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Technical Memo

To	Environmental Defence Fund
From	Ellen Robo, Dave Seamonds
Date	16 May 2022
Subject	Analysis of Alternative Medium- and Heavy-Duty Zero-Emission Vehicle Business-As-Usual Scenarios

ERM was retained by the Environmental Defense Fund (EDF) to perform an assessment of projected business-as-usual medium- and heavy-duty[1] (M/HD) zero emission vehicle (ZEV) sales and in-use vehicles within the US. This memo describes the analytical methodologies and data sources used to develop the baseline assessment as well as an overview of the results.

Summary

1) How fast ZEV sales grow will depend on state policies, federal funding programs, falling costs, and commitments to transition fleets to ZEVs. To understand the range of possible ZEV sales projections, ERM modeled five scenarios: Scenarios 1, 2a, 2b, 2c, and 3. Scenario 1 included only finalized state regulatory action and assumed no advancement in ZEV technology or price, while Scenario 3 assumed a higher number of states adopted the Advanced Clean Trucks (ACT) regulation and substantial technology improvements consistent with current predictions.

2) To estimate M/HD ZEV sales projections, this analysis combined sales driven by state regulatory measures, federal funding, and market growth. Under the five scenarios, **2029 M/HD ZEV sales span a wide range: 8.3 percent (Scenario 1) to 33.7 percent (Scenario 3).**

3) Zero-emission buses (ZEBs), including transit buses and school buses, are a large portion of the current and near-term M/HD ZEV population. This analysis found **2029 ZEB sales are projected to range between 10.4 percent (Scenario 1) and 36.3 percent (Scenario 3).**

Background

On March 28, 2022, the U.S. Environmental Protection Agency (EPA) proposed new heavy-duty engine and vehicle standards aimed at reducing greenhouse gas (GHG) and nitrogen oxide (NOx) emissions for new vehicles sold beginning with model year (MY) 2027.[2]

As part of EPA's announcement, the agency calculated a "baseline" trajectory which included a small level of zero-emission vehicle (ZEV) sales. Specifically, EPA "estimate[d] the overall percentage of heavy-duty electric vehicles in MY 2027…at approximately 1.5 percent."[3] To arrive at this estimate, EPA assumed 42 percent of M/HD ZEV sales would occur in California and then used the California Air

[1] The analysis includes M/HD vehicles greater than 14,001 lbs. gross vehicle weight (Class 4 to 8) but excludes long-haul combination trucks. See *ZEV Combination Trucks* for more information about why long-haul combination trucks were excluded. The appendix contains results for all Class 4-8 vehicles (including long-haul combination trucks).

[2] U.S. Environmental Protection Agency, Proposed Rule, "Control of Air Pollution From New Motor Vehicles: Heavy-Duty Engine and Vehicle Standards," Federal Register 87, no. 59 (March 28, 2022): 17414-17888, https://www.govinfo.gov/content/pkg/FR-2022-03-28/pdf/2022-04934.pdf.

[33] EPA, "Heavy-Duty Engine and Vehicle Standards," 17600.

Resources Board's estimate of ZEV sales due to the ACT to calculate overall M/HD ZEV sales for the nation..[4]

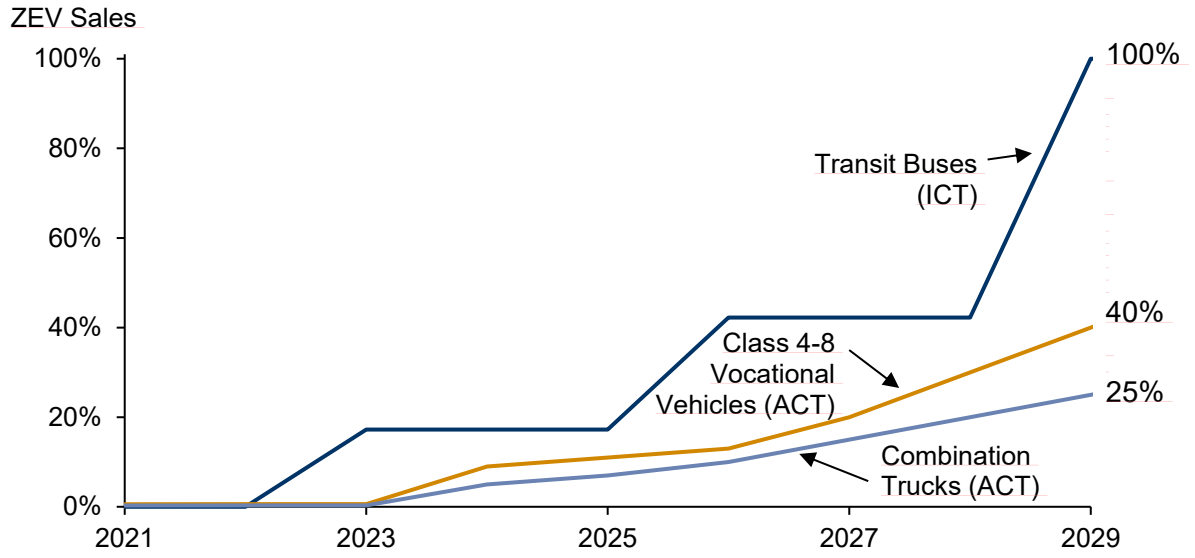
Contributing Factors for ZEV Adoption

The ZEV baseline adoption levels projected by the EPA fail to consider many factors that will significantly increase ZEV sales, including state regulatory action, federal funding, fleet commitments, and cost parity between internal combustion engine (ICE) vehicles and ZEVs. This analysis explicitly calculated the impact of additional state regulatory actions, the Infrastructure Investment and Jobs Act, and general market growth which broadly encompasses fleet commitment and ZEV-ICE cost parity impacts on M/HD ZEV sales. Including these factors resulted in substantially higher baseline M/HD ZEV adoption projections than EPA's assessment.

State Regulatory Action

Many states in the US have taken regulatory action to increase ZEV adoption, but EPA only considered California's adoption of the Advanced Clean Trucks (ACT) regulation in their baseline ZEV projection for setting new GHG emission standards. The ACT, which California passed in 2020, requires manufacturers to sell increasing shares of M/HD ZEVs starting with MY2024. The exact percentage required differs by vehicle types. See Figure 1 for more specifics around the required sales percentages.

Figure 1. Advanced Clean Trucks manufacturer's ZEV sales requirements and California Innovative Clean Transit purchasing requirement



Note: "Class 4-8 Vocational Vehicles" does not include transit buses. ICT distinguishes between "large" (≥100 vehicles) and "small" (<100 vehicles) agencies in the regulation. Small agencies are still required to purchase 100 percent ZEV buses in 2029 but the earlier purchasing mandates are delayed later compared to large agencies. This analysis assumes 31 percent of transit agencies in California are "small." This is based on the data from the National Transit Database.[5]

[4] Ibid.

[5] Federal Transit Administration, National Transit Database, "2020 Vehicles," https://www.transit.dot.gov/ntd/data-product/2020-vehicles

Outside the states that have already adopted the ACT, additional states have ongoing ACT proceedings or are evaluating the impacts of the regulation in their state. These states include Colorado, Connecticut, Rhode Island, District of Columbia, Maryland, Pennsylvania, and Vermont.[6]

Along with the ACT, California has also adopted the Innovative Clean Transit (ICT) regulation which requires all new transit bus purchases to be ZEV by 2029[7] and the Zero-Emission Airport Shuttle Regulation which requires a third of airport shuttle fleets to be ZEV by 2027 and 100 percent by 2035.[8]

EPA's analysis does not consider the other five states that have already adopted the ACT: Massachusetts, New Jersey, New York, Oregon, and Washington. Collectively, the six states that have currently adopted the ACT account for 19 percent of in-use Class 4-8 vehicles in the US.

The California Air Resources Board is also currently drafting the Advanced Clean Fleets (ACF) regulation which includes ZEV in-use requirements for large fleet owners in California as well as sets the manufacturers ZEV sales requirement to 100 percent in 2040 within California.[9] Due to the fleet requirements in the ACF, M/HD ZEV sales in 2029 would be 71 percent higher in California compared to ZEV sales from the ACT alone.

Further, seventeen states as well as the District of Columbia have signed the Multi-State Medium- and Heavy-Duty Zero Emission Vehicle Memorandum of Understanding (MOU). The MOU's goal is to reach 30 percent ZEV truck sales by 2030 and 100 percent by 2050.[10] These states account for 32 percent of the Class 4-8 vehicles in the US. While not all these states have indicated they plan to adopt the ACT, they have signed onto the MOU demonstrating their desire to increase the share of M/HD ZEVs in their respective states.

Federal Funding

Actions at the Federal level, such as the Infrastructure Investment and Jobs Act (IIJA), will influence M/HD ZEV sales by providing significant levels of funding which can be used for vehicle purchases or charging infrastructure development. IIJA can provide direct incentives to vehicle owners or fleets, helping to offset the incremental cost of ZEVs in exchange for retiring their older trucks. The funding will be distributed over five years beginning with the 2022 fiscal year and continuing through 2026.[11] This analysis quantifies the impact of direct IIJA funded M/HD ZEV purchases, but, for reasons discussed in more detail below, this analysis does not consider the impact of infrastructure funding on M/HD ZEV sales.

IIJA funding programs related to vehicles and infrastructure can be broken down into two categories: 1) formula grants and 2) competitive grants. The former provides a calculated funding amount to individual states based on an apportionment formula, while the latter includes programs at the Federal level which applicants, regardless of state, apply to for grant funding. Although formula programs, such as the

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[6] Adam Hsu, "California Leads, States Follow on Zero-Emission Rule for MD, HD Trucks." *ACT News.* February 8, 2022. https://www.act-news.com/news/california-leads-states-follow-on-zero-emission-rules-for-md-hd-trucks/.

[7] "Innovative Clean Transit (ICT) Regulation Fact Sheet," *California Air Resources Board,* (April 2019), https://ww2.arb.ca.gov/sites/default/files/2019-07/ICTreg_factsheet.pdf.

[8] "Zero-Emission Airport Shuttle Regulation Factsheet," *California Air Resources Board* (October 2019), https://ww2.arb.ca.gov/sites/default/files/2019-10/asb_reg_factsheet.pdf.

[9] "Advanced Clean Fleets." *California Air Resources Board.* https://ww2.arb.ca.gov/our-work/programs/advanced-clean-fleets

[10] The states that have signed the M/HD ZEV MOU: California, Colorado, Connecticut, Hawaii, Maine, Maryland, Massachusetts, Nevada, New Jersey, New York, North Carolina, Oregon, Pennsylvania, Rhode Island, Vermont, Virginia, and Washington. "Multi-State Medium- and Heavy-Duty Zero Emission Vehicle Memorandum of Understanding." March 29, 2022. https://www.nescaum.org/documents/mhdv-zev-mou-20220329.pdf/.

[11] 117th US Congress., Public Law 117-58, "Infrastructure Investment and Jobs Act," November 15, 2021, https://www.congress.gov/bill/117th-congress/house-bill/3684/text.

Congestion Mitigation and Air Quality Improvement program (CMAQ) have set amounts allocated to individual states, each state will conduct their own competitive grant announcement and provide funds on the quality of the proposals received.

As mentioned, the IIJA can provide funding to purchase ZEVs, but it can also fund the purchase and installation of electric vehicle charging infrastructure, helping to increase the density of chargers available to EV owners. Charging infrastructure availability may also lead to additional ZEV sales due to reduced range anxiety and driving freedom; however, the impact of this relationship has not been included as part of this analysis. Since the majority of buses, single-unit trucks, and short-haul combination trucks are assumed to charge while domiciled overnight, the impact of access to EV charging infrastructure is assumed to be lower than for vehicles reliant on public charging infrastructure such as long-haul combination trucks.

In addition to IIJA, federal programs such as EPA's Diesel Emissions Reduction Act (DERA) national competitive grants or their DERA School Bus Rebate program (SBR) can offer additional opportunities for M/HD vehicle owners to offset the purchase of low- or zero-emission vehicles using federal grant funds. Although these beneficial programs could contribute to additional purchases of ZEVs, DERA and SBR have not been included in this analysis.

Fleet Commitments

Both private companies and local governments have made commitments to transition a portion or all of their fleet to ZEVs in the next couple decades. These commitments have the potential to increase overall ZEV adoption within the US. Many large vehicle fleets including Amazon, FedEx, UPS, DHL, Walmart, and PepsiCo have pledged to purchase ZEVs with some announcing long term goals of having 100 percent fleet electrification within the next decade.[12] Municipal governments including New York City, Chicago, and Houston have all announced commitments to transition to 100 percent ZEV purchases in the next decade. In December 2021, President Biden signed Executive Order 14057 entitled "Catalyzing Clean Energy Industries and Jobs Through Federal Sustainability" which sets a goal for the federal fleet of 100 percent ZEV acquisitions by 2035.[13] These commitments encourage vehicle manufacturers to develop more ZEV models and to continue investing in ZEV development.

See the Appendix for a table outlining currently announced fleet commitments.

ZEV-ICE Cost Parity

ZEV trucks are currently more expensive than their ICE counterparts, but most vehicle types are projected to be cost competitive with ICE vehicles within the next 5 to 10 years when considering total cost of ownership (TCO). TCO includes the initial purchase price as well as charging infrastructure, fuel, and vehicle and charger maintenance.. Many vehicle types well suited to electrification are projected to

[12] Andrew Hawkins. "Amazon will order 100,000 electric delivery vans from EV startup Rivian, Jeff Bezos says." *The Verge.* September 19, 2019. https://www.theverge.com/2019/9/19/20873947/amazon-electric-delivery-van-rivian-jeff-bezos-order;
Arunima Banerjee. "FedEx expands fleet to add 1,000 Chanje electric vans." *Reuters.* November 20, 2018. https://www.reuters.com/article/us-fedex-chanje-vans/fedex-expands-fleet-to-add-1000-chanje-electric-vans-idUSKCN1NP1C3;
Steve Hanley. "UPS Places Order For 950 Workhorse N-GEN Electric Delivery Vans." *CleanTechnica.* June 20, 2018. https://cleantechnica.com/2018/06/20/ups-places-order-for-950-workhorse-n-gen-electric-delivery-vans/#:~:text=UPS%20Places%20Order%20For%20950%20Workhorse%20N-GEN%20Electric,to%20UPS%2C%20bringing%20the%20total%20order%20to%201%2C000;
https://www.dhl.com/us-en/home/press/press-archive/2019/dhl-expands-green-fleet-with-addition-of-new-electric-delivery-vans.html;
Fred Lambert. "Tesla Semi receives order of 30 more electric trucks from Walmart." *Electrek.* September 6, 2018. https://electrek.co/2018/09/06/tesla-semi-new-order-electric-truck-walmart/;
https://www.pepsico.com/sustainability/focus-areas/climate

[13] Joseph Biden, Executive Order 14057, "Catalyzing Clean Energy Industries and Jobs Through Federal Sustainability," White House Briefing Room, December 8, 2021, https://www.whitehouse.gov/briefing-room/presidential-actions/2021/12/08/executive-order-on-catalyzing-clean-energy-industries-and-jobs-through-federal-sustainability/.

be cost competitive to ICE vehicles based on vehicle purchase price alone by MY2027.[14] Given the reduced fuel and vehicle maintenance costs, M/HDV owners may choose to switch to ZEVs without government funding or regulations requiring ZEV sales. If ZEVs become cheaper to operate than ICE vehicles, as is predicted, the market could see a rapid shift in purchasing habits towards ZEVs.

ERM's internal analysis found the average single-unit and combination truck will reach parity for TCO by MY2030. A report by NREL found some medium-duty trucks will reach parity for TCO as early as 2026 and all M/HD ZEVs will be at TCO parity by at least 2035.[15] Finally, a report by Roush Industries found most M/HDV categories will achieve TCO parity by 2027.[16] The exact timing of ZEV-ICE parity depends on several factors: how quickly battery prices fall, availability of vehicles and models, and changes in diesel, electricity, and hydrogen prices.

Analysis Methodology

ERM developed a M/HD vehicle adoption model focused on understanding the factors that drive ZEV sales during the 2022 to 2029 timeframe. The penetration model examined the change in vehicle populations of M/HDV types using current population estimates as well as annual assumptions around vehicle retirement, fleet growth, and ZEV vehicle sales. The model analyzed each state within the US individually before aggregating the results at the national level. This level of granularity allowed ERM to model state-specific changes to vehicle sales based on policy changes, but also combine these state results to determine the overall impact to the US as a whole. Further detail on the elements in the adoption model are provided in the following sections.

Vehicle Population and Lifetime Assumptions

Base populations for M/HDV types and their fleet growth rates within ERM's adoption model were taken from EPA's latest version of Motor Vehicle Emission Simulator 3 (MOVES3). MOVES3 assumes, by 2029, the population of single-unit trucks (SUT) will increase by 14.9 percent compared to 2022, while buses will increase by 8.7 percent and the combination truck population will increase by 0.8 percent.

Another element considered in the model was the annual retirement of vehicles when they reach the end of their useful life. ERM analyzed historical data (1970-2018) from Oak Ridge National Laboratory's Transportation Energy Data Book (TEDB)[17] on annual vehicle registration in the US. Based on TEDB registration data, M/HDVs were assumed to have a lifetime of approximately 21 years in this analysis. This means 4.7 percent of the vehicle population retired on an annual basis.

ZEV sales were layered on top of the population assumptions discussed above. Each year, M/HDVs were purchased – regardless of technology – replacing the vehicles that were retired or added due to vehicle population growth. ERM's adoption model assumes, depending on the scenario, that increasing levels of ZEV sales would take place, replacing sales of internal combustion engine (ICE) vehicles. As ICE vehicles retire and ZEV sales occur, the in-use population of ICE vehicles declined as the ZEV population

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[14] A Roush Industries study found many ZEVs would reach parity for the vehicle price (compared to diesel vehicles) starting in MY2027. Depending on the type of charging infrastructure M/HDV owners choose to buy for their ZEVs, the total upfront cost (vehicle price and charging infrastructure purchase and installation cost) could be higher than the upfront diesel vehicle cost. In almost all cases, the reduced fuel and maintenance costs more than make up for the charging infrastructure costs, even if high-speed chargers are installed, resulting in lower TCO.

Vishnu Nair et al., "Technical Review of: Medium and Heavy-Duty Electrification Costs MY 2027-2030" Roush Industries (February 2022). http://blogs.edf.org/climate411/files/2022/02/EDF-MDHD-Electrification-v1.6_20220209.pdf.

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

[16] Nair et al., "Medium and Heavy-Duty Electrification Costs MY 2027-2030".

[17] Stacy Davis and Robert Boundy, Transportation Energy Data Book Edition 39 (Oak Ridge National Laboratory, US Department of Energy, August 2021), Tables 4.3-4.7 and 5.1-5.3, https://tedb.ornl.gov/wp-content/uploads/2021/02/TEDB_Ed_39.pdf.

rose. Assumptions around fleet growth and the lifetime of a vehicle will impact how quickly the ZEV population share increases.

Sales Impact of State Regulatory Action

ERM analyzed three different state regulatory scenarios with varying levels of ZEV sales based on assumed adoption of the ACT or ACF within individual states.

Scenario 1: This scenario included only states that have already adopted the ACT: California, Massachusetts, New Jersey, New York, Oregon, and Washington. Scenario 1 represents a conservative level of ZEV adoption where no technology advancement occurs, and no additional states take regulatory action. This scenario resulted in 7.40 percent ZEV sales in 2029 due to state regulatory action.[18]

Scenario 2: In addition to the ACT states from Scenario 1, Scenario 2 assumed states with current ACT proceedings (Connecticut and Rhode Island) and states currently evaluating the ACT (Colorado, District of Columbia, Maryland, Pennsylvania, and Vermont) adopt the ACT in 2022. This scenario also assumed California adopts the ACF.[19] While the ACT allows for a five-year lifetime for ZEV credits, this analysis assumed no ZEV crediting after 2026. This scenario resulted in 12.44 percent ZEV sales in 2029 due to state regulatory action.

Scenario 3: This scenario assumed all signatories of the M/HD ZEV MOU adopt the ACT. All the states that adopted the ACT in Scenario 2 are signatories as well as Hawaii, Maine, Nevada, North Carolina, and Virginia. All states were assumed to have adopted the ACT by 2022. Scenario 3 also assumed the same California ACF adoption as in Scenario 2. Under this scenario, ZEV sales reached 14.72 percent in 2029 due to state regulatory action.

The first model year with ACT sales requirements depends on the year the ACT was adopted in a given state. For California, which adopted the ACT in 2020, the first MY with ZEV sales requirements is 2024. For the five states that adopted the ACT in 2021, the first MY is 2025 and for states that adopt the ACT in 2022, the first MY will be 2026. This analysis assumed all states that have not currently adopted the ACT did so in 2022. Even if states adopted the ACT in 2023 instead of 2022, this would not change the ZEV sales projections for 2027 and beyond.

The analysis divided Class 4-8 vehicles into three categories: buses, single-unit trucks, and combination trucks.[20] In California, transit bus sales are required to be 100 percent ZEV by 2029 due to the ICT. This analysis incorporated ICT's ZEV transit bus requirements. The trajectory of ICT is shown in Figure 1. Since the ACT does not apply to transit buses, only school and other buses, and since no other state has a similar regulation to the ICT, the ZEV bus sales percentages in ACT states other than California were lowered to account for the lack of sales requirement for transit buses. For instance, the 2029 ACT sales requirement for Class 4-8 vocational vehicles (including school and other buses) is 40 percent but when adjusted to exclude transit buses, this analysis assumed bus ZEV sales to be 35 percent in 2029 for all ACT states other than California.[21]

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[18] For all Class 4 to 8 vehicles (including long-haul combination trucks), Scenario 1, 2, and 3 had 6.35 percent, 11.20 percent, and 13.15 percent ZEV sales in 2029, respectively.

[19] California's Air Resources Board has announced they plan to present a regulation recommendation to the Board in October of 2022. While this analysis used the current ACF draft regulation (May 2022), the exact previsions may change between now and when it is adopted.

[20] The results discussed in this report include all Class 4-8 vehicles except long-haul combination trucks.

[21] This analysis assumed 13 percent of buses were transit buses based on National Transit Database records for transit bus vehicle miles traveled.

Sales Impact of IIJA Funding

As discussed previously, IIJA funding could help bolster ZEV sales within the US between 2022 to 2026. To calculate the impact of IIJA funding on ZEV sales, ERM undertook an assessment of publicly available information on IIJA programs, including eligibility criteria, funding levels, and the likelihood that M/HD ZEVs will be purchased under a given program.

First, ERM analyzed individual IIJA programs to pinpoint which ones could be used to purchase new ZEV vehicles. Some programs under the IIJA were legacy initiatives and thus had substantial documentation on eligibility of vehicle types, while several programs were newly introduced as part of IIJA. These new programs did not have a significant amount of information to assess, but enough to assume their relevance. Table 1 provides the grant programs assessed, their total apportioned funding, along with the vehicle types[22] included and ERM's assumed percentage of funding that would be used for M/HD ZEV purchases.

As shown, IIJA is anticipated to provide nearly $20 billion in FY2022 funding, with four programs available to all M/HD vehicle types purchasing ZEVs, two for all bus types, and two for school buses specifically. Funding provided under these programs will change slightly for FY2023 to 2026, but for the purposes of this analysis, it is assumed that funding will remain at FY2022 levels through 2026.

Table 1. IIJA funding programs

Program	Total Annual Apportioned Funding	Grant Type	Eligible Vehicle Type	Percent of Total for M/HD ZEV Purchases
Surface Transportation Block Grant Program	$13,835,404,382	Formula	All M/HD	5%
Grants for Buses and Bus Facilities	$204,000,000	Formula	Bus	50%
Grants for Buses and Bus Facilities	$376,000,000	Competitive	Bus	50%
Congestion Mitigation & Air Quality Improvement	$2,536,490,803	Formula	All M/HD	5%
Clean School Bus Program	$1,000,000,000	Competitive	School Bus	80%
State Energy Program	$125,000,000	Formula	All M/HD	5%
Carbon Reduction Program	$1,233,656,891	Formula	All M/HD	25%
Grants for Energy Efficiency Improvements and Renewable Energy Improvements at Public School Facilities	$125,000,000	Competitive	School Bus	25%
Total IIJA Funding Allocation	**$19,435,552,076**			

[22] IIJA funding is assumed to be used for M/HD vehicle types other than combination trucks (e.g., single unit trucks and buses) due to the timeframe of the funding and model availability.

Next, ERM allocated each funding program to individual states. For formula grants, each state had a set allocation amount identified, but for competitive grant programs ERM allocated the total funding amount based on each state's total population.[23]

With the funding allocations for each state calculated, ERM then apportioned the total funding in each state to M/HD vehicle types using the assumed "Percent of Total for M/HD ZEV Purchases" shown in Table 1. The resulting funding amounts for each vehicle type are shown in Table 2.

Table 2. Total annual M/HD ZEV funding in all states for by vehicle type

Eligible Vehicle Type	Total FY2022 Funding
Any M/HD Vehicle	$1,133,258,982
Bus	$290,000,000
School Bus	$831,250,000

ERM then removed amounts apportioned to states adopting the ACT in the three policy scenarios. (see above section *Sales Impact of State Regulatory Action*). This was done to exclude funding amounts that may be used to meet regulatory sales requirements in states that have adopted the ACT and avoid double counting ZEV sales.

To calculate the number of ZEVs sold, ERM divided the total funding under each scenario by 80 percent of the assumed ZEV purchase price. This level of funding per vehicle was chosen because many grant programs will fund up to 80 percent of the cost to purchase the vehicle with the grant recipient providing the remaining 20 percent.

To calculate the total purchase price of ZEVs, ERM utilized economic analyses including ICF's report, "Comparison of Medium- and Heavy-Duty Technologies in California"[24] as well as Roush Industries' "Technical Review of Medium and Heavy-Duty Electrification Costs for MY 2027-2030."[25] The ICF report provided costs for both ICE and ZEV M/HD vehicle technologies, but due to the rapidly evolving ZEV market and economies of scale in battery manufacturing, their pricing estimates were only used to obtain the base price of 2019 diesel M/HDVs. The Roush Industries study, being much more recent than the ICF report, was used for information on battery costs, BEV non-battery powertrain costs, and costs that will be avoided by "deleting" the standard diesel or gasoline powertrain and using an electric powertrain in its place. Calculating the total cost of a ZEV involved using the base cost of an ICE vehicle from ICF's report, subtracting the delete costs and adding in the battery and non-battery powertrain costs from Roush's study. As mentioned previously, ERM then took 80 percent of the total calculated cost to determine the impact of IIJA funding on vehicle sales.

Since four of the IIJA programs will allow the purchase of any M/HD vehicle type, ERM assumed 73 percent of this funding would go to single-unit trucks (SUT) and 27 percent would be buses. As mentioned earlier, IIJA funding was not assumed to fund combination trucks due to market readiness.

[23] US Census Bureau, "Annual Estimates of the Resident Population for the United States", 2020, https://www2.census.gov/programs-surveys/popest/tables/2010-2020/state/totals/nst-est2020.xlsx.

[24] ICF International, "Comparison of Medium- and Heavy-Duty Technologies in California," (December 2019), https://efiling.energy.ca.gov/GetDocument.aspx?tn=236878.

[25] Nair et al., "Medium and Heavy-Duty Electrification Costs MY 2027-2030".

Based on these assumptions, the total funding from Table 2 was apportioned to the three M/HD vehicle types. The number of ZEVs purchased under the three scenarios were then calculated by dividing by the 80 percent purchase cost. See Table 3 for the total ZEV sales by vehicle type for each scenario.

Table 3. M/HD ZEV sales funded by IIJA programs

Scenario 1			
	SUT	Bus	School Bus
2022	10,405	4,887	8,153
2023	10,703	4,989	8,272
2024	11,094	5,117	8,440
2025	11,331	5,200	8,517
2026	11,579	5,285	8,594
Scenario 2			
	SUT	Bus	School Bus
2022	9,093	4,241	7,115
2023	9,354	4,330	7,219
2024	9,695	4,442	7,366
2025	9,903	4,514	7,432
2026	10,119	4,587	7,500
Scenario 3			
	SUT	Bus	School Bus
2022	8,163	3,765	6,278
2023	8,397	3,845	6,370
2024	8,703	3,944	6,499
2025	8,890	4,006	6,558
2026	9,084	4,072	6,618

Sales Impact of Market Growth

Different sources project a wide range of M/HD ZEV sale percentages. Some projections, like EIA's Annual Energy Outlook 2022,[26] predict M/HD ZEV sales will be less than 5 percent of all M/HDV sales even in 2050. Others, such as the recent report from NREL,[27] predict the vast majority of M/HD ZEVs achieve cost parity with ICE vehicles by 2035 resulting in a rapid increase in M/HD ZEV sales. That model found ZEVs will account for 42 percent of M/HDV sales in 2030 and 100 percent of M/DHV sales by 2046. A study by ACT Research projects 24 percent of Class 4-8 vehicle sales will be ZEV in 2027 growing to 34 percent in 2031 and 43 percent in 2040.[28] Given the wide array of projections, this analysis examined a range of M/HD ZEV market growth assumptions.

The market growth considerations in this analysis were most relevant for non-ACT states. For ACT states, market growth driven sales were disregarded unless the market growth sales percentage rose above the

[26] "Annual Energy Outlook 2021," Reference Case Projections Tables, US Energy Information Administration (EIA), table 49, https://www.eia.gov/outlooks/aeo/tables_ref.php.

[27] Ledna et al., "Zero-Emission Vehicles Cost Analysis."

[28] Deborah Lockridge, "ACT: Third of Class 4-8 Vehicles to be Battery-Electric in 10 Years," *Trucking Info,* June 4, 2021, https://www.truckinginfo.com/10144947/act-third-of-class-4-8-vehicles-to-be-battery-electric-in-10-years.

manufacturer's sales requirement from the ACT.[29] The growth in non-ACT states in this analysis was assumed to be driven by spill-over from ACT states, the lower operating costs of ZEVs, commitments by private companies as well as municipal, state, and federal governments to transition part or all of their fleet to ZEVs, and lastly, other federal and state funding and incentives for ZEV adoption. See above sections for further discussion about these drivers.

For Scenario 1, only one market growth assumption was considered. Scenario 1 represents a conservative level of ZEV adoption that assumes very minimal technology improvement or battery price decreases. To calculate the market growth levels, a compound annual growth rate (CAGR) was applied to the current levels of M/HD ZEV sales. The Annual Energy Outlook 2022 projects around a 5 percent CAGR for ZEV sales.[30] Research and Markets projects a 60 percent CAGR between 2021 and 2026. For Scenario 1, this analysis assumed between a 7 and 10 percent CAGR.[31] In 2029, the market growth sales are 1.3 percent, 1.1 percent, and 1.4 percent for buses, single-unit trucks, and short-haul combination trucks, respectively.

For Scenario 2, three market growth assumptions were considered: a, b, and c. The market growth assumption for Scenario 2a was close to the assumption used with Scenario 1. It is slightly higher because it was assumed that if more states have adopted the ACT, there will be more spill-over into non-ACT states and the market will have matured slightly faster. For this scenario, the analysis assumed between a 10 and 13 percent CAGR.

For Scenarios 2b and 2c, the sales trajectories from the NREL report[32] were lengthened so the time to reach the sales milestones was longer. For the Scenario 2b growth assumption, the increase in sales between each year was halved so it would take twice as long to reach each sales milestone. For example, instead of taking the three years for sales to increase from 5 percent to 23 percent that NREL projections, in the Scenario 2b growth assumption it took 6 years. For the Scenario 2c growth assumption, the rate of sales increase is reduced by a third so instead of taking 16 years to reach 90 percent ZEV sales, it took 25 years. The market growth assumptions in Scenarios 2b and 2c are reasonable and indeed both are lower than those projected by NREL.

For Scenario 3, only one market growth assumption was considered. This market growth scenario matches the medium- and heavy truck sales projections in the NREL report. In 2029, ZEV sales driven by market growth in Scenario 3 were assumed to be 29 percent. To understand the upper end of reasonable M/HD ZEV sales projections, Scenario 3 combines the market growth projected by NREL with the assumption that the MOU states adopt the ACT (as discussed above). While both assumptions are not guaranteed, they are reasonable projections for what might happen in the next seven years.

The market growth sales percentages used in non-ACT states are shown in Figure 2.

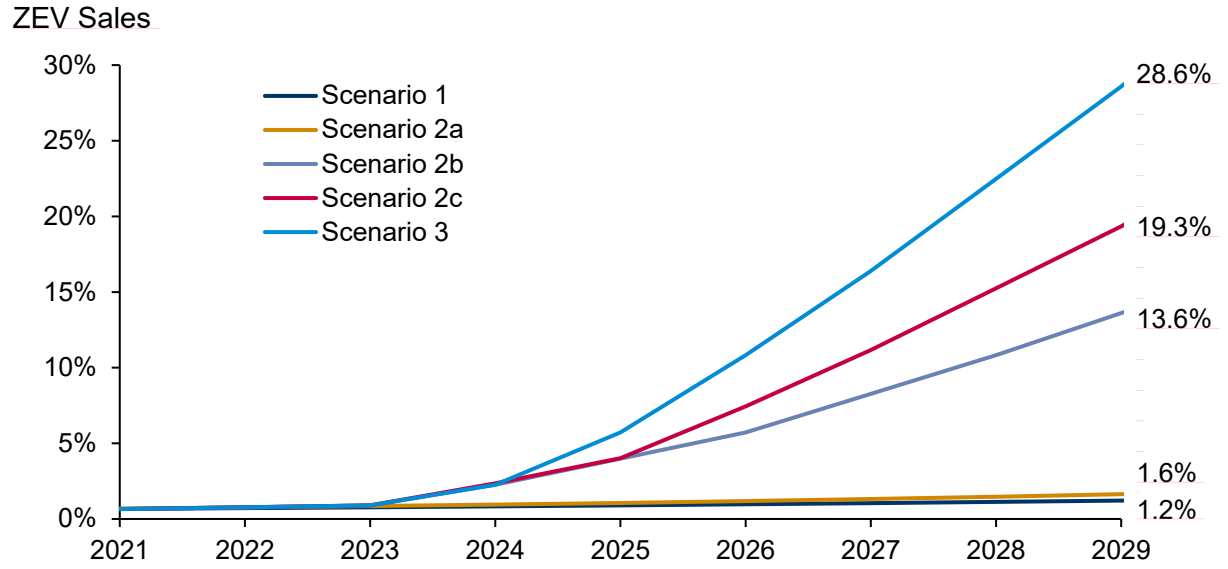
[29] In Scenario 3, market growth sales percentage exceeded the ACT driven sales percentage starting in 2032 for buses, 2033 for single-unit trucks, and 2032 for combination trucks. In Scenario 2c, this occurred for combination trucks starting in 2034.

[30] "Annual Energy Outlook 2021," table 49.

[31] Markets and Research, "USA Electric Truck Market Analysis, 2021," (April 2021), https://www.researchandmarkets.com/reports/5439589/usa-electric-truck-market-analysis-2021?utm_source=BW&utm_medium=PressRelease&utm_code=b835sn&utm_campaign=1627358+-+United+States+Electric+Truck+Market+Growth+Forecasts+to+2026%3a+60%25+Compound+Annual+Growth+Forecast+During+2021-2026&utm_exec=cari18prd

[32] Ledna et al., "Zero-Emission Vehicles Cost Analysis."

Figure 2. Average Class 4-8 ZEV sales due to market growth



ZEV Combination Trucks

Since the GHG portion of the EPA regulation does not apply to sleeper cab combination trucks, it is also important to understand the ZEV sales for Class 4-8 vehicles excluding long-haul combination trucks. MOVES3 and the EPA regulation assume 37 percent of combination trucks (CTs) are short-haul and the remaining 63 percent are long-haul. [33] This analysis used the same assumption.

For state regulation driven ZEV sales, all ZEV CTs were assumed to be short-haul when possible. Since the maximum sales requirement for CTs under the ACT is 40 percent, a small portion of long-haul CT sales were ZEVs starting in 2032.

For Scenarios 1 and 2a, short-haul CT were assumed to make up all the CT ZEV sales. For Scenarios 2b, 2c, and 3, short-haul CTs had the same ZEV sales percentage as single-unit trucks. Since short-haul CT are easier to transition to ZEV compared to long-haul CTs, it was assumed that they will have similar sales projections to single-unit trucks.

Results

Under the five different scenarios, projected Class 4-8 ZEV sales span a wide range, from 8 percent to 34 percent ZEV sales in 2029.[34] The slight fall in ZEV sales between 2026 and 2027 is due to the conclusion of IIJA funded programs. While this analysis modeled ZEV sales as occurring in the same year the funding was provided, the reality may be that ZEV sales from IIJA are shifted to be later than this analysis projects, with fewer ZEV purchases in 2022 and IIJA funded ZEV purchases continuing for several years past 2026. This may reduce or eliminate the drop in ZEV sales seen in 2027.

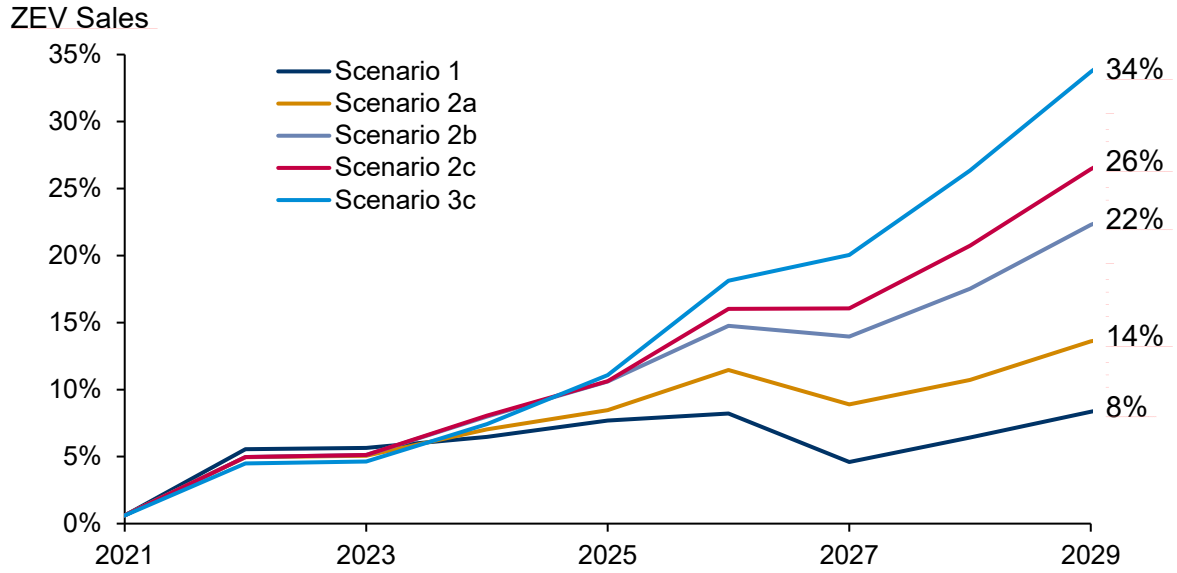
The relative share of ZEV sales caused by state regulation, IIJA, and market growth changes between scenarios and through time. While IIJA funded ZEV sales make up roughly 85 percent of ZEV sales in 2023 for all five scenarios, by 2026 that share has fallen to 60 percent for Scenario 1 and to 21 percent for Scenario 3. In 2029, the share of state regulation-driven sales is 89 percent for Scenario 1, 56 percent for Scenario 2b, and only 44 percent for Scenario 3. The remaining ZEV sales in 2029 are driven by

[33] EPA, "Heavy-Duty Engine and Vehicle Standards," 17600.

[34] The sales percentages for each scenario and each year are included in a table in the appendix.

market growth. Figure 3 shows the ZEV sales under different scenarios. See the appendix for in-use ZEV projections and for ZEV sales projections out to 2035.

Figure 3. M/HD ZEV sales under different scenarios

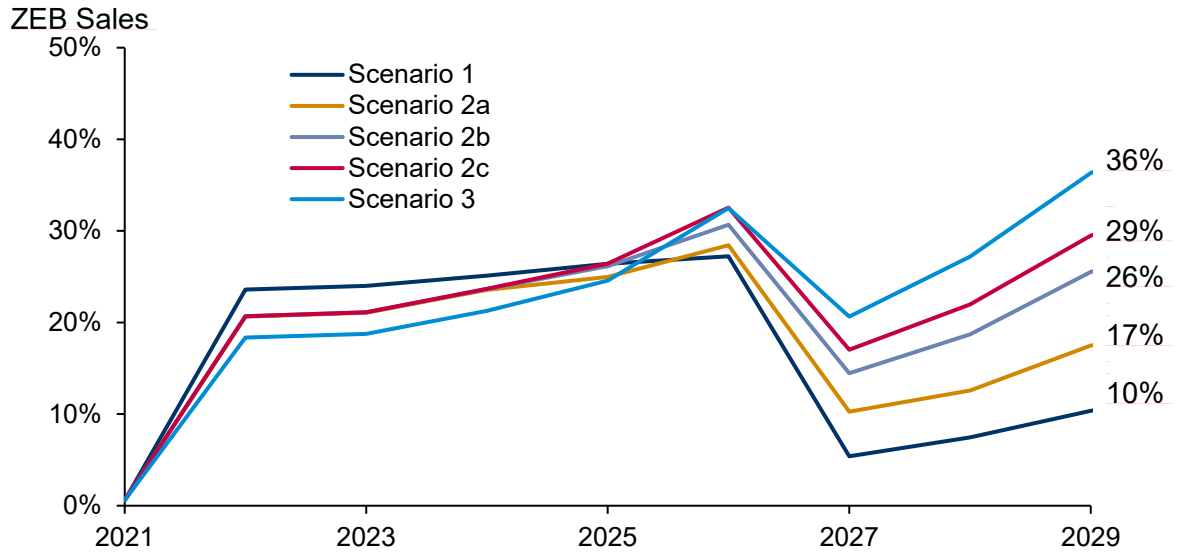


Note: the initial higher ZEV sales for Scenario 1 and lower ZEV sales for Scenario 3 is due to the assumptions made around IIJA funding. Since credits from M/HD ZEVs sold before ACT begins can be used once the state has sales requirements, IIJA funded ZEVs in states with the ACT are not counted since they will not increase the total number of ZEVs sold in the US.

Transit and School Bus Sales Projections

Zero-emission buses (ZEBs) are a large portion of the current M/HD ZEV population. In particular, transit and school buses are two categories of vehicles where there is a lot of interest in transitioning due to their captive nature and consistent layover periods. Both types of buses heavily contribute to air pollution for those in close proximity to their routes. Transitioning these vehicle types to ZEVs can help combat localized emissions, improving the health of passengers and local residents. Figure 4 shows the assumed ZEB sales projections in the analysis for the five scenarios.

Figure 4. Zero-emission bus sales under different scenarios



Note: the initial higher ZEB sales for Scenario 1 and lower ZEB sales for Scenario 3 is due to the assumptions made around IIJA funding. Since credits from M/HD ZEVs sold before ACT begins can be used once the state has sales requirements, IIJA funded ZEVs in states with the ACT are not counted since they will not increase the total number of ZEVs sold in the US.

The decrease in sales in 2027 is more pronounced for buses compared to all M/HD ZEVs due to the presence of several bus specific programs in IIJA. While a shift in the exact schedule of the IIJA funded ZEB sales may reduce the magnitude of the drop as discussed above, it is also possible that the large increase in sales and in-use ZEBs will accelerate market maturity. If vehicle prices decrease earlier than expected due to economies of scale and charging availability is increased, ZEB sales may decline less in 2027 or continue growing.

While this analysis does not explicitly project transit and school bus ZEV sales percentages, there are many reasons to believe transit and school bus ZEV sales will be higher than average M/HD ZEV sales in the next decade. California, which accounts for 16 percent of the US transit bus population,[35] has adopted the ICT regulation which requires 100 percent of transit bus purchases be ZEV starting in 2029. If California adopts the ACF, the remaining M/HDV categories will not reach 100 percent ZEV sales until 2040.

Many state and municipal governments have set goals for transit and school bus fleet ZEV transition. A few of those commitments include New Jersey committing to 100 percent ZEB purchases by 2032, New York City committing to 100 percent ZEV school buses by 2035 and 100 percent ZEV transit buses by 2040, Montgomery County, Maryland committing to 100 percent ZEV school buses by 2033, and Chicago committing to 100 percent ZEV transit buses by 2040.

A report by CALSTART quantified the number of transit ZEBs in the US and found 3,533 full size ZEBs had been ordered or deployed as of September 2021. This accounts for 5.3 percent of the total full size

[35] Federal Transit Administration, National Transit Database, "2020 Vehicles," https://www.transit.dot.gov/ntd/data-product/2020-vehicles.

transit fleet.[36] Transit ZEBs have had high growth in the last few years with the number of deployed ZEBs growing by 78 percent between 2020 and 2021.[37]

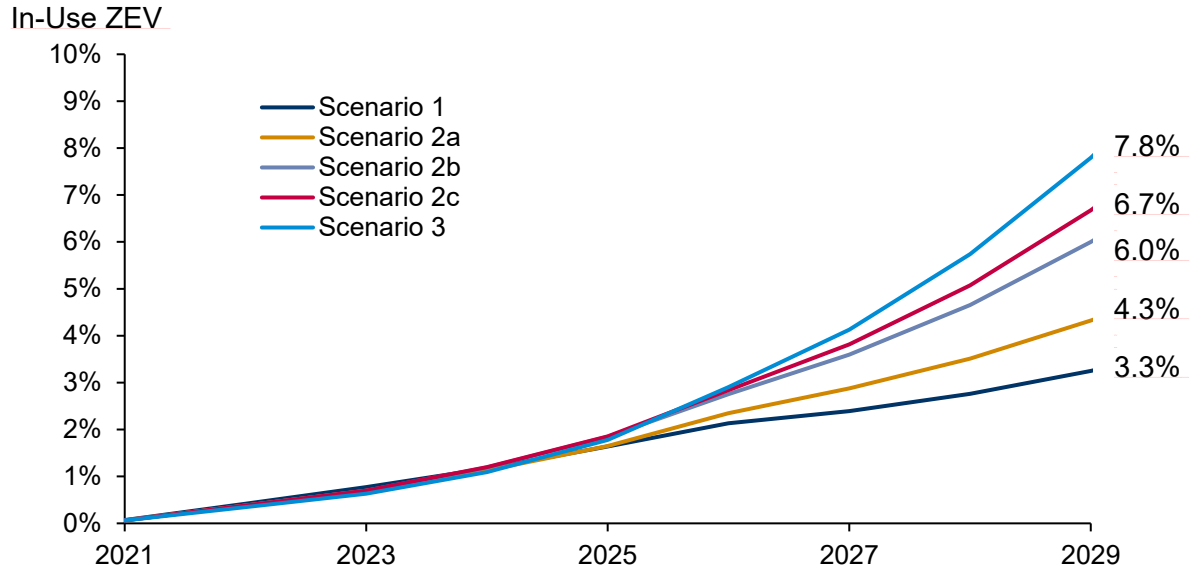
[36] Assumes 67,000 full size (Class 7 or 8) transit buses which includes the Bus, Articulated Bus, Over-the-road Bus, and Double Decker Bus categories in the National Transit Database.

[37] Hannah Hamilton et al., "Zeroing in on ZEBS: The Advanced Technology Transit Bus Index", CALSTART, (December 2021), https://calstart.org/wp-content/uploads/2022/01/2021-ZIO-ZEB-Final-Report_1.3.21.pdf

Appendix

In-Use ZEV Projections

Figure A1. M/HD in-use ZEVs under different scenarios out to 2035



Including Long-Haul Combination Trucks

As discussed above, long-haul CTs were not included in the above analysis. Given the challenges of transitioning long-haul CTs to ZEVs, they are expected to make up a smaller share of CT ZEV sales relative to short-haul CTs. However, to get a clearer sense of overall Class 4-8 ZEV sales, the analysis was also conducted including long-haul CTs. Figures A3 and A4 show the ZEV sales and in-use ZEVs for Class 4-8 vehicles including long-haul CTs.

Figure A2. M/HD ZEV sales under different scenarios including long-haul combination trucks

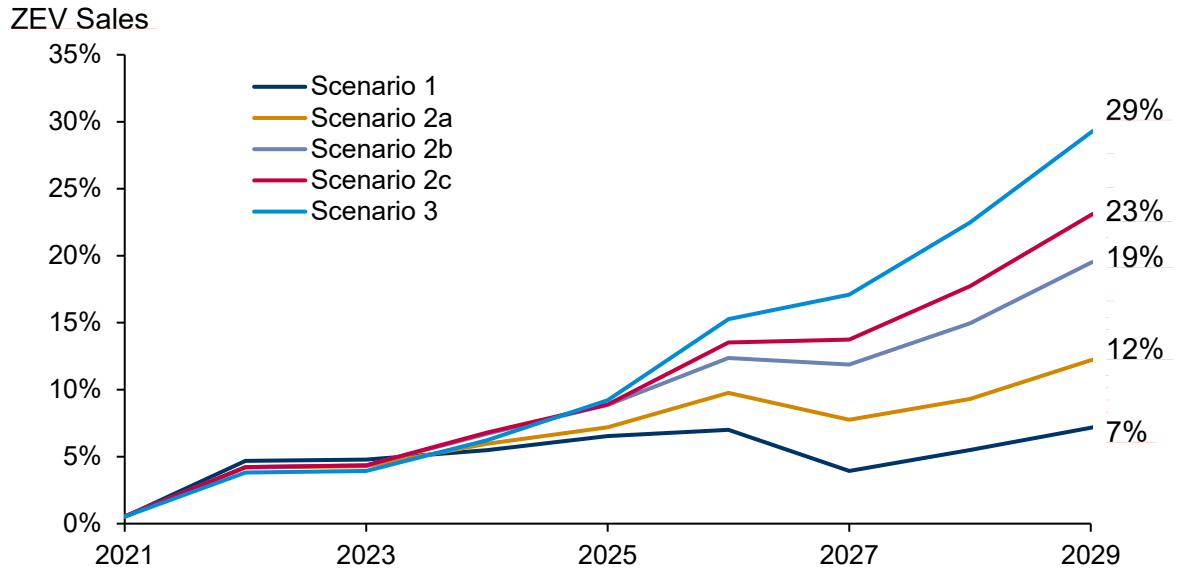
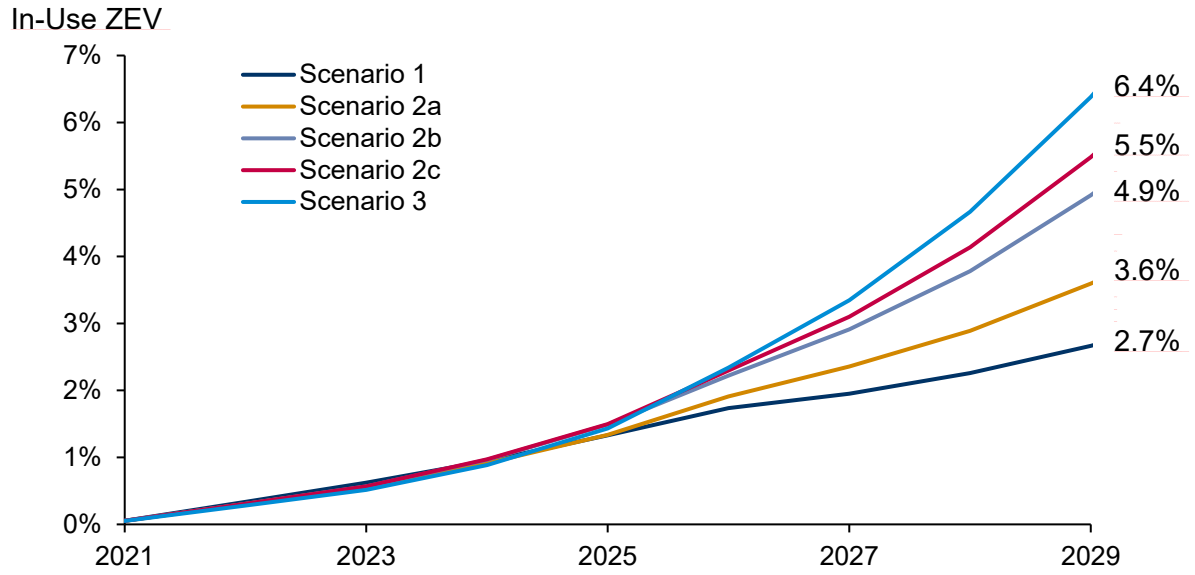


Figure A3. M/HD in-use ZEVs under different scenarios including long-haul combination trucks



M/HD ZEV Sales by Scenario

Below are the ZEV sales in thousand vehicles and percent of total M/HD sales broken out by each factor examined in this analysis: state regulatory action, IIJA funding, and market growth.

Table A1. Scenario 1 results

	Scenario 1								
		M/HD ZEV Sales (Thousands)				Percent			
	M/HDV Annual Sales	State Reg. Action	IIJA	Market Growth	**Total ZEV**	ACT	IIJA	Market Growth	**Total ZEV**
2021	470.75	0.48		2.41	**2.89**	0.1%	0.0%	0.5%	**0.6%**
2022	478.78	0.50	23.45	2.64	**26.59**	0.1%	4.9%	0.6%	**5.6%**
2023	486.96	0.66	23.96	2.91	**27.53**	0.1%	4.9%	0.6%	**5.7%**
2024	495.30	4.20	24.65	3.19	**32.04**	0.8%	5.0%	0.6%	**6.5%**
2025	503.80	10.22	25.05	3.51	**38.77**	2.0%	5.0%	0.7%	**7.7%**
2026	512.46	12.80	25.46	3.85	**42.11**	2.5%	5.0%	0.8%	**8.2%**
2027	521.29	19.73		4.23	**23.97**	3.8%	0.0%	0.8%	**4.6%**
2028	530.29	29.41		4.65	**34.06**	5.5%	0.0%	0.9%	**6.4%**
2029	539.46	39.92		5.11	**45.04**	7.4%	0.0%	0.9%	**8.3%**

Table A2. Scenario 2a results

	Scenario 2a								
	M/HDV Annual Sales	M/HD ZEV Sales (Thousands)				Percent			
		State Reg. Action	IIJA	Market Growth	**Total ZEV**	ACT	IIJA	Market Growth	**Total ZEV**
2021	470.75	0.67		2.25	**2.92**	0.1%	0.0%	0.5%	**0.6%**
2022	478.78	0.70	20.45	2.56	**23.71**	0.1%	4.3%	0.5%	**5.0%**
2023	486.96	0.87	20.90	2.91	**24.68**	0.2%	4.3%	0.6%	**5.1%**
2024	495.30	10.02	21.50	3.30	**34.83**	2.0%	4.3%	0.7%	**7.0%**
2025	503.80	17.05	21.85	3.76	**42.65**	3.4%	4.3%	0.7%	**8.5%**
2026	512.46	32.26	22.21	4.27	**58.74**	6.3%	4.3%	0.8%	**11.5%**
2027	521.29	41.54		4.86	**46.40**	8.0%	0.0%	0.9%	**8.9%**
2028	530.29	51.36		5.52	**56.88**	9.7%	0.0%	1.0%	**10.7%**
2029	539.46	67.10		6.28	**73.38**	12.4%	0.0%	1.2%	**13.6%**

Table A3. Scenario 2b results

	Scenario 2b								
	M/HDV Annual Sales	M/HD ZEV Sales (Thousands)				Percent			
		State Reg. Action	IIJA	Market Growth	**Total ZEV**	ACT	IIJA	Market Growth	**Total ZEV**
2021	470.75	0.67		2.24	**2.92**	0.1%	0.0%	0.5%	**0.6%**
2022	478.78	0.70	20.45	2.66	**23.81**	0.1%	4.3%	0.6%	**5.0%**
2023	486.96	0.87	20.90	3.15	**24.93**	0.2%	4.3%	0.6%	**5.1%**
2024	495.30	10.02	21.50	8.06	**39.59**	2.0%	4.3%	1.6%	**8.0%**
2025	503.80	17.05	21.85	14.52	**53.41**	3.4%	4.3%	2.9%	**10.6%**
2026	512.46	32.26	22.21	21.19	**75.66**	6.3%	4.3%	4.1%	**14.8%**
2027	521.29	41.54		31.22	**72.76**	8.0%	0.0%	6.0%	**14.0%**
2028	530.29	51.36		41.58	**92.94**	9.7%	0.0%	7.8%	**17.5%**
2029	539.46	67.10		53.16	**120.27**	12.4%	0.0%	9.9%	**22.3%**

Table A4. Scenario 2c results

	Scenario 2c								
	M/HDV Annual Sales	M/HD ZEV Sales (Thousands)				Percent			
		State Reg. Action	IIJA	Market Growth	**Total ZEV**	ACT	IIJA	Market Growth	**Total ZEV**
2021	470.75	0.67		2.24	**2.92**	0.1%	0.0%	0.5%	**0.6%**
2022	478.78	0.70	20.45	2.66	**23.81**	0.1%	4.3%	0.6%	**5.0%**
2023	486.96	0.87	20.90	3.15	**24.93**	0.2%	4.3%	0.6%	**5.1%**
2024	495.30	10.02	21.50	8.43	**39.95**	2.0%	4.3%	1.7%	**8.1%**
2025	503.80	17.05	21.85	14.64	**53.53**	3.4%	4.3%	2.9%	**10.6%**
2026	512.46	32.26	22.21	27.62	**82.09**	6.3%	4.3%	5.4%	**16.0%**
2027	521.29	41.54		42.17	**83.71**	8.0%	0.0%	8.1%	**16.1%**
2028	530.29	51.36		58.59	**109.95**	9.7%	0.0%	11.0%	**20.7%**
2029	539.46	67.10		75.56	**142.66**	12.4%	0.0%	14.0%	**26.4%**

Table A5. Scenario 3 results

	Scenario 3								
	M/HDV Annual Sales	M/HD ZEV Sales (Thousands)				Percent			
		State Reg. Action	IIJA	Market Growth	**Total ZEV**	ACT	IIJA	Market Growth	**Total ZEV**
2021	470.75	0.82		2.06	**2.88**	0.2%	0.0%	0.4%	**0.6%**
2022	478.78	0.86	18.21	2.44	**21.50**	0.2%	3.8%	0.5%	**4.5%**
2023	486.96	1.04	18.61	2.89	**22.54**	0.2%	3.8%	0.6%	**4.6%**
2024	495.30	10.20	19.15	7.42	**36.76**	2.1%	3.9%	1.5%	**7.4%**
2025	503.80	17.23	19.45	19.13	**55.81**	3.4%	3.9%	3.8%	**11.1%**
2026	512.46	36.26	19.77	36.85	**92.89**	7.1%	3.9%	7.2%	**18.1%**
2027	521.29	47.75		56.73	**104.48**	9.2%	0.0%	10.9%	**20.0%**
2028	530.29	60.58		79.18	**139.76**	11.4%	0.0%	14.9%	**26.4%**
2029	539.46	79.42		102.40	**181.82**	14.7%	0.0%	19.0%	**33.7%**

Table A1. Data sources used

Data Element	Data Source(s)
Base Vehicle Populations	MOVES3
Annual Fleet Growth	MOVES3
Annual Vehicle Retirement	ERM analysis of data in the Transportation Energy Data Book, Tables 5.1 to 5.3
M/HD ZEV Purchase Costs	ICF's report, "Comparison of Medium- and Heavy-duty Technologies in California" Roush Industries "Technical Review of: Medium and Heavy-Duty Electrification Costs MY 2027-2030"
Market Growth in non-ACT States	NREL "Decarbonizing Medium- & Heavy-Duty On-Road Vehicles: Zero-Emission Vehicles Cost Analysis." Markets and Research, "USA Electric Truck Market Analysis, 2021" US Energy Information Administration (EIA) "Annual Energy Outlook 2021," Reference Case Projections, Table 49
Innovative Clean Transit (ICT) Transit Agency Size	National Transit Database

Table A2. Sample of Fleet Electrification Commitments

Sector	Company	Electric Fleet Plans
Retail	Ikea Group*	2020: Electrify deliveries in Amsterdam, Los Angeles, New York, Paris, and Shanghai (25% global of deliveries) 2025: 100% EV or other zero-emissions solutions for deliveries and services through suppliers
	Amazon	2022: 10,000 electric delivery vans (short-term goal) 2030: 100,000 electric delivery vans total (long-term goal)
	Clif Bar & Company*	2030: 100% fleet electrification
	Unilever	2030: 100% fleet electrification (11,000 vehicles)
	LG Energy Solutions	2030: 100% fleet electrification (380 vehicles) and install charging at all locations for staff
	Walmart	2040: Zero emission vehicle fleet, including long-haul (6,000 trucks)
Power	Schneider Electric*	2030: 100% electric fleet (14,000 vehicles)
	Edison Electric Institute (EEI) Member Companies (investor-owned utilities)	2030: More than 70 percent of EEI member companies will collectively electrify more than one-third of their total fleet vehicles, including two-thirds of passenger vehicles in fleets. Examples include: • Xcel Energy: 2023: 100% electric sedan portion of fleet; 2030: 100% electric light-duty fleet; 30% M/HD vehicles • Consumers Energy: 2025: Buy or lease 100% of EVs for fleet • Southern California Edison: 2030: 100% electric passenger car and small-to-midsize SUV, 30% medium-duty vehicles and pickup trucks, 8% heavy-duty trucks, 60% forklifts
	National Grid	2030: 100% electric fleet (5,700 vehicles)
	Public Service Co.	2022: 10% electric fleet minimum 2030: 50% electric fleet 2045: 100% electric fleet
Transportation	Lyft**	2026: 100% new vehicles for Express Drive (driver rental program) are electric 2030: 100% EVs on platform
	King County Metro (WA)	2030: 100% zero-emissions fleet
	Lime*	2030: 100% conversion of operations fleet
	Uber**	2030: 100% of rides take place in EVs in U.S., Canadian, and European cities 2040: 100% of rides take place in ZEVs, on public transit or with micromobility
	Alto	2023: 100% all-electric fleet with services in Washington D.C., Los Angeles, Houston, Miami and Dallas
	Port Authority of New York and New Jersey	2030: 100% fleet electrification (1,400 vehicles)
Delivery	DHL	2025: 70% of first- and last-mile delivery services with clean transport modes 2050: Reduce logistics-related emissions to zero
	FedEx	2025: 50% of Express global parcel pickup and delivery (PUD) fleet purchases electric 2030: 100% PUD fleet purchases electric 2040: 100% ZEV PUD fleet
Biotech	AstraZeneca	2025: 100% fleet electrification (16,000 vehicles)
	Genentech	2030: 100% electrification of sales fleet (1,300 vehicles) and commuter buses
	Biogen	2030: 100% fleet electrification (1,600 vehicles)
Municipal	New York City, New York	2017: Only purchase PHEVs for non-emergency sedans going forward 2025: Add 2,000 EVs to NYC sedan fleet 2035: 100% Electric School bus fleet 2040: 100% electric MTA bus fleet
	New Jersey	2024: At least 10% of new bus purchases will be zero emission buses

		2026: At least 50% of new bus purchases will be zero emissions buses 2032: 100% of new bus purchases will be zero emissions buses
	Los Angeles, California	2028: 100% ZEV vehicle conversions “where technically feasible” (2028: taxi fleet, school buses; 2035: urban delivery vehicles) 2035: 100% electrification of sanitation fleet through LA Department of Sanitation Commitment
	Houston, Texas	2030: 100% EV non-emergency, light-duty municipal fleet
	Chicago, Illinois	2040: 100% electric Chicago Transit Authority (CTA) bus fleet (1,850 buses)
	Montgomery County, Maryland	2033 (approximately 12-year process): Electrify entire school bus fleet for Montgomery County Public School district (1,400 school buses serving over 200 schools)
	Vermont	2025: 40% of new vehicle sales to be electric (43,000 vehicles) 2030: 80% of new vehicle sales to be electric (166,000 vehicles)

*Member companies of EV100, through which 121 committed member companies will electrify over 4.8 million vehicles globally
**Drivers for Lyft and Uber are contractors rather than employees, so it may be difficult to convince drivers to switch to EVs. Lyft does not intend to remove drivers from platform who do not drive electric or provide financial incentives to drivers for the transition. Instead, much of the plan revolves around exerting pressure on competitors, lawmakers, and automakers. Uber will pay BEV and hybrid drivers an incentive of $1.50 and $0.50 per trip, respectively, and GM and Renault-Nissan will offer discounts to EVs. While Uber has not explicitly stated they will not remove non-electric drivers, they may be in a similar position as Lyft. Uber recently announce it will roll out “Uber Green” in 1,400 North American cities and launch partnerships to expand EV access for its drivers.

Source: Rachel MacIntosh, Sophie Tolomiczenko, and Grace Van Horn, “Electric Vehicle Market Update, Table 2. Sample of Fleet Electrification Commitments” ERM, (April 2022). https://www.sustainability.com/globalassets/sustainability.com/thinking/pdfs/2022/ev_market_report_v6_11april22.pdf