DRIVING *Demand*

Solutions to Increase the Market for Heavy-Duty Zero-Emission Vehicles

DECEMBER 2025
Policy Report

Climate Change
and Business
Research Initiative

UC Berkeley Center for Law, Energy & the Environment

UCLA School of Law Emmett Institute on Climate Change & the Environment

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Photo provided by Mack Trucks

I. EXECUTIVE SUMMARY

Medium- and heavy-duty trucks are major contributors to greenhouse gas emissions and air pollution. Although they make up only 6% of all vehicles in California, they account for 25% of the state's on-road greenhouse gas emissions and 35% of transportation-caused nitrogen oxide emissions. Their pollutants also disproportionately impact low-income communities near shipping centers and highways. The state needs to reduce these vehicle emissions significantly to meet its air quality and climate goals, including to meet ambient air quality mandates and achieve carbon neutrality by 2045.

Yet the state's efforts to boost zero-emission trucks, particularly its advanced clean trucks mandate on truck makers to produce zero-emission models, have faced strong federal pushback. The U.S. Congress voted in June 2025 to overturn federal permission for California's mandate and then terminated many of the tax incentives needed to lower zero-emission truck costs in July. While zero-emission trucks in some market segments are already price competitive with fossil-fuel alternatives when considering the total cost of ownership, in the near term they are often more expensive for many use cases. As a result, even with decreasing battery costs and improved range and charging times, demand is not yet sufficient to match the pace of the needed transition and will still require near-term federal and state policy support.

In the absence of sufficient regulatory tools and new incentives to increase demand for zero-emission trucks, and given the urgent need to boost demand for heavy-duty zero-emission trucks, the Center for Law, Energy & the Environment (CLEE) at UC Berkeley and the UCLA Law Emmett Institute on Climate Change and the Environment convened experts and stakeholders in May 2025 to articulate a vision for the heavy-duty zero-emission vehicle market, help identify the most pressing barriers to reaching that vision, and propose actionable solutions. This report summarizes the recommendations from that gathering, along with a literature review.

By 2035, participants envisioned a significant increase in sales and deployment of heavy-duty zero-emission vehicles, ranging from 30% to 100% of heavy-duty truck sales. In this vision, every freight use case would transition to zero-emission solutions by that year, while heavy-duty zero-emission vehicles would reach either total cost of ownership or upfront-cost parity with diesel trucks, or surpass them to become the more economical and therefore more desirable choice.

TOP BARRIERS AND SOLUTIONS FOR INCREASING HEAVY-DUTY ZERO-EMISSION VEHICLE DEMAND

BARRIER I: LACK OF POLICY SUPPORT TO DRIVE DEMAND

SOLUTIONS

The California Legislature could direct the Public Utilities Commission or Air Resources Board to create a Clean Miles Standard for freight, which would require shippers to meet a certain percentage of the miles their goods travel via clean technologies, like heavy-duty zero-emission vehicles.

The California Air Resources Board could create a statewide Indirect Source Rule under the Clean Air Act, which would regulate facilities like ports and warehouses that generate pollution indirectly by attracting mobile sources of emissions like trucks, requiring emission reductions from that vehicle traffic.

The California Air Resources Board could initiate new regulations under the Clean Air Act to drive zero-emission truck adoption by setting emission standards for heavy-duty vehicles that help transition the trucking industry to zero-emissions over time.

The California Governor's Office and Department of General Services could create government procurement regulations requiring purchase or lease of zero-emission trucks and direct the Department of General Services to implement and oversee them, which would increase demand for zero-emission heavy-duty vehicles overall.

The Governor's Office of Business and Economic Development could help facilitate aggregation of shipper demand by coordinating various efforts and groups to enhance collective truck purchasing power and aggregating shipper demand for zero-emission freight initiatives to reduce supply chain and vehicle costs.

The Governor's Office and state agencies could support large-scale infrastructure deployment by identifying priority corridors to direct zero-emission vehicle infrastructure and related deployment, expanding the existing "ZEV Ready Zones" that are equipped with the necessary infrastructure, policies, and planning to facilitate the transition.

BARRIER II: HIGH TOTAL COST OF OWNERSHIP

SOLUTIONS

The California Legislature could create long-term, consistent, flexible, and stackable incentives for zero-emission truck purchases to reduce investment risk and uncertainty about incentives.

The Governor's Office of Business and Economic Development could facilitate coordination of incentives by periodically convening administering entities such as ports, utilities, and agencies, or organizing in-depth sessions aimed at streamlining, restructuring, and coordinating across the various entities and incentives.

The California Legislature could create revenue neutral, self-funding incentive programs for heavy-duty zero-emission vehicles, in which fees on non-zero-emission vehicles fund rebates for zero-emission vehicles.

The California Legislature could create tax credits for heavy-duty zero-emission vehicles to help offset the purchasing cost of a new zero-emission heavy-duty vehicle.

The California Legislature could exempt heavy-duty zero-emission vehicles from the state sales tax or ensure they are taxed no more than their diesel-counterparts to bolster the early adoption of heavy-duty zero-emission vehicles and enhance market competitiveness.

The California Legislature and Department of Motor Vehicles could equalize registration fees to ensure that zero-emission trucks do not pay more for registration than diesel trucks, based on their purchase price and vehicle weight, among other factors.

Federal leaders could exempt medium- and heavy-duty zero-emission vehicles from the federal excise tax and reinstate tax credits to reduce costs, such as by maintaining and re-authorizing sections 45X (the Advanced Manufacturing Production Credit) and 45W (the Clean Commercial Vehicle Credit) in the federal tax code.

Ports could create incentive programs for zero-emission heavy-duty vehicles, such as by providing green lanes, preferential reservation, or reduced fees for zero-emission vehicles.

The California Public Utilities Commission could continue to help improve energization timelines for charging infrastructure and address fueling constraints to help lower total cost of ownership for fleets.

The California Legislature and Air Resources Board could modify the Low Carbon Fuel Standard in future years to increase support for zero-emission heavy-duty vehicles by shifting a greater share of credit value under the program from biofuels towards electrification, including vehicle charging infrastructure.

The California Public Utilities Commission and Energy Commission could continue integrated planning and policy initiatives that support and enable proactive grid planning, particularly in anticipation of load growth amid accelerated electrification.

The California Legislature and Transportation Commission could adapt the existing Trade Corridor Enhancement Program to better align with the needs of zero-emission vehicle infrastructure development projects, including charging stations.

The California Legislature and Public Utilities Commission could speed deployment of distributed energy resources that enhance charging infrastructure by streamlining permitting and increasing regulatory clarity.

California municipal utility leaders could adopt Rule 29 procedures to support electric vehicle charging infrastructure deployment, which could accelerate needed

deployment in the service territories of utilities like the Los Angeles Department of Water and Power.

The California Legislature, Public Utilities Commission, and electric utilities could extend demand-charge "holidays" or offer other mitigation options and create a customer rate class for heavy-duty customers, waiving or reducing demand charges for charging stations and giving fleets and heavy-duty charging depot operators the opportunity to deploy zero-emission trucks and experiment with charging strategies to reduce risks.

The California Legislature could take specific programs and costs out of electricity rates to lower them—i.e., by excluding wildfire costs—and make heavy-duty zero-emission vehicle charging much more affordable to achieve cost parity quicker.

The California Legislature could create electricity tax breaks for medium- and heavy-duty charging station meters to further reduce fueling costs.

Congress could extend the Alternative Fuel Vehicle Refueling Property Credit (section 30C of the tax code), which provides incentives for installing qualified alternative fuel vehicle refueling infrastructure, including electricity or hydrogen charging ports.

BARRIER III: NEGATIVE PERCEPTIONS OF HEAVY-DUTY ZERO-EMISSION VEHICLES

SOLUTIONS

Industry leaders and advocates could address mis- and disinformation through trusted messengers who share success stories with fleets, shippers, and policymakers.

Industry leaders and advocates could address the politicization of zero-emission trucks by focusing on the co-benefits of deployment, including improved global competitiveness, supply chain resilience through diversity of options for product shipping, more sustainable economic growth, and increased consumer choice and personal freedom.

The Governor's Office of Business and Economic Development, the California Air Resources Board, and industry leaders (particularly fleet owners) could enable peer-to-peer learning by convening industry representatives and emphasizing opportunities for improved cost and increased demand, as well as highlighting specific use cases.

This report contains more information on these top barriers and recommendations, as well as background on zero-emission heavy-duty vehicles.

Photo provided by EV Realty

II. INTRODUCTION

California and jurisdictions around the world will need to transition to heavy-duty zero-emission vehicles, both to address air pollution, particularly in marginalized communities, and to reduce greenhouse gas emissions.

Pollution from diesel trucks poses significant health risks. California's heavy-duty vehicles (including the focus of this report: a wide range of long-haul trucks, vocational, and drayage trucks) are responsible for a disproportionate share of smog-causing pollutants and toxic air contaminants. Diesel exhaust has been linked to cancer, heart attacks, asthma, and allergies.[1] Premature deaths associated with this exhaust globally cost nearly 1 trillion US dollars per year.[2] In California alone, diesel particular matter is estimated to lead to approximately 1,400 premature deaths from cardiovascular disease.[3] Experts estimate that 70% of cancer risk related to air toxins in California stem from diesel engine emissions.[4] These emissions particularly affect lower-income and racially marginalized communities that are disproportionately located near freight facilities, ports and highway corridors.[5]

Medium- and heavy-duty trucks are also major contributors to greenhouse gas emissions, causing roughly 23% of transportation emissions in the United States, while the sector overall contributes 29% of all U.S. greenhouse gas emissions.[6] Furthermore, U.S.-wide greenhouse gas emissions from medium- and heavy-duty trucks show a clear upward trend from 1990 to 2022.[7] Although California has seen greenhouse gas emissions from heavy-duty trucking decrease since 2000, the transportation sector overall still accounts for 39% of California's greenhouse gas emissions, and more when factoring in emissions from fossil fuel production within the state.[8] Although trucks make up only 6% of all vehicles in California as of 2023, they accounted for 25% of the state's on-road greenhouse gas emissions and 35% of transportation-caused nitrogen oxide emissions.[9] Notably, these statistics do not differentiate between emissions from older trucks and newer ones that meet more recent emission standards. Older in-use vehicles that lack modern emission reduction technology can emit even higher levels of nitrogen oxides and other pollutants, therefore potentially generating a disproportionate amount of truck emissions and underscoring the urgent need to transition them to zero-emission

models.[10] Otherwise, without significant reductions in these on-road vehicle emissions, the state will be unable to meet its climate goals, including achieving carbon neutrality by 2045.[11]

Zero-emission vehicles, particularly battery electric trucks but also hydrogen fuel cell vehicles, can help reduce this pollution and its public health, air quality, and climate impacts.[12] According to a modelling study by Ledna et al. (2024), a full transition to zero-emission truck sales by 2035 could result in a 65% reduction in greenhouse gas emissions by 2050, compared to 2019 levels.[13] Life cycle assessments show that even when considering indirect emissions (e.g., from producing truck parts), both hydrogen and electric trucks lead to significant emission reductions compared to their diesel counterparts.[14] They can contribute to several state goals, including a carbon-free electricity grid by 2045,[15] clean air mandates,[16] criteria pollutant reduction goals,[17] greenhouse gas emission reductions of 40% below 1990 levels by 2030, and the aforementioned statewide carbon neutrality by 2045.

The following sections outline the current landscape of heavy-duty zero-emission vehicle developments, incentives and regulations, in order to understand drivers and barriers to deployment and inform strategies for boosting demand.

