, Tesla plans to build a $3.5 billion semi-truck manufacturing facility in Nevada, its second plant in the state.[185]

ZETA member companies like Arrival, SEA Electric, GreenPower Motor Company, Lion Electric, Proterra, and Tesla are all working to manufacture sufficient HDEVs to meet demand. These companies are capable of producing tens of thousands of HDEVs annually. These production capacities are proven in part by these companies' investments in new manufacturing plants like Tesla's Gigafactory in Texas, Rivian's plant in Georgia, Lion Electric's plant in Illinois, Proterra's heavy-duty battery manufacturing facility in South Carolina, and GreenPower Motor Company's plant in West Virginia.

7. Conclusion

The EV supply chain is making investments today that will lead us to a decarbonized and zero-emission transportation system. Electrification offers a litany of benefits, from improving public health and reducing carbon emissions to creating jobs and preserving American economic competitiveness. Emissions standards like these are critical to ensuring the supply chain has the regulatory certainty needed to put the sector on a glide path to a zero-emission future.

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[180] "Proterra Announces EV Battery Factory in South Carolina as Demand for Commercial Electric Vehicles Grows," Proterra, (December 14, 2021) https://www.proterra.com/press-release/proterra-sc-battery-factory/
[181] "Lion Electric Inaugurates Its Battery Manufacturing Factory for Medium and Heavy-Duty Vehicles" PR Newswire, (April 17, 2023) accessed June 5, 2023 https://www.prnewswire.com/news-releases/lion-electric-inaugurates-its-battery-manufacturing-factory-for-medium-and-heavy-duty-vehicles-301799083.html
[182] "Arrival to build its first U.S. electric vehicle Microfactory in York County, South Carolina," Arrival, (October 13, 2020) accessed June 5, 2023 https://arrival.com/news/arrival-to-build-its-first-us-electric-vehicle-microfactory-in-york-county-south-carolina
[183] "Arrival to open a second US microfactory to build electric vans for UPS," Arrival, (March 17, 2021) accessed June 5, 2023 https://techcrunch.com/2021/03/17/arrival-to-open-a-second-us-microfactory-to-build-electric-vans-for-ups/
[184] "GreenPower Motor Co. to begin manufacturing at South Charleston, West Virginia facility 'this quarter'," The State Journal, (January 16, 2023) accessed June 5, 2023 https://www.wvnews.com/statejournal/greenpower-motor-co-to-begin-manufacturing-at-south-charleston-west-virginia-facility-this-quarter/article_4c7f8440-92bb-11ed-a2c8-6bc5445cbe85.html
[185] "Tesla Will Build Heavy Trucks at a New Factory in Nevada," New York Times, (January 24, 2023) accessed June 5, 2023 https://www.nytimes.com/2023/01/24/business/tesla-truck-factory-nevada.html

We again thank EPA for the opportunity to comment on its notice of proposed rulemaking to set Phase 3 GHG emission standards for model year 2027-2032 heavy-duty vehicles. We encourage EPA to finalize standards that are more stringent than proposed and are consistent with the targets in California's ACT regulation. We also urge the agency to finalize these standards before the end of calendar year 2023 to ensure they take effect as early as permitted under the Clean Air Act.

Thank you again for your consideration.

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

Figure A.3: List of Full Battery Electric HD Models on the road today among vocational chassis, street sweepers, refuse, tractor, transit and school buses.[186]

Manufacturer	Model	Category
Autocar	ACTT Terminal Tractor	Tractor
Battle Motors	LET2	Vocational/Cab Chassis
Battle Motors	LNT	Vocational/Cab Chassis
Blue Bird	All American RE Electric	School Bus
Blue Bird	Micro Bird G5 Electric	School Bus
Blue Bird	Vision Electric	School Bus
BYD	6F	Vocational/Cab Chassis
BYD	6R	Refuse
BYD	8R	Refuse
BYD	8TT Day Cab	Tractor
BYD	8Y Terminal Tractor	Tractor
BYD	C10MS (45' double deck)	Transit Bus
BYD	C8MS (35' double deck)	Transit Bus
BYD	K11M (60')	Transit Bus
BYD	K7M (30')	Transit Bus
BYD	K7M ER (30')	Transit Bus
BYD	K8M (35')	Transit Bus
BYD	K9M (40')	Transit Bus
BYD	K9MD (40')	Transit Bus
BYD	Type D	School Bus
COBUS Industries	e.COBUS 2700	Transit Bus
COBUS Industries	e.COBUS 2700S	Transit Bus
COBUS Industries	e.COBUS 3000	Transit Bus

186 https://afdc.energy.gov/vehicles/search/results?view_mode=grid&search_field=vehicle&search_dir=desc&per_page=8&current=true&display_length=25&model_year=2023,2022,2021&fuel_id=41,-1&category_id=17,11,7,13,5,1,-1&manufacturer_id=67,205,117,394,415,201,113,5,408,9,13,11,81,57,416,141,197,417,121,53,397,418,85,414,17,21,143,23,398,27,399,31,207,396,107,193,35,115,147,199,-1

Collins Bus Corp.	Type A Electric School Bus (DE516)	School Bus
Collins Bus Corp.	Type A Electric School Bus (DE516WF)	School Bus
ENC	Axess-BEB 32' low floor	Transit Bus
ENC	Axess-BEB 35' low floor	Transit Bus
ENC	Axess-BEB 40' low floor	Transit Bus
Ford	E-450 Box Truck	Vocational/Cab Chassis
Ford	E450 Cutaway	Vocational/Cab Chassis
Ford	E-450 School Bus	School Bus
Ford	E450 Stripped Chassis	Vocational/Cab Chassis
Ford	E-450 Work Truck	Vocational/Cab Chassis
Ford	E-Transit Cutaway/Chassis Cab	Vocational/Cab Chassis
Ford	F-59 School Bus	School Bus
Ford	F-59 Stripped Chassis	Vocational/Cab Chassis
Ford	F-650 Box Truck	Vocational/Cab Chassis
Ford	Transit CC-CA 250, 350	Vocational/Cab Chassis
Freightliner	eCascadia	Tractor
Freightliner Custom Chassis	MT-50e	Vocational/Cab Chassis
Gillig	Low Floor Plus	Transit Bus
GreenPower Motor Company	BEAST	School Bus
GreenPower Motor Company	EV250	Transit Bus
GreenPower Motor Company	EV350	Transit Bus
GreenPower Motor Company	EV500/EV550	Transit Bus
GreenPower Motor Company	EV Star Cargo+	Vocational/Cab ChassisVan
GreenPower Motor Company	EV Star CC	Vocational/Cab Chassis
GreenPower Motor	Nano BEAST	School Bus

Company		
Hometown Manufacturing	Commuter	Transit BusPassenger Van/Shuttle Bus
Hometown Manufacturing	Low-Floor Urban	Transit Bus
Hometown Manufacturing	Mainstreet	Transit Bus
Hometown Manufacturing	Streetcar	Transit Bus
Hometown Manufacturing	View	Transit Bus
IC Bus	Electric CE Series	School Bus
Kalmar	Ottawa T2E+	Tractor
Kenworth	K270/K370	Vocational/Cab Chassis
Kenworth	T680E	Tractor
Lion Electric	LION6	Vocational/Cab Chassis
Lion Electric	LION8 - Class 8	Vocational/Cab Chassis
Lion Electric	LION8 Refuse ASL and REL - Class 8	Refuse
Lion Electric	LION8T - Class 8	Tractor
Lion Electric	LIONA	School Bus
Lion Electric	LIONC	School Bus
Lion Electric	LIOND	School Bus
Mack	LR	Refuse
MCI	D45 CRT CHARGE/LE CHARGE	Transit Bus
MCI	J4500 CHARGE	Transit Bus
New Flyer	Xcelsior CHARGE NG 35'	Transit Bus
New Flyer	Xcelsior CHARGE NG 40'	Transit Bus
New Flyer	Xcelsior CHARGE NG 60'	Transit Bus
Nova Bus	LFSe	Transit Bus
Nova Bus	LFSe+	Transit Bus
Orange EV	T Series terminal	Tractor
Peterbilt	220EV - Class 7	Vocational/Cab Chassis
Peterbilt	220EV - Class 6	Vocational/Cab Chassis

Peterbilt	520EV - Class 8	Refuse
Peterbilt	579EV - Class 8	Tractor
Proterra	ZX5+ 35-Foot Bus - Class 8	Transit Bus
Proterra	ZX5+ 40-Foot Bus	Transit Bus
Proterra	ZX5MAX 40-Foot Bus - Class 8	Transit Bus
Thomas Built	Saf-T-Liner C2 Jouley	School Bus
Van Hool	CX45E	Transit Bus
Workhorse	W4 CC	Vocational/Cab Chassis