HEAVY-DUTY ZERO-EMISSION VEHICLE COST, DEPLOYMENT, AND INFRASTRUCTURE

Heavy-duty vehicles are vehicles with a gross weight of 26,001 pounds or more. They are divided into Class 8 (over 33,001 pounds; including cement mixers and dump trucks) and Class 7 (26,001-33,000 pounds; including refuse, box, and tow trucks). Medium-duty vehicles are vehicles with a gross weight of 10,001 to 26,000 pounds.

Medium- and heavy-duty zero-emission vehicle sales in California are increasing. From 2022 to 2023, they more than doubled from 8,009 sales in 2022 to 18,473 sales in 2023 and almost doubled again to 30,026 sales in 2024.[18] 1 in 4 medium- and heavy-duty vehicles sold in California in 2024 was a zero-emission vehicle, indicating positive trends.[19] However, continued policy support will still be necessary to reach the state's goal of 100% medium- and heavy-duty zero-emission vehicles.

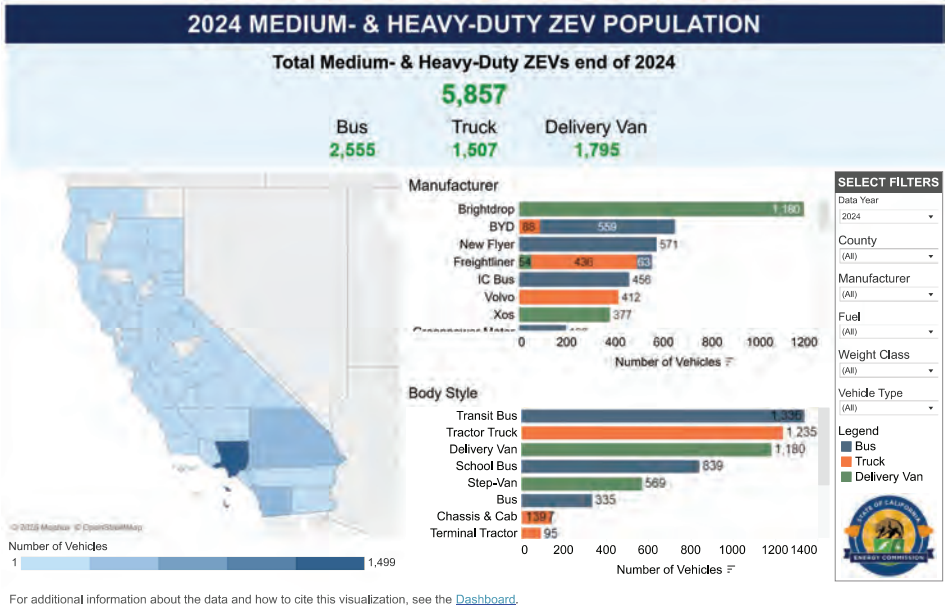

Figure 1 Zero-Emission Truck Population in California, end of 2024 (Source: CALSTART).

As of report publication, CALSTART's Drive to Zero database listed 24 original equipment manufacturers that produce and sell 44 different models for Class 7 and 8 zero-emission vehicles.[20] U.S. manufacturers include BYD Auto, Daimler Truck North America, Peterbilt Motors, and Volvo Trucks. In addition to manufacturers, key actors in the trucking industry include fleets (carriers) that own or operate multiple trucks, shippers that own the goods being transported (e.g., Walmart, Amazon, PepsiCo, Frito Lay), owner-operators that own and operate a truck and often work as contractors to larger carriers, and owners and operators of major freight hubs (like ports). Utilities and energy providers also build infrastructure to deliver electricity or hydrogen to the vehicles. These actors operate within a policy and regulatory framework that can drive or slow zero-emission vehicle adoption.

Vehicle costs and sales

The upfront costs of zero-emission vehicles play a key role in their deployment. The cost is currently higher than the cost of their fossil-fueled counterparts.[21] Based on data from California's hybrid and zero-emission truck voucher invoices, the "average US/California zero-emission Class 8 truck" in 2024 was priced at $435,839, compared to the average diesel truck price of $155,902.[22] Yet the global market indicates these prices in California are higher than in other places. For example, a similar Class 8 zero-emission truck in Europe was priced much lower at $342,000.[23] And while the 2024 median price of a battery electric truck was $379,800 in the U.S., China's average price was $119,600.[24] Furthermore, a recent report by the International Council on Clean Transportation (ICCT) showed that prices for Class 6 and larger battery electric trucks are increasing in the U.S., whereas prices in the European Union have decreased.[25] Based on this global data, the higher upfront cost in California should likely diminish in the near term and disappear in the long term: ICCT estimated that Class 8 battery electric trucks will reach cost parity with their diesel counterparts by 2040, whereas

hydrogen trucks are unlikely to do so.[26] Globally, the numbers of zero emission medium- and heavy-duty trucks are growing, with prices trending towards parity with diesel counterparts.[27]

Zero-emission trucks in some market segments (though not yet for Class 8 vehicles) are already price competitive with fossil fuel alternatives when considering the total cost of ownership, though in the near term they are more expensive for many use cases. This metric includes the upfront purchasing costs along with the cost of operation, such as labor, maintenance, and fuel for hydrogen and battery electric trucks.[28] ICCT estimated that battery electric trucks will reach total cost of ownership parity with diesel trucks by 2030 in California.[29] Modelling estimates for the entire U.S. by Ledna et al. (2024) suggested that improvements in fuel prices, tax incentives, and continued advancements in technology can lead to total cost of ownership parity with diesel trucks across all market segments by 2035.[30] In the near term, battery electric trucks suffer on total cost of ownership parity due to long charging times, inadequate fueling infrastructure, limited range, and high battery weight that can restrict payload capacity.[31] For hydrogen trucks, inadequate refueling infrastructure poses a challenge.[32] Yet today, the total cost of ownership for certain duty cycles in California is already similar to that of conventional vehicles (though not yet the case for Class 8 tractors or trucks), even in the absence of grants or rebates.[33]

Technological advancements can speed up this development, for instance through the development of solid state batteries that are lighter, more energy dense to improve range, and faster to charge.[34] Megawatt Charging System technology (developed by CharIN and the National Renewable Energy Laboratory)[35] can significantly reduce charging times to under 30 minutes, compared to 80% charge in 40 minutes to 2.5 hours for a 600kWh battery using a direct current fast charger.[36] The first charging station using this system opened in Bakersfield, California, in May 2024.[37]

Infrastructure development

Charging infrastructure for heavy-duty vehicles remains underdeveloped, with substantial time required for deployment.[38] Improved infrastructure could lower the costs of operation by reducing charging times and therefore improving total cost of ownership. The California Energy Commission's Medium-and Heavy-Duty Zero Emission Vehicle Charging and Hydrogen Infrastructure Map indicated 20,093 electric vehicle and hydrogen fueling positions (both completed and in development) in California as of October 2025.[39] In addition to the charging stations themselves, infrastructure development for electric trucks requires electricity grid expansion, including transmission and distribution lines. Slow energization (connecting facilities to the grid) timelines and lengthy utility and related infrastructure planning processes inflict operational costs and disincentivize deployment. To address this issue, the California Public Utilities Commission established statewide energization timelines in September 2024, including for EV charging stations.[40]

Electricity rates indirectly affect the costs of hydrogen fuel and directly influence the charging costs for electric trucks. Electricity rates in California have been surging in the past ten years, due primarily to wildfire mitigation costs, as well as infrastructure maintenance and development, clean energy policies and programs, and complex rate structures.[41] Both electric and hydrogen technologies for heavy-duty zero-emission vehicles rely on electricity supplies. Electric trucks directly use electricity, whereas

hydrogen primarily requires electricity in the production process (electricity use varies depending on the type of hydrogen).[42] Zero-emission hydrogen and electric charging also rely on sufficient and affordable renewable energy. Policies and incentives that influence these factors can help reduce fueling costs for zero-emission vehicles and therefore reduce the total cost of ownership. Modelling estimates by Ledna et al. (2024) suggested that long-haul applications for heavy-duty zero-emission vehicles in the U.S. will become cost competitive when charging costs fall below $0.18 per kilowatt hour, and hydrogen fuel cells will achieve cost parity when hydrogen prices drop below $5 per kilogram.[43]

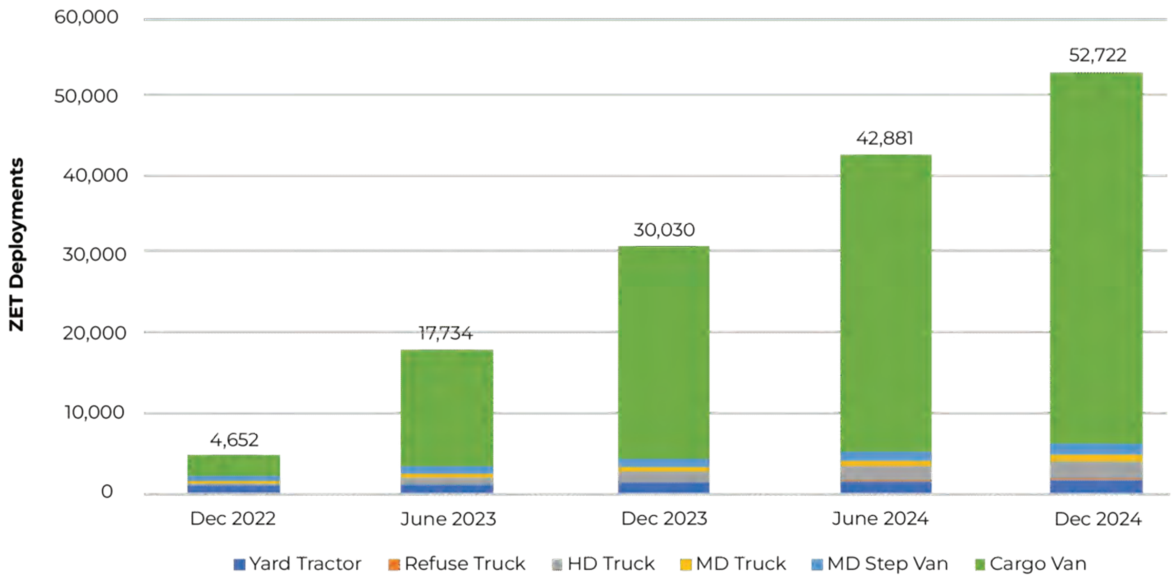

Figure 2 Cumulative Zero-Emission Trucks by reporting period (Source: CALSTART)[44]

Despite the challenges, the U.S. medium- and heavy-duty zero-emission vehicle market has gained momentum in recent years, as every heavy-duty vehicle segment in the U.S. saw growth in 2024.[45] Atlas EV Hub reported 120,000 electric medium-and heavy-duty vehicle sales in the U.S. for 2024 (compared to a few hundred annual sales before 2021).[46] The majority of these vehicles were Class 2B and 3 vehicles (vans, buses, and smaller trucks). For Classes 4-8, electric vehicle sales increased from 896 in 2023 to 3,435 in 2024.[47] In 2025, 192 different medium- and heavy-duty zero-emission models were available in the U.S., most of which were medium-duty trucks.[48]

California and United States Policies, Programs, and Incentives to Boost Heavy-Duty Zero-Emission Vehicle Deployment and Infrastructure

California has embraced wide-scale deployment of commercially available zero-emission vehicles where feasible, including medium- and heavy-duty trucks, to achieve the state's

long-term air quality, climate, and public health goals. Federal policies and incentives also continue to shape the zero-emission truck landscape, though 2025 has brought notable changes. Congress has paused, repealed or downsized several key programs under the Inflation Reduction Act. The federal government also repealed Clean Air Act waivers that previously supported California's authority to set stricter vehicle standards, though the state is challenging that repeal in federal court. These changes create uncertainty for fleets and infrastructure developers. In response, state action to support and accelerate zero-emission vehicle deployment seeks to reaffirm and expand the state's commitment to clean trucks. For a full list of current federal and California programs and incentives, see Appendix II.

In addition to the federal and state governments, private entities, ports and regional entities contribute to heavy-duty zero-emission vehicle deployment. For instance, ports can create incentives such as exempting zero-emission trucks from loading fees.[49] Local air districts operate on a regional scale and play a role in implementing different regulatory and incentives programs and local initiatives. Much of the private sector's initial investments focused on the light-duty transportation sector. For example, as part of its diesel scandal settlement with California and the U.S., Volkswagen is investing two billion dollars on ZEV infrastructure and consumer education through its charging company Electrify America.[50] And since the Inflation Reduction Act passed, private investments in medium- and heavy-duty charging infrastructure increased.[51] How private investments will develop after the repeal of these federal incentives remains to be seen.

URGENT NEED TO INCREASE DEMAND FOR HEAVY-DUTY ZERO-EMISSION VEHICLES

While truck makers are producing more heavy-duty zero-emission models with improved range and charging times, demand is not yet sufficient to match the pace of the needed transition. The key inhibitors that limit demand for heavy-duty zero-emission vehicles include high upfront vehicle costs, insufficient charging infrastructure and operational challenges. Furthermore, the federal government's recent actions have undermined this transition. As discussed, congressional invalidation of the Environmental Protection Agency's previous approval of California's waiver request to institute the Advanced Clean Trucks rule along with the termination of key zero-emission heavy-duty vehicle incentives included in the Inflation Reduction Act have dramatically scaled back important demand drivers. Furthermore, California's withdrawal of its waiver request from the Environmental Protection Agency for the Advanced Clean Fleets regulation and the Environmental Protection Agency's proposed repeal of the 2009 endangerment rule, which is the legal basis for regulating greenhouse gas emissions of vehicles under the Clean Air Act,[52] created significant headwinds for zero-emission heavy-duty vehicle demand.

In the absence of regulatory tools and new incentives to increase demand for zero-emission trucks, and given the urgent need to boost demand for heavy-duty zero-emission, the Center for Law, Energy & the Environment (CLEE) at UC Berkeley and the UCLA Law Emmett Institute on Climate Change and the Environment convened experts and stakeholders to articulate a vision for the heavy-duty zero-emission vehicle market, help identify the most pressing barriers to reaching that vision, and propose actionable solutions. CLEE and the Emmett Institute then combined desk research

and a half-day workshop with a select group of stakeholders to identify key barriers and inform the solutions presented in this report.

On May 19, 2024, the law schools organized an expert convening at UCLA to identify the key barriers and solutions to boost demand for heavy-duty zero-emission vehicles in California. Attendees included state leaders, industry representatives, environmental advocates, and other stakeholders (see Appendix I for list of attendees), who identified the key public and private sector actions. The following sections summarize and combine the key consensus findings from this convening, including the vision for enhanced demand, priority barriers inhibiting demand, and the recommended actions to address them.

Photo provided by Daimler Truck North America

III. VISION FOR THE HEAVY-DUTY ZERO-EMISSION VEHICLE MARKET IN CALIFORNIA

During the May 2025 convening, participants outlined a comprehensive vision for the heavy-duty zero-emission vehicle market by 2035, as well as a nearer-term vision.

NEAR-TERM VISION

Early adoption and market stability: Participants emphasized the need to focus on supporting early adopters and developing strategies to facilitate broader adoption for the next group of implementors. Overcoming the 'great pause'—the current slowdown or delay in adoption and deployment of zero-emission trucks—would be essential for driving this momentum and facilitating increased adoption. This near-term development would be characterized by non-prescriptive, flexible rules and incentives focused on lowering market entry barriers.

Regional-focused strategies to accelerate infrastructure development: Strategies for increasing heavy-duty zero-emission vehicle adoptions would include accelerated infrastructure deployment, focusing on region-specific policies and incentives. These would include priority locations for clean freight corridors and ports, where a combination of incentives and committed stakeholders can build out the infrastructure ecosystem.

Collaboration and innovative approaches: To accelerate deployment and improve total cost of ownership, manufacturers, fleet operators, policymakers, and infrastructure developers would collaborate to accelerate meaningful deployments beyond small pilots, ensuring access to affordable, high-quality trucks, as well as pilot programs for battery swap deployment.

Foundation for long-term market development: Stakeholders would target their actions toward sustained incremental progress to reach the 2035 goals outlined below. This trajectory would involve continuously improved energization timelines and identifying the leading zero-emission technology—whether hydrogen fuel cells or battery-electric—to allow for more targeted strategies. By 2030, industry would achieve

total cost of ownership parity across all freight modes, with infrastructure, vehicle capability and cost constraints no longer posing a barrier to widespread heavy-duty zero-emission vehicle adoption.

VISION FOR 2035

Heavy-duty zero-emission vehicle market share: Participants envisioned a significant increase in sales and deployment of heavy-duty zero-emission vehicles, ranging from reaching close to 30% to 100% of all truck sales. Every freight use case would transition to zero-emission solutions. At the same time as they advance heavy-duty zero-emission vehicles, industry leaders would continue to improve combustion truck fuel efficiency for diverse technology options.

Zero-emission business case: By 2035, participants envisioned heavy-duty zero-emission vehicles reaching either total cost of ownership or upfront cost parity with diesel trucks, or surpassing them to become the more economical and therefore more desirable choice. This parity would contribute to strong demand driven by performance and affordability, higher density, and lower cost batteries and abundant public charging infrastructure. The market would have reached a tipping point at which it can stand on its own without substantial incentives. A robust secondary market would exist for heavy-duty zero-emission vehicles.

Grid infrastructure and electricity supply: Grid infrastructure would be sufficient with improved public charging with charger reliability and redundancy. This expansion would be supported by targeted clean energy development and affordable electricity ensuring economic feasibility.

Regulatory certainty and market efficiency: Infrastructure development would be driven by faster permitting and energization timelines, reduced regulatory uncertainty, and faster permitting for infrastructure development. Improved coordination among utilities, industry, regulators, and the legislature would drive this development.

Perception of heavy-duty zero-emission vehicles: Participants envisioned that consumer, investor, and policymaker perceptions of heavy-duty zero-emission vehicles will improve with success stories, drawing from examples in California and other states. Debates over heavy-duty zero-emission vehicles would be depoliticized, letting rational economic decision-making prevail.

Equity and public health: By 2035, heavy-duty trucking emissions would not negatively impact public health, especially in environmental justice communities. High-pollution areas, like drayage hubs, would have transitioned to zero-emission solutions.

Photo by Stock.Adobe

IV. BOOSTING DEMAND FOR HEAVY-DUTY ZERO-EMISSION VEHICLES: BARRIERS & SOLUTIONS

Participants at the May 2025 convening identified three priority barriers hindering the realization of this vision for the heavy-duty zero-emission vehicles market. They then developed a list of policies and other actions that state and local (and federal) leaders, as well as private sector actors, could take to overcome these barriers and achieve the needed demand.

BARRIER I: LACK OF POLICY SUPPORT TO DRIVE DEMAND

Participants identified lack of demand as the primary overarching barrier to widespread heavy-duty zero-emission vehicle adoption, as manufacturers and infrastructure developers hesitate to scale production without demand. Lack of demand is caused in part by the high total cost of ownership and perception issues (discussed in more detail below).[53] Insufficient and difficult-to-access incentives to offset high costs and operational disadvantages in comparison to diesel trucks—caused by infrastructure uncertainty and range limitations—fail to address the lack of demand.[54] With larger fleet operators ineligible for certain incentives, they are less likely to participate in the transition to zero-emission solutions.

In addition, regulatory uncertainty and associated market instability further slow demand. For instance, the repeal of California's Advanced Clean Fleets rule[55] and (potentially temporary) loss of waiver authority for 100% zero-emission vehicle sales mandates send inconsistent policy signals and thus challenge long-term planning for fleet operators and manufacturers.[56] In the absence of clear rules, mandates and sufficient incentives, infrastructure developers, fleet operators and manufacturers will hesitate to make investments until zero-emission vehicles become the more economic choice across freight applications.[57]

SOLUTIONS

The California Legislature could direct the Public Utilities Commission and/or Air Resources Board to create a "Clean Miles Standard" for freight

Legislators and agencies could require shippers to meet a certain percentage of the miles their goods travel via clean technologies, like heavy-duty zero-emission vehicles. Shippers would then need to consider these "clean mile" provisions when contracting with freight carriers. Depending on the design of the program, implementation authority could lie with the California's Public Utilities Commission or Air Resources Board. Legislators and agencies could model this approach on the existing Clean Miles Standard for transportation network companies (such as Uber or Lyft), which requires ridesharing providers to gradually increase the percentage of miles travelled using zero-emission vehicles.[58] Regulators enforce the program through annual compliance targets that entail penalties for companies failing to meet them, which includes reporting requirements and financial assistance (funded via a per-trip fee collected by the companies but administered through a state-regulated program) for drivers to transition to zero-emission vehicles. Like the Clean Miles Standard for ridesharing, the state would need to design compliance to avoid federal preemption challenges. For instance, by focusing on performance (e.g., clean miles travelled) and not directly regulating carriers, the state could avoid conflicting with federal laws that limit state authority over vehicle standards and trucking operations.

The California Air Resources Board could create a statewide Indirect Source Rule under the Clean Air Act

Indirect Source Rules under the Clean Air Act allow local air districts to regulate facilities like ports and warehouses that generate pollution indirectly by attracting mobile sources of emissions (like trucks). The Air Resources Board could create a statewide Indirect Source Rule to ensure consistent regulatory oversight and maximize effectiveness in reducing emissions. A statewide rule would build on existing regional rules, which seek to reduce emissions from vehicle traffic or construction equipment associated with stationary sources.[59] As an example, the South Coast Air Quality Management District established the Warehouse Actions and Investments to Reduce Emissions Program in 2021.[60] It included requirements for reporting and compliance for warehouse owners and operators and has led to increased deployment of heavy-duty zero-emission vehicles and charging stations.[61] To comply, warehouse owners and operators can choose from a catalog of actions to reduce emissions, including transitioning to heavy-duty zero-emission vehicles or paying a fine. Other examples of Indirect Sources Rules include the San Joaquin Valley Air Pollution Control District's points-based program for large developments, as well as proposed rules in San Diego County and in New York City.[62]

In February 2025, Assemblymember Robert Garcia introduced Assembly Bill 914 to affirm that the Air Resources Board has authority to address air pollution from indirect sources.[63] Lawmakers placed the bill on hold to allow more time for stakeholder negotiations over compliance costs and regulatory details, and the bill may return for a floor vote in early 2026. If the legislature and governor approve the bill, the California Air Resources Board would be primarily responsible for developing a statewide rule to regulate indirect sources of vehicular air pollution.[64] Furthermore, in their 2025 report to the governor on zero-emission vehicle deployment policies, the state's key transportation agencies recommended developing and implementing a statewide indirect

source rule.[65] Some participants highlighted the importance of ensuring continued availability of incentives if and when the state implements an Indirect Source Rule in order to ensure feasibility of compliance.

The California Air Resources Board could initiate new regulations under the Clean Air Act to drive zero-emission truck adoption

The California Air Resources Board maintains authority under the Clean Air Act to adopt vehicle emission standards that are more stringent than federal requirements.[66] The board could begin a new set of regulations to drive zero-emission truck adoption, which could be ready to be submitted to the next federal Environmental Protection Agency for a federal waiver request.

The California Governor's Office and Department of General Services could create government procurement regulations

The governor could issue an Executive Order to establish procurement policies requiring purchase or lease of zero-emission trucks and direct the Department of General Services to implement and oversee them.[67] Procurement policies and programs, such as the Environmentally Preferable Purchasing Program[68] and the City of San Francisco's Buying Green Mandate,[69] help state agencies and local governments to prioritize more sustainable goods and services in their procurement. Statewide government procurement regulations that target deliveries to state agency locations could require or incentivize state institutions to prioritize zero-emission services. This policy could encourage shippers and carriers to provide these services and thus increase demand for zero-emission heavy-duty vehicles.

The Governor's Office of Business and Economic Development could help facilitate aggregation of shipper demand

The Governor's Office of Business and Economic Development (GO-Biz) could coordinate various efforts and groups to enhance collective truck purchasing power and aggregate shipper demand for zero-emission freight initiatives to reduce supply chain and vehicle costs. Convening participants pointed out that multiple coordination efforts are underway, including the Smart Freight Center's Zero-Emission Truck Shipper-Carrier Alliance, which aggregates demand for battery electric trucks and supports the build out of a charging infrastructure network along Interstate 10 between Los Angeles and El Paso, Texas.[70] The alliance aims to address two challenges: first, shippers have trucks operating in their supply chains that they do not own but that are the source of scope 3 emissions (which are indirect emissions that occur across the value chain)[71] for these companies; and second, carriers do not have the purchasing power individually to impact vehicle costs or infrastructure development. The Alliance aims to generate a large-scale order (up to ten Class 8 battery electric trucks with a 400-mile range at a target price below $250,000 per vehicle), enabling a three-year payback period based on total cost of ownership, with plans for deployment by 2026. This timeline and volume can provide the demand certainty to trigger supply chain cost reductions and to support forward-pricing from manufacturers. Shippers would benefit from affordable zero-emission road freight, while carriers gain access to discounted trucks, guaranteed volumes, and a charging network where they are operating. GO-Biz and other state agencies could similarly engage additional shippers and carriers in the effort and thus build more scale.

Other coordination efforts include CALSTART's initiative to accelerate heavy-duty zero-emission vehicle deployment along the Interstate 10 corridor,[72] electrification coordination efforts (such as by the California Public Utility Commission[73] or the City of Long Beach's Zero-Emission Vehicle Infrastructure Blueprint[74]), and GMA Trucking's request for proposals for carriers looking to transition to zero-emission fleets.[75] GO-Biz could leverage these efforts to facilitate a more coordinated effort to aggregate buyers. The initial phase of these efforts could involve convening key stakeholders, which participants estimated currently include approximately 15-20 companies and institutions. This gathering would serve to facilitate information sharing on ongoing initiatives and establish discourse on how to move toward market aggregation.

The Governor's Office and state agencies could support large-scale infrastructure deployment along priority corridors by identifying new "ZEV Ready Zones" (areas equipped with the infrastructure, policies, and planning needed to support zero emission vehicles)

Because lack of infrastructure development suppresses demand, the Governor's Office could support large scale infrastructure deployment efforts by identifying "zero-emission vehicle ready"[76] zones along the 617 designated priority freight corridors the California Transportation identified in its 2023 Clean Freight Corridor Efficiency Assessment. Senate Bill 671 (Gonzalez, 2021) required this identification of freight routes as priority areas for investment, risk mitigation and regulatory streamlining.[77] Building on the California Transportation Commission's efforts to plan and implement priority clean freight corridors,[78] the governor could direct GO-Biz and other state agencies to coordinate these efforts and invite shippers to prioritize corridors for zero-emission vehicle infrastructure and deployment. Corridor selection efforts could also consider environmental justice concerns. In addition, the Governor's Office could initiate a centralized cross-agency delivery team to streamline implementation for priority corridors and projects, cutting red tape and coordinating necessary approvals and permits to accelerate adoption. For priority corridors, additional risk mitigation measures, such as guaranteed freight contracts for zero-emission vehicle fleets, could further reduce uncertainty for fleets investing in zero-emission vehicles. Such priority efforts would rely on a coalition of committed industry leaders to provide consistent demand signals for manufacturers.

BARRIER II: HIGH TOTAL COST OF OWNERSHIP

Convening participants identified high total cost of ownership as a critical barrier to heavy-duty zero-emission vehicle demand and adoption, as fleet operators assess the financial viability of transitions from diesel trucks. Total cost of ownership is influenced by a wide range of factors, including vehicle purchasing and operational costs, including fueling.[79] Participants noted that high vehicle costs are in part caused by the prevalent independent owner-operator business model and lack of demand aggregation that prevent smaller-scale buyers from achieving economies of scale. In addition, because sales tax and registration costs are based on a vehicle's purchase price, the higher zero-emission truck upfront costs compared to diesel counterparts means that the state's tax and registration regime effectively penalizes zero-emission vehicle purchasers for choosing cleaner technology. Participants also discussed the compounding challenges of high electricity rates, grid bottlenecks, limited vehicle ranges, long charging times, and insufficient infrastructure, partly due to challenging permitting and infrastructure

development processes. Operationally, electric trucks can often exceed weight limits on certain highways due to heavy batteries, which potentially restricts their highway access and adds to costs. This dynamic is exacerbated by a lack of an externality penalty on pollution from diesel trucks. Finally, the lack of a secondary market and uncertainty pertaining to the residual values of used vehicles increases the financial uncertainties for both buyers and investors.

SOLUTIONS

The California Legislature could create long-term, consistent, flexible, and stackable incentives for truck purchases

States agencies like California's Air Resources Board, Energy Commission, and Public Utilities Commission administer multiple incentive programs, though many of these programs are subject to annual appropriations that can fluctuate and create uncertainty. The legislature, in partnership with these agencies, could establish robust, long-term, and consistent incentive programs to reduce investment risk and uncertainty about incentives. They could ensure incentive eligibility for large fleets to engage them in large-scale deployment efforts. Grant programs could focus on merit-based grant awards that consider factors such as the number of vehicles served, projected emission reductions, and the applicant's capacity to complete the project, in order to ensure funds go to high-impact projects. In the absence of the Advanced Clean Fleets rule and other regulations, policymakers may need to develop more market-oriented incentives to make up for the policy gap. They could gear these incentives toward offsetting costs and ultimately reaching cost parity with diesel trucks. Options include adjustments to the following programs and funds:

- Greenhouse Gas Reduction Fund: a program that channels funds from auctioning allowances through the cap-and-invest program into climate, equity and clean energy investments to reduce greenhouse gas emissions. The legislature could establish a continuous, multi-year appropriation for clean transportation from the fund, which would reduce reliance on annual budget cycles and send appropriate signals to market participants.
- The Low Carbon Fuel Standard: the California Air Resources Board designed the Low Carbon Fuel Standard to reduce greenhouse gas emissions from transportation fuels by incentivizing the production of low-carbon fuels. This market-based program sets an annual target for reducing the carbon intensity of fuels. Depending on their carbon footprint, fuels have a high carbon intensity score (e.g., diesel) or a lower score (e.g., electricity or hydrogen).[80] Producers of low-carbon fuels generate credits that they can sell to producers of high-carbon fuels that need to buy credits to comply with the standard. The credit trading system can potentially lower the cost of less carbon intensive fuels and incentivize innovation. The legislature and Air Resources Board could modify the program in future years to increase support for zero-emission heavy-duty vehicles (more details in Appendix II).

Some convening participants were also engaged in amendments to programs like the Hybrid and Zero-Emission Truck and Bus Voucher Incentive Program, which offers vouchers to fleets to help offset the costs of purchasing zero-emission trucks and buses

(funded via the Greenhouse Gas Reduction Fund). They wanted to see more alignment among these incentive programs, while ensuring that they not be overly prescriptive.

The Governor's Office of Business and Economic Development could facilitate coordination of incentives

Multiple entities offer incentives in California, including utilities, ports, air districts, the California Air Resources Board, Energy Commission, and State Transportation Agency. GO-Biz could help align these various efforts by periodically convening these entities for in-depth sessions aimed at streamlining, restructuring, and coordinating across the various entities and incentives. This effort would require GO-Biz to navigate the legislatively prescribed timelines of incentive programs, which a single agency cannot change unilaterally. GO-Biz could begin by establishing a central portal that consolidates all incentive programs in a single location, making them easier to access and navigate.

The California Legislature could create revenue neutral, self-funding incentives programs for heavy-duty zero-emission vehicles

The state could create a "feebate" program, in which fees on non-zero-emission vehicles fund rebates for zero-emission vehicles. For example, ICCT suggested a "a revenue- and technology-neutral manufacture incentive program that encourages cleaner internal combustion engine vehicle sales while providing the largest incentives to zero-emission vehicles."[81] The program would charge manufacturers a pollution fee, based on a baseline of a performance-based measure of pollution, and use the revenue to fund a zero-emission vehicle sales incentive for manufacturers. This solution would not require a federal waiver but could potentially require a two-thirds vote in the California Legislature.

The California Legislature could create tax credits for heavy-duty zero-emission vehicles

The state could create tax credits to help offset the purchasing cost of a new zero-emission heavy-duty vehicle. In its report to the Governor on zero-emission vehicle deployment, the state's transportation-related agencies recommended policies to "backfill the federal tax credits" that ended after September 30, 2025.[82] To support zero-emission vehicle sales and help expand the used vehicle market, the state could provide vouchers, rebates, or other credits for used and new vehicle purchases, both individual and in bulk.[83]

The California Legislature could exempt heavy-duty zero-emission vehicles from the state sales tax or ensure they are taxed no more than their diesel counterparts

The state could exempt zero-emission vehicle truck purchases from California's 7.25% state sales tax. Participants noted that taxes at the time of truck purchase further increase the already higher upfront costs of zero-emission trucks compared to their diesel counterparts. Even if rebates and other incentives significantly lower the vehicle cost, the state calculates taxes based on the full pre-rebate price, meaning that an ostensibly free truck could still cost well over $50,000 in state and federal taxes (see recommendation for the federal excise tax below). A state sales tax exemption, especially in combination with the aforementioned feebates and tax credits, could

bolster the early adoption of heavy-duty zero-emission vehicles and enhance market competitiveness. As an alternative to the exemption, the legislature could eliminate the penalty by setting the sales tax based on a comparable diesel truck.

The California Legislature and Department of Motor Vehicles could equalize registration fees

The state could ensure that zero-emission trucks do not pay more for registration than diesel trucks. California calculates registration fees based on purchase price and vehicle weight, among other factors.[84] Because zero-emission vehicles tend to be heavier and cost more than their diesel counterparts, fees calculated based on price and weight are typically higher for zero-emission vehicles. They also incur an additional road improvement fee (to offset the loss of fuel tax revenue), which can further increase overall registration fees. The legislature could reduce these costs by equalizing registration fees between zero-emission and diesel trucks.

Federal leaders could exempt medium- and heavy-duty zero-emission vehicles from the federal excise tax and reinstate tax credits

Both new diesel and zero-emission trucks are subject to a 12% federal excise tax at the time of purchase, with some exemptions.[85] Federal leaders could exempt heavy-duty zero-emission vehicles from this excise tax to reduce costs. In addition, Congress could maintain and re-authorize sections 45X[86] and 45W[87] in the federal tax code. The Inflation Reduction Act created these provisions in 2022 to incentivize the domestic manufacturing of clean energy components, including battery cells and modules essential to zero-emission vehicles, as well as the deployment of clean vehicles. Section 45W established a Clean Commercial Vehicle Credit, incentivizing the deployment of zero-emission vehicles. Section 45X established an Advanced Manufacturing Production Credit to encourage the domestic manufacturing of clean energy components, including battery cells and modules essential to zero-emission vehicles. However, the July 2025 tax legislation repealed the Clean Commercial Vehicle Credit for vehicles purchased after September 2025.[88] And while the Advanced Manufacturing Production Credit for batteries remains, the new law introduced foreign entity-restrictions and an earlier end date for the tax credits. A new Congress could reinstate these provisions to benefit the uptake of zero-emission heavy-duty vehicles.

Ports could create incentive programs for zero-emission heavy-duty vehicles

Ports have several tools to promote zero-emission heavy-duty vehicles. They can place fees on diesel vehicles and then reinvest the collected funds on infrastructure or incentives that can support zero-emission vehicles. As an example, the Ports of Los Angeles and Long Beach's Clean Trucks Program generates funds for zero-emission trucks and infrastructure. Each port assigns a "Clean Truck Fund Rate" on nonexempt trucks ($10 per 20-foot equivalent unit; with exemptions for trucks that meet certain emission standards). Cargo owners or their agents pay the rate on loaded containers moved by truck. Other ports could replicate the program, though establishing these programs required two years of stakeholder engagement, and replicating the program could therefore take significant time (especially given the impact of tariffs today). Ports could also offer priority reservation, loading, and access for zero-emission trucks.[89] Ports that do not yet have these incentive or fee programs to support zero-emission vehicles could adopt best practices from those that do.

The California Public Utilities Commission could continue to help improve energization timelines

Slow utility planning, charging infrastructure development,[90] and energization represent barriers to zero-emission heavy-duty vehicle deployment. Shorter timelines to deploy and power this new infrastructure would therefore be a key solution to managing fueling challenges and increasing demand. The California Public Utilities Commission could build on its existing efforts, like the Transportation Electrification Proactive Planning[91] process, to accelerate energization timelines for charging infrastructure and reduce fueling-related operational challenges to help lower total cost of ownership for fleets. In its report to the Governor on electric vehicle deployment, the state's key energy and transportation agencies noted that strategies to accelerate infrastructure development could include faster utility energization processes.[92] To address the challenge, the state passed Senate Bill 410 (Becker, 2023), the "Powering Up Californians Act."[93] Among other provisions, the law instructed the California Public Utilities Commission to set average and maximum target energization timelines. However, some convening participants doubted whether the bill is making a sufficient difference and suggested more regulatory or legislative action to address this challenge. For example, some utilities are piloting Flexible Service Connections (FSCs) to bring reduced capacity to a site, allowing charging stations to come online more quickly using existing power availability. This interim temporary solution provides power as the utility is making the necessary grid upgrades to bring full power to the site. Taking advantage of FSC programs or working with utilities to implement other temporary bridge solutions to energize sites more quickly could help expand charging opportunities for medium- and heavy-duty vehicles while protecting the existing grid and allowing time for grid improvements and modernization.

The California Legislature and Air Resources Board could modify the Low Carbon Fuel Standard in future years to increase support for zero-emission heavy-duty vehicles

California's Low Carbon Fuel Standard program helps encourage zero-emission heavy-duty vehicle deployment through higher fees on high-carbon fuel and credit proceeds that can support clean vehicle purchases and infrastructure. Yet participants noted that much of the credit proceeds go to low-carbon biofuels rather than to supporting electricity as a long-term comprehensive solution to transportation decarbonization. The program's most recent update took effect in July 2025, and the legislature and the Air Resources Board could track market and industry needs to anticipate necessary changes in the next update to the program. The California Air Resources Board could improve the impact on electrification by shifting a greater share of Low Carbon Fuel Standard credit value from biofuels towards electrification, including vehicle charging infrastructure. Specifically, the legislature or board could require providers eligible for credits to deliver fuels to be used in California, rather than subsidizing out-of-state fuels like dairy digesters that never reach the state as transportation fuel. The board or legislature could require these credits to support in-state greenhouse gas emission reduction goals. The board could also consider a hard volume cap on or ultimate phasing out of biofuels, which would reduce competition for credits and raise their value for zero-emission vehicle fuels. In addition, the board could require or encourage credit multipliers for electricity fuels, along with credit restrictions on other fuels to avoid over-supply of credits that would reduce the credit price or create a glut. This

shift could drive more support to de-risk infrastructure investments by increasing utilization and providing revenue certainty.[94]

The California Public Utilities Commission and Energy Commission could continue integrated planning and policy initiatives that support proactive grid planning

Both commissions could offer integrated planning and policy support to enable more proactive grid planning, particularly in anticipation of load growth amid accelerated electrification. Other entities that could be involved include the California Independent System Operator, transportation agencies, and GO-Biz. This process could incorporate local knowledge of deployment needs into forecasting processes and utility plans and decisions. These efforts could build on the Integrated Energy Policy Report, which the California Energy Commission uses to forecast energy demand (reviewed by the California Public Utilities Commission).[95] Agencies could integrate this local knowledge and transmission-level considerations into developing the forecasts.

The California Legislature and Transportation Commission could adapt the Trade Corridor Enhancement Program to better align with the needs of charging infrastructure projects

The California Transportation Commission established the Trade Corridor Enhancement Program to provide funding for infrastructure improvements on California's portions of designated trade corridors of national and regional significance and the National Highway Freight Network.[96] Besides funding improvements on trade corridors with high freight volume, policymakers also use the program to support charging infrastructure. The legislature and the California Transportation Commission could amend the program by clarifying eligibility and updating project evaluation criteria so it can better support zero-emission vehicle infrastructure development, including charging stations.

The California Legislature and Public Utilities Commission could speed up deployment of distributed energy resources to enhance charging infrastructure through streamlined permitting and regulatory clarity

Distributed energy resources, such as EV chargers, battery storage, and rooftop solar, can help with the deployment of heavy-duty EV charging stations and improve nearby grid flexibility and reliability.[97] They can help alleviate grid bottlenecks and manage operational challenges for heavy-duty zero-emission vehicles by providing on-site generation or averting the need for grid upgrades. Legislators could expand existing environmental review exemptions and streamlining (such as for rooftop solar and EV charging stations) under the California Environmental Quality Act (CEQA) to speed deployment of these resources where they would support heavy-duty zero-emission vehicles. For example, in instances where a grid connection is infeasible, on-site energy generation could remain an option, and the legislature could amend CEQA to make this installation less burdensome. In its report to the governor on zero-emission vehicle deployment, the Air Resources Board mentioned that strategies to accelerate infrastructure development could include permit streamlining.[98] The California Public Utilities Commission could also help bolster distributed energy resource processes by improving speed and regulatory clarity.

California municipal utility leaders could adopt Rule 29 procedures to support EV charging infrastructure deployment

The California Public Utilities Commission established Rule 29 to provide an electric vehicle infrastructure tariff for Pacific Gas and Electric and Southern California Edison customers.[99] The commission designed the rule to help cover the costs of developing EV infrastructure for industrial, commercial, and multi-family charging station projects. For qualifying properties, the utility designs, installs, owns, and maintains all equipment on the utility side of the meter. Rule 29 can therefore reduce developer costs, depending on the site. Participants suggested that promoting and replicating Rule 29 beyond oversight of the California Public Utilities Commission to apply to publicly owned municipal utilities could further support needed infrastructure deployment, such as in the service territory of the Los Angeles Department of Water and Power. Utility "make-ready" programs, such as Southern California Edison's Charge Ready Program,[100] can also offer an alternative to infrastructure tariffs like Rule 29. The program covers the design and installation of infrastructure for fleet owners and operators at both the utility- and customer-side of the meter. However, infrastructure installations at leased warehouses, fleet depots, and other locations may not be feasible or suitable for all fleets. As a result, the state will still need to increase deployment of medium- and heavy-duty-specific public charging (and funding programs to support) to make it easier and cheaper for fleets to electrify.

The California Legislature, Public Utilities Commission, and electric utilities could extend demand-charge "holidays" and create a customer rate class for heavy-duty customers

Demand charges are extra fees customers pay when they use a high amount of electricity at one time, even if for a short period. Charging eletric trucks requires a large amount of power and can therefore trigger substantial fees based on peak electricity use that increase charging costs. California's legislature, Public Utilities Commission and electric utilities could design rates and tariff options for truck charging that mitigate demand charges. For example, utilities can offer demand-charge "holidays," representing a period where they waive or reduce demand charges for charging stations. Utilities could expand existing holidays to give fleets the opportunity to experiment with charging strategies.[101] The California Public Utilities Commission could also create a distinct customer rate class for zero-emission trucks when designing electricity rates. A rate class determines how customers are charged for energy, how demand charges apply, and whether customers have access to specific incentives. A separate class for zero-emission trucks could help cap or smooth demand charges and therefore reduce charging costs.

The California Legislature could take specific programs and costs out of electricity rates to lower them

Surging electricity rates in California are in part caused by the cost of wildfire damage and mitigation, as well as distribution and transmission upgrades and rooftop solar incentives.[102] Participants highlighted the former as a major hurdle after the Los Angeles fires in January 2025, as utilities may be held liable for wildfire damage caused by their equipment and then raise their rates to cover the costs. The legislature could remove these and other social costs that affect rates from the rate base and instead pay for them out of the general fund. The legislature could also improve the process

for utility identification and implementation of wildfire prevention plans to include consideration for cost effectiveness prioritization. The recently enacted Senate Bill 254 (Becker, 2025) addressed some of these issues, for example by requiring utilities to finance a portion of their wildfire safety investments instead of passing the full cost on to ratepayers.[103] Reduced electricity rates would not only benefit lower-income ratepayers, but it could also make heavy-duty zero-emission vehicle charging much more affordable.

The California Legislature could create electricity tax breaks for medium- and heavy-duty meters

The price of electricity sold at EV charging stations includes California's sales tax. The legislature could introduce tax breaks applied at truck charging stations to further reduce fueling costs. This tax break would require submeters for these chargers to track truck charging separately from other charging and electricity use.

Congress could extend the Alternative Fuel Vehicle Refueling Property Credit

Congress could extend section 30C of the federal tax code, which is a federal tax credit that provides incentives for installing qualified alternative fuel vehicle refueling property, including electricity or hydrogen charging ports.[104] The July 2025 tax law ended the tax credit for charging infrastructure placed in service after June 2026, and future congressional action could further extend this deadline.

BARRIER III: NEGATIVE PERCEPTIONS OF HEAVY-DUTY ZERO-EMISSION VEHICLES

Participants identified negative perceptions of heavy-duty zero-emission vehicles as another barrier to increasing demand and adoption. Many potential consumers and investors perceive zero-emission trucks as too expensive and difficult to deploy, especially when compared to fossil fuel counterparts. The perceived lack of safety, credibility, and market capability of heavy-duty zero-emission vehicles exacerbates this dynamic. Participants noted that these perceptions prevail in part due to a lack of countervailing positive storytelling. Another limiting perception participants discussed was a misguided belief that the transition to heavy-duty zero-emission vehicles needs to happen "all at once," hindering the prioritization of specific segments that can transition economically more quickly or that could yield the greatest environmental and public health benefits. In addition, the topic of zero-emission vehicles has become more controversial and politicized, making it a partisan issue that inhibits pragmatic conversations and creates policy uncertainty. Political framing of the transition can also entail dis- and misinformation.

SOLUTIONS

Industry leaders and advocates could address mis- and disinformation through trusted messengers

Industry leaders and advocates could recruit, develop and train trusted messengers to address dis- and misinformation and improve perception of heavy-duty zero-emission vehicles by sharing success stories with fleets, shippers, and policymakers. Messengers

could include industry champions, manufacturers, dealers, fleets, and shippers to address a wide audience, including industry peers and policy- and decision-makers. Messages could address concerns around the lack of demand, offer demand aggregation solutions, and explain the need for multi-year incentives. They could also clarify that the goal is a long-term transition, where not all market segments need to transition at once. Participants advocated showing a humble approach to document successes with heavy-duty zero-emission vehicle deployment, including highlighting successful use cases, as well as the specific geographies where total cost of ownership parity is already available or could be soon. Messengers could also highlight where electrification is needed most. The messages could emphasize the public health benefits and reduced air pollution. Messengers and state agency leaders could create processes to identify these success stories and direct public resources toward developing them for public consumption. One option could involve working with recipients of the Hybrid and Zero-Emission Truck and Bus Vouchers to identify what programs and technologies are working well and which ones require improvement.

Industry leaders and advocates could address the politicization of zero-emission trucks by focusing on the co-benefits of deployment

To counteract the politicization of zero-emission vehicles, advocates and industry leaders could reframe the conversation using 'the language of the moment' to gain bipartisan support. Possible framing could include improving global competitiveness, bolstering supply chain resilience through diversity of product shipping, enhancing sustainable economic growth, and increasing consumer choice and personal freedom. Delivering this message would require involvement from businesses and leadership from CEOs who can connect economic opportunity with the zero-emission transition. Industry leaders could also explore whether success stories from Europe or China would resonate with U.S. audiences and help reinforce the narrative that a transition to zero-emission vehicles can be economically advantageous.

The Governor's Office of Business and Economic Development, the California Air Resources Board, and industry leaders (particularly fleet owners) could enable peer-to-peer learning

Fleets and owner-operators could share success stories through word of mouth and business-to-business marketing techniques. GO-Biz and the California Air Resources Board could facilitate this peer-to-peer learning by convening industry representatives. Messages could revolve around total cost of ownership and economic feasibility. They could emphasize cost and demand opportunities, highlighting specific use cases. For example, PROLOGIS publishes success stories of zero-emission vehicle operators and related infrastructure projects.[105] Participants discussed that communicating compelling market data can shift the narrative beyond the need for regulatory 'sticks' and toward stories of smart, strategic investments. They could highlight how policy makers spend public funds strategically to accelerate market development, such as by documenting how addressing mobile source pollution from trucks often delivers cleaner air at lower cost than addressing stationary sources. Messengers could focus on building trust though transparency, honesty and optimism. Furthermore, sellers and manufacturers could seek to match truck sales to appropriate use cases, as sales that cannot lead to effective operations risk damaging the reputation of a still-small industry. Ensuring long-term economic suitability can help maintain trust and support for market growth.

V. CONCLUSION: ZERO-EMISSION HEAVY-DUTY VEHICLE DEMAND IS NEEDED FOR A SUCCESSFUL TRANSITION

As California faces significant federal pushback on its efforts to transition medium- and heavy-duty fleets to zero-emission vehicles, alignment among the state's elected and agency officials, advocates, and industry leaders will be critical to developing the state-based policies necessary to overcome the various challenges to deployment. While continued advancements in battery and charging technologies promise a bright future for those market segments where zero-emission vehicle costs are not already price-competitive with fossil gas, the state will need ongoing policy support to hasten zero-emission vehicle deployment.

State leaders will therefore need to address the myriad policy-based obstacles to deployment, as well as the economic and infrastructure barriers, such as by refocusing existing policies and developing new ones to meet this current moment. Given the state's leadership role among other U.S. states and countries, the steps that California leaders take now will set an important example for leaders seeking to transition to zero-emission trucks around the world, helping not just in-state residents but all who will benefit from a more stable climate and cleaner air.

Photo provided by Volvo

APPENDIX I – LIST OF PARTICIPANTS

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APPENDIX II – LIST OF STATE AND FEDERAL REGULATIONS, POLICIES, PLANS AND INCENTIVES FOR HEAVY-DUTY ZERO-EMISSION VEHICLE DEPLOYMENT AND INFRASTRUCTURE

REGULATIONS, POLICIES, PLANS AND STRATEGIES

California

- **Advanced Clean Trucks Regulation & Clean Truck Partnership**: The California Air Resources Board (CARB) adopted the Advanced Clean Trucks rule in 2021, which requires truck manufacturers to transition to zero-emission models starting in 2024. It mandates that manufacturers progressively increase the percentage of annual sales of zero-emission vehicles.[106] In June 2025, the U.S. Congress voted to invalidate the Environmental Protection Agency waiver that allowed the State of California to enforce the rule.[107] Due to legal uncertainties and litigation, the finality and enforceability of this repeal are still unclear. In anticipation of challenges, the California Air Resources Board entered into the Clean Truck Partnership agreement with truck manufacturers: in exchange for increased flexibility and regulatory certainty, truck manufacturers agreed to comply with California's emission standards, regardless of challenges to California's authority to set these standards.[108] In August 2025, truck manufacturers sued the board, challenging the legality of the Clean Truck Partnership agreement.[109] The Federal Trade Commission invalidated the agreement, stating it was 'unenforceable.'[110] In November 2025, a federal judge blocked California from enforcing the sales agreement while litigation is ongoing.
- **Advanced Clean Fleets Regulation**: The California Air Resources Board adopted the Advanced Clean Fleets rule in 2023, which sought to achieve a 100% zero-emission truck and bus fleet by 2045 where feasible, and sooner for market segments such as last-mile delivery and drayage trucks. The rule built on the Advanced Clean Trucks manufacturer sales mandate and required fleet owners to purchase an increasing percentage of zero-emission medium-and heavy-duty trucks. However, the board withdrew the rule from consideration for federal approval in January 2025 due to the likelihood of rejection by the incoming Trump administration. Yet the board asserted it has the authority to implement the rule for public fleets, which it is committed to doing as of report publication. In September 2025, the California Air Resources Board amended the Advanced Clean Fleets regulation to remove the drayage and priority fleets regulations from the rule and to increase flexibility for public fleet owners.[111] The board maintained the 100% ZEV sales requirement that will still require an Environmental Protection Agency waiver. California will

need new policies to encourage more fleet owners and operators to purchase the zero-emission heavy-duty vehicles required to be deployed in the state.[112]

- **Executive Order N-27-25 Zero Emissions Vehicle Deployment & Agency Report**: In June 2025, Governor Newsom signed Executive Order N-27-25 to boost California's clean vehicle transition in response to federal efforts to invalidate the state's clean air waivers—instructing state agencies to assess additional actions zero emission vehicle adoption in California and to deliver formal recommendations for additional actions to the governor.[113] The resulting agency report to the Governor included a wide range of actions, such as incentives, regulations, and private investments.[114] For heavy-duty zero-emission vehicle deployment specifically, recommendations included support for market deployment incentive and rebate programs and a statewide indirect source rule.
- **Low Carbon Fuel Standard**: The California Air Resources Board designed the Low Carbon Fuel Standard to reduce greenhouse gas emissions from transportation fuels by incentivizing the production of low-carbon fuels. It is a market-based program that sets an annual target for reducing the carbon intensity of fuels. Depending on their carbon footprint, fuels have a high carbon intensity score (e.g., diesel) or a lower score (e.g., electricity, hydrogen).[115] Producers of low-carbon fuels generate credits that they can sell to producers of high-carbon fuels that need to buy credits to comply with the standard. The credit trading system can potentially lower the cost of less carbon intensive fuels and incentivize innovation. The program also allows fuel users (like fleets) to generate credits by using clean fuels, which they can sell to create revenue. The program also includes zero-emission vehicle infrastructure crediting provisions that generate credits for the construction of hydrogen refueling or fast charging infrastructure for zero-emission vehicles.[116] The California Air Resources Board amended the program in July 2025 and created a fueling infrastructure pathway for heavy-duty zero-emission vehicles fueling. The amendment allows infrastructure operators to generate credits based on fueling station capacity.
- **Heavy-Duty Engine and Vehicle Omnibus Regulation**: The California Air Resources Board adopted the omnibus regulation to reduce particulate matter and nitrogen oxide emissions from new heavy-duty vehicles. The regulation requires a 75% reduction in nitrogen oxide emissions from on-road heavy-duty vehicle engines for 2024-2026 model years, with further reduction for later model years, leading to a 90% reduction requirement by 2031 (compared to existing standards).[117] In June 2025, the U.S. Congress voted to invalidate the Environmental Protection Agency waiver that allowed California to enforce the rule. While litigation was ongoing as of report publication, the Air Resources Board proposed emergency amendments to safeguard regulatory continuity.
- **Innovative Clean Transit Regulation**: The California Air Resources Board adopted the Innovative Clean Transit Regulation in 2018. It requires all public transit agencies in the state to gradually transition to 100% zero-emission bus fleets. In 2029, all new bus purchases from these agencies must be zero-emission vehicles.[118]

- **California Sustainable Freight Action Plan**: State entities can enable zero-emission vehicle and infrastructure deployment by providing a broader implementation and coordination framework through strategies, such as California's Sustainable Freight Action Plan. The plan provides a vision for a less polluting freight transportation system. It is a statewide initiative to integrate policies and investments across various state agencies towards a more economically competitive, efficient and sustainable freight system. It integrates both vehicle deployment and infrastructure development initiatives.[119]
- **Senate Bill 671 Clean Freight Corridor Assessment**: Senate Bill 671 (Gonzalez, 2021) required the California Transportation Commission to collaborate with other state agencies to develop a Clean Freight Corridor Efficiency Assessment by December 2023.[120] The assessment identified 34 priority freight corridors for deploying medium- and heavy-duty zero-emission vehicles, and 6 top corridors for an initial viable network.[121]

Federal

- **Federal National Zero-Emission Freight Corridor Strategy**: In March 2024, the Joint Office of Energy and Transportation and U.S. Department of Energy, in collaboration with the and the Environmental Protection Agency and the Department of Transportation, released a National Strategy to Accelerate Deployment of Zero-Emission Infrastructure for Freight Trucks.[122] The plan outlined a phased approach from 2024 to 2040 for building a national infrastructure network for hydrogen and electric fueling infrastructure for medium- and heavy-duty vehicles.[123]

INCENTIVES[124]

California

- **Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project**: The Hybrid & Zero-Emission Truck & Bus Voucher Incentive Program offers vouchers to fleets to help offset the costs of purchasing zero-emission trucks and buses. The program is administered by CALSTART, providing point-of-sale vouchers for zero-emission buses and trucks that reduce upfront costs for buyers. From 2023 to 2024, voucher redemptions surged 177%.[125] Since its introduction in 2009, it has funded over 14,000 zero-emission vehicles.[126] The voucher project includes the Innovative Small E-Fleet Pilot Program, which supports small fleets with vouchers for innovative mechanisms that can support zero-emission vehicle adoption.[127] The voucher project is part of the California Air Resources Board's Low Carbon Transportation Incentives and Air Quality Improvement Program.[128]
- **On-Road Heavy Duty Voucher Incentive Program & Carl Moyer Program**: The Carl Moyer Program provides grants to public agencies and private entities to replace, retrofit or repower their heavy-duty diesel engines with clean ones.[129] The On-Road Heavy-Duty Voucher Incentive Program is one of several eligible categories for funding within the Carl Moyer Program. The voucher program provides funding for fleet owners with 20 or fewer

vehicles to replace their fleet with zero-emission vehicles.[130] The Carl Moyer Program is implemented as a partnership between CARB and California's 35 local air districts.

- **Clean Transportation Program, California Electric Vehicle Infrastructure Project & Energy Infrastructure Incentives for Zero-Emission Commercial Vehicles**: The California Energy Commission's Clean Transportation Program promotes infrastructure development and deployment of zero-emission vehicles through annual investments of up to $100 million. The program includes support for medium-and heavy-duty zero emission vehicle deployment through pilot projects, grants, and loans. 50% of its investments must benefit low-income and disadvantaged communities.[131] The Clean Transportation Program also includes Energy Infrastructure Incentives for Zero-Emission Commercial Vehicles. The California Energy Commission awarded the block grant for designing and implementing infrastructure incentive projects to CALSTART.[132]
- **Cap-and-Trade (now Cap-and-Invest) Program**: Although California's Cap-and-Invest program does not regulate trucks, it delivers essential funding for incentives for heavy-duty zero-emission vehicles. The program sets an emissions cap for various sectors and allows trading of emission allowances. The California Air Resources Board has received budget allocations from these auction proceeds to support its Low Carbon Transportation Incentives Programs, including the Hybrid & Zero-Emission Truck & Bus Voucher Incentives.[133] The state also uses funds to support the Clean Transportation Program. With the passing of Assembly Bill 1207 (Irwin) in September 2025, the legislature extended the program until 2045, renamed the program "California Cap-and-Invest Program," and updated its framework.[134] The program's extension secured potential funding for a variety of incentive programs.[135]
- **Trade Corridor Enhancement Program**: The California Transportation Commission's Trade Corridor Enhancement Program provides funding for infrastructure improvements on California portions of designated trade corridors of national and regional significance and the National Highway Freight Network. The program combines roughly $515 million National Highway Freight Program funds and $300 million in state funding for this competitive program, including support for zero-emission infrastructure for medium-and heavy-duty vehicles.[136]

Federal

- **Federal Charging and Fueling Infrastructure Discretionary Grant Program**: The Biden administration's Bipartisan Infrastructure Law established a Charging and Fueling Infrastructure Grant Program, administered by the Department of Transportation.[137] The program provided funds for strategically deployed zero-emission charging and fueling infrastructure. In January 2025, the Trump administration paused the disbursement of new funds appropriated though the law, halting new funding obligations. In June 2025, a federal judge issued a preliminary injunction to reinstate the funds.
- **National Electric Vehicle Infrastructure Formula Program**: The Department of Transportation's Federal Highway Administration Program provides states with funding for strategic electric vehicle charging infrastructure.[138] Earlier

guidance for the program focused on chargers for light-duty vehicles, but states have flexibility to also use to funds to expand medium- and heavy-duty charging infrastructure. After the Federal Highway Administration suspended the program in early 2025, a lawsuit followed, which led to a continuation of fund disbursement in August 2025.[139]

- **Federal Clean Heavy Duty Vehicles Grant Program**: The Inflation Reduction Act directed the Environmental Protection Agency to establish a Clean Heavy Duty Vehicles Grant Program. The program allocated roughly $900 million for grants to accelerate the replacement of Class 6 and 7 diesel vehicles with zero-emission vehicles. It aimed to reduce pollution in communities disproportionately affected by pollution.[140] The funding opportunity application period closed in July 2024, and the recent July 2025 Congressional tax law rescinded all unobligated funds.
- **Federal Tax Code Sections 45X (Advanced Manufacturing Credit) & 45W (Commercial Clean Vehicle Credit):** The Inflation Reduction Act of 2022 introduced new sections to the federal tax code to create tax credits to incentivize the uptake of zero-emission vehicles. Section 45W established a Clean Commercial Vehicle Credit,[141] incentivizing the deployment of zero-emission vehicles. Section 45X established an Advanced Manufacturing Production Credit to incentivize the domestic manufacturing of clean energy components, including battery cells and modules essential to zero-emission vehicles.[142] In July 2025, the Congressional tax law repealed 45W credits for vehicle purchases placed after September 2025, reducing incentives for fleets. The new law also phased out 45X credits for wind and solar components but left electric vehicle battery benefits intact. However, the law made important changes, such as requiring battery cells to meet stricter rules on U.S. manufacturing and supply chain sourcing and that battery modules must be "comprised of all other essential equipment needed for battery functionality."[143] It also set an earlier end date for the Advanced Manufacturing Production Credit and modified foreign entity rules to prioritize domestic manufacturing.[144]
- **Federal Tax Code Section 30C (Alternative Fuel Vehicle Refueling Credit)**: The 2022 Inflation Reduction Act enhanced section 30C of the internal revenue code, the Alternative Fuel Vehicle Refueling Credit. The credit provided incentives for installing qualified alternative fuel vehicle refueling property, including hydrogen fueling stations and electric charging ports.[145] The 2025 tax law phased out this incentive for installing charging infrastructure placed in service after June 2026.

SOURCES

1 California Air Resources Board (CARB), "Summary: Diesel Particulate Matter Health Impacts" (webpage), available at https://ww2.arb.ca.gov/resources/summary-diesel-particulate-matter-health-impacts

2 2015 estimates. Susan Anenberg et al., *A Global Snapshot of the Air Pollution Related Health Impacts of Transportation Sector Emissions in 2010 and 2015*, The International Council on Clean Transportation (ICCT) (2018), available at https://theicct.org/wp-content/uploads/2021/06/Global_health_impacts_transport_emissions_2010-2015_20190226.pdf

3 CARB, "Summary: Diesel Particulate Matter Health Impacts" (webpage), available at https://ww2.arb.ca.gov/resources/summary-diesel-particulate-matter-health-impacts

4 Ibid.

5 Julian D. Marshall et al., P*rioritizing Environmental Justice and Equality: Diesel Emissions in Southern Californi*a, Environ. Sci. Technol. 48-7 (2014), available at https://doi.org/10.1021/es405167f; Union of Concerned Scientists, *Inequitable Exposure to Air Pollution from Vehicles in California* (*factsheet*), (2019), p.2-7, available at https://www.ucs.org/sites/default/files/attach/2019/02/cv-air-pollution-CA-web.pdf

6 U.S. Environmental Protection Agency (EPA), *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2022*. EPA 430-R-24-004, (2024), available at https://www.epa.gov/system/files/documents/2024-04/us-ghg-inventory-2024-main-text_04-18-2024.pdf

7 U.S. EPA, *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2022*. EPA 430-R-24-004, (2024), available at https://www.epa.gov/system/files/documents/2024-04/us-ghg-inventory-2024-main-text_04-18-2024.pdf

8 CARB, "Current California GHG Emission Inventory Data" (webpage) (2025), available at https://ww2.arb.ca.gov/ghg-inventory-data

9 CARB, "California meets its target for zero-emissions truck sales two years ahead of schedule" (webpage), available at https://ww2.arb.ca.gov/news/california-meets-its-target-zero-emissions-truck-sales-two-years-ahead-schedule

10 California Energy Commission (CEC), *In-Use Emissions Testing and Activity Profiles for On-Road Heavy-Duty Vehicles*, (2023), available at: https://www.energy.ca.gov/sites/default/files/2023-03/CEC-500-2023-002.pdf

11 Pierre-Louis Ragon et al., P*otential Benefits of the U.S. Phase 3 Greenhouse Gas Emissions Regulation for Heavy-Duty Vehicles*, ICCT (2024), available at https://theicct.org/wp-content/uploads/2023/04/hdv-phase3-ghg-standards-benefits-apr23.pdf

12 While many of the barriers and solutions here address electric trucks, we acknowledge that the State of California pursues both technologies.

13 Catherine Ledna et al., *Assessing total cost of driving competitiveness of zero-emission trucks*, iScience, Volume 27, Issue 4, 109385 (2024), available at https://doi.org/10.1016/j.isci.2024.109385

14 Adrian O'Connell et al., *A comparison of the life-cycle greenhouse gas emissions of European heavy-duty vehicles and fuels*, ICCT (2023), available at https://theicct.org/publication/lca-ghg-emissions-hdv-fuels-europe-feb23/

15 CEC, "SB 100 Joint Agency Report" (webpage), available at: https://www.energy.ca.gov/sb100

16 CARB, "Climate Goals" (webpage), https://ww2.arb.ca.gov/resources/documents/climate-goals

17 CARB, *2020 Mobile Source Strategy*, available at https://ww2.arb.ca.gov/sites/default/files/2021-12/2020_Mobile_Source_Strategy.pdf

18 CARB, "1 in 6 new trucks, buses, and vans in California are zero-emission" (webpage), available at https://ww2.arb.ca.gov/news/1-6-new-trucks-buses-and-vans-california-are-zero-emission;CARB, "Nearly 1 in 4 new trucks, buses and vans in California go zero-emission, 2 years ahead of schedule" (webpage), available at https://ww2.arb.ca.gov/news/nearly-1-4-new-trucks-buses-and-vans-california-go-zero-emission-2-years-ahead-schedule
CARB, "Advanced Clean Trucks Credit Summary Through the 2023 Model Year" (webpage) (2024), available at https://ww2.arb.ca.gov/resources/fact-sheets/ACT-Credits-Summary%202023

19 CARB, "Nearly 1 in 4 new trucks, buses and vans in California go zero-emission, 2 years ahead of schedule" (webpage) (2025), available at https://ww2.arb.ca.gov/news/nearly-1-4-new-trucks-buses-and-vans-california-go-zero-emission-2-years-ahead-schedule

20 CALSTART, Drive to Zero's Zero-emission Technology Inventory (ZETI) Tool Version 9.0 (2024), available at https://globaldrivetozero.org/tools/zero-emission-technology-inventory/

21 CARB, *Zero-Emission Class 8 Truck Pricing Comparisons* – EU & US, (2024), available at https://ww2.arb.ca.gov/sites/default/files/2024-12/Zero%20Emission%20Class%208%20Tractor%20Pricing%20Comparisons_ADA.pdf

22 Ibid.

23 Ibid.

24 Yihao Xie and Ray Minjares, *Battery electric commercial vehicle pricing in the United States*, ICCT (2025), available at https://theicct.org/publication/battery-electric-commercial-vehicle-pricing-in-the-us-sept25/

25 Ibid.

26 Yihao Xie et al., P*urchase costs of zero-emission trucks in the United States to meet future Phase 3 GHG standards*, ICCT (2023), p.15-22, available at https://theicct.org/wp-content/uploads/2023/03/cost-zero-emission-trucks-us-phase-3-mar23.pdf

27 Ellen Kennedy et al., "Electric Vehicles Are on the Road to Mass Adoption," (2025), available at https://rmi.org/electric-vehicles-are-on-the-road-to-mass-adoption/?utm_medium=email&utm_source=spark&utm_content=spark&utm_campaign=2025_07_03&utm_term=title-1

28 Thunder Said Energy, "Heavy truck costs: diesel, gas, electric or hydrogen?," (2025), available at https://thundersaidenergy.com/downloads/is-natural-gas-a-competitive-truck-fuel/

29 Hussein Basma et al., *Total Cost of Ownership of Alternative Powertrain Technologies for Class 8 Long-Haul Trucks in the United State*s, ICCT (2023), p.20-21, available at https://theicct.org/wp-content/uploads/2023/04/tco-alt-powertrain-long-haul-trucks-us-apr23.pdf

30 Catherine Ledna et al., *Assessing total cost of driving competitiveness of zero-emission trucks*, iScience, Volume 27, Issue 4, 109385 (2024), available at https://doi.org/10.1016/j.isci.2024.109385

31 KPMG LLP, *Alternative fuels for trucking? Consider hydrogen*, KPMG (2024), p.1–30, available at https://kpmg.com/kpmg-us/content/dam/kpmg/pdf/2024/hydrogen-trucks-final-secured.pdf

32 Ibid.

33 CARB, "California's Plan for Zero-Emission Vehicles, ZEV TruckStop" (webpage), available at https://ww2.arb.ca.gov/our-work/programs/truckstop-resources/zev-truckstop/zev-101/californias-plan-zero-emission-vehicles

34 Jack Ewing, "Mercedes Invests in U.S. Battery Maker to Speed Up Electric Transition," The New York Times (2025), p.1–3, available at https://www.nytimes.com/2025/05/09/business/mercedes-factorial-solid-state-battery.html

35 CharIN, "Megawatt Charging System" (webpage), available at https://www.charin.global/technology/mcs/

36 DHL Freight Connections, "Charging Times for Electric Trucks: The Goal is Less Than 30 Minutes" (webpage) (2024), available at https://dhl-freight-connections.com/en/solutions/charging-times-for-electric-trucks-the-goal-is-less-than-30-minutes/

37 Electrek, "WattEV opens US' first megawatt charge station with 1.2MW speeds and solar" (May 6, 2024), available at https://electrek.co/2024/05/06/wattev-opens-us-first-megawatt-charge-station-with-1-2mw-speeds-and-solar/

38 Jacob Richard, *Zeroing in on Zero-Emission Trucks: June 2025 Market Update,* CALSTART (2025), p.1–40, available at https://calstart.org/wp-content/uploads/2025/05/ZIO-ZET-June.pdf

39 CEC, "Publicly Accessible Medium- and Heavy-Duty Zero-Emission Vehicle Charging and Hydrogen Refueling Infrastructure" (webpage) (2024), available at https://experience.arcgis.com/experience/f951c1433f804daea7f4c33c271aa935/

40 California Public Utilities Commission (CPUC), "CPUC Sets New Statewide Energization Timelines and Targets for Timely Grid Connections" (webpage) (2024), available at https://www.cpuc.ca.gov/news-and-updates/all-news/cpuc-sets-new-statewide-energization-timelines-and-targets-for-timely-grid-connections

41 Public Policy Institute of California, "A Closer Look at California's Surging Electricity Rates" (2025), available at https://www.ppic.org/blog/a-closer-look-at-californias-surging-electricity-rates/

42 e.g., green hydrogen directly relies on renewable energy sources for the electrolysis of water, whereas grey or blue hydrogen are produced from fossil fuels and natural gas and indirectly rely on electricity supply in their production process.

43 Catherine Ledna et al., *Assessing total cost of driving competitiveness of zero-emission trucks*, iScience, Volume 27, Issue 4, 109385 (2024), available at https://doi.org/10.1016/j.isci.2024.109385

44 Jacob Richard, *Zeroing in on Zero-Emission Trucks: June 2025 Market Update,* CALSTART (2025), p.1–40, available at https://calstart.org/wp-content/uploads/2025/05/ZIO-ZET-June.pdf

45 Jacob Richard, "States Must Lead the Charge in Zero-Emission Truck Expansion", CALSTART (webpage) (2025), available at https://calstart.org/states-must-lead-the-charge-in-zet-expansion/

46 Atlas EV Hub, "U.S. Market & Policy Update: Medium- and Heavy-Duty Electric Vehicles" (webpage) (2025), available at https://www.atlasevhub.com/data-stories/u-s-market-policy-update-medium-and-heavy-duty-electric-vehicles/

47 Atlas EV Hub, "U.S. Market & Policy Update: Medium- and Heavy-Duty Electric Vehicles" (webpage) (2025), available at https://www.atlasevhub.com/data-stories/u-s-market-policy-update-medium-and-heavy-duty-electric-vehicles/

48 CALSTART, ZETI Data Explorer Version 1.5 (2024), available at https://globaldrivetozero.org/tools/zeti-data-explorer/

49 Port of Long Beach, "Port to Increase Investment in Clean Trucks" (webpage) (2025), available at https://polb.com/port-info/news-and-press/port-to-increase-investment-in-clean-trucks-03-28-2025/

50 Paul Eisenstein, "VW's $2 billion penalty for diesel scam, Electrify America, builds electric charging network across US to boost EV market," CNBC (2019), available at https://www.cnbc.com/2019/05/10/vws-2-billion-penalty-for-diesel-scam-builds-ev-charging-network-across-us.html

51 Atlas EV Hub, "More than $30 Billion Estimated for Medium- and Heavy-Duty Charging – Large Sites with High Port Counts and Megawatt Charging Being Built" (webpage) (2025), available at https://www.atlasevhub.com/data-stories/more-than-30-billion-estimated-for-medium-and-heavy-duty-charging-large-sites-with-high-port-counts-and-megawatt-charging-being-built/; Atlas EV Hub, "Estimated $30 Billion Committed to Medium- and Heavy-Duty Charging Infrastructure in the United States" (webpage) (2024), available at https://www.atlasevhub.com/data-stories/estimated-30-billion-committed-to-medium-and-heavy-duty-charging-infrastructure-in-the-united-states/; Bloomberg, "US Big-Truck Charging Has Private Money's Attention" (webpage) (2024), available at https://www.bloomberg.com/news/articles/2024-09-26/ev-charging-for-big-electric-trucks-in-us-draws-private-equity-grants

52 Lisa Friedman, "In Game-Changing Climate Rollback, E.P.A. Aims to Kill a Bedrock Scientific Finding," The New York Times (2025), available at https://www.nytimes.com/2025/07/29/climate/epa-endangerment-finding-repeal-proposal.html

53 Claire Sugihara et al., *Social, technological, and economic barriers to heavy-duty truck electrification, Research in Transportation Business & Management, Volume 51*, 101064 (2023), available at https://doi.org/10.1016/j.rtbm.2023.101064

54 Ibid.

55 The California Air Resources Board adopted the Advanced Clean Fleets rule in 2023, which sought to achieve a 100% zero-emission truck and bus fleet by 2045 where feasible. The rule built on the Advanced Clean Trucks manufacturer sales mandate and required fleet owners to purchase an increasing percentage of zero-emission medium-and heavy-duty trucks. However, the board withdrew the rule from consideration for federal approval in January 2025 due to the likelihood of rejection by the incoming Trump administration. Yet the board asserts it has the authority to implement the rule for public fleets, which it is currently committed to doing.

56 Suzanne Seivright-Sutherland, "Regulatory Whiplash: CARB Set to Repeal Key Portions of ACF Rule—What It Means for Fleets," CalCIMA (blog post) (2025), available at https://www.calcima.org/blog_home.asp?display=88; Camila Domonoske, "Senate Votes to Revoke California's EV Air Pollution Waiver," NPR (2025), available at https://www.npr.org/2025/05/22/nx-s1-5387729/senate-california-ev-air-pollution-waiver-revoked

57 Youngeun Bae et al., *Factors influencing alternative fuel adoption decisions in heavy-duty vehicle fleets*, Transportation Research Part D: Transport and Environment, Volume 102, 103150 (2022), available at https://doi.org/10.1016/j.trd.2021.103150

58 CARB, "Clean Miles Standard" (webpage), available at https://ww2.arb.ca.gov/our-work/programs/clean-miles-standard/about

59 Brennon Mendez and Cara Horowitz, *Wielding the Power of ISRs: Using Indirect Source Rules to Fight Air Pollution from Mega Facilities*, Pritzker Briefs, Policy Brief No. 19, UCLA Emmett Institute (2025), p.1–28, available at https://law.ucla.edu/sites/default/files/PDFs/Publications/Emmett%20Institute/PritzkerPaper_19-1ccFinalPDF.pdf

60 South Coast Air Quality Management District, "WAIRE Program" (webpage), available at https://www.aqmd.gov/home/rules-compliance/compliance/waire-program

61 Zoe Woodcraft, "New Legislation from Assemblymember Robert Garcia Tackles California's Growing Pollution Hotspots," Earthjustice (2025), available at https://earthjustice.org/press/2025/new-legislation-from-assemblymember-robert-garcia-tackles-californias-growing-pollution-hotspots

62 NYC Office of the Mayor et al., *Indirect Source Rules: Case Studies from California*, (2025); NYC Environmental Protection, "Testimony of Rohit T. Aggarwala Chief Climate Officer and Commissioner NYC DEP before the New York City Council Committee on Environmental Protection, Resiliency, and Waterfronts Oversight Hearing Air Quality and Last Mile Deliveries" (webpage) (2025), available at https://www.nyc.gov/site/dep/news/022825/testimony-rohit-t-aggarwala-chief-climate-officer-commissioner-nyc-dep-before-new-york

63 California Legislature, Assembly Bill 914: Air Pollution – Indirect Sources, 2025, available at https://legiscan.com/CA/text/AB914/id/3131930

64 CalMatters, "AB 914 – Pollution Hotspots Solution Act" (webpage) (2025), available at https://calmatters.digitaldemocracy.org/bills/ca_202520260ab914

65 CARB, *Report to Governor on Executive Order N-27-25 on Zero Emissions Vehicle Deployment*, (2025), available at https://ww2.arb.ca.gov/resources/documents/report-governor-executive-order-n-27-25-zero-emissions-vehicle-deployment

66 42 U.S.C. § 7543(b).

67 California Department of General Services (DGS), "Procurement Division" (webpage), available at https://www.dgs.ca.gov/PD/

68 DGS, "Environmentally Preferable Purchasing" (webpage), available at https://www.dgs.ca.gov/PD/Resources/Find-EPP-Goods-and-Services

69 San Francisco Environment Department, "Buying Green" (webpage) (2025), available at https://www.sfenvironment.org/buying-green

70 Smart Freight Centre, "ZET SCALE – Zero-Emission Truck Shipper-Carrier Alliance Leading Electrification" (webpage) (2025), available athttps://www.smartfreightcentre.org/en/our-programs/road-freight/fleet-electrification-coalition-lp/fec-projects-20/zet-scale-zero-emission-truck-shipper-carrier-alliance-leading-electrification/

71 "Known as Scope 3 emissions, these are the greenhouse gases generated by the delivery trucks, business travel, employee commuting, and waste generated as part of company operations." Yale Sustainability, "Scope 3 Emissions" (webpage), available at https://sustainability.yale.edu/priorities-progress/climate-action/greenhouse-gas-emissions/scope-3-emissions

72 Smart Freight Centre, "Smart Freight Centre Launches New Shipper-Carrier Coalition to Pilot Heavy-Duty EV Charging with Terawatt Along the First Ever US Over-the-Road Electrified Corridor" (webpage) (2024), available at https://www.smartfreightcentre.org/en/about-sfc/news/smart-freight-centre-launches-new-shipper-carrier-coalition-to-pilot-heavy-duty-ev-charging-with-terawatt-along-the-first-ever-us-over-the-road-electrified-corridor/; Trucking Info, "I-10 Truck Charging Project to Cross 4 States Starting in 2027" (webpage) (2025), available at https://www.truckinginfo.com/10239975/i-10-truck-charging-project-to-cross-4-states-starting-in-2027

73 CPUC "Transportation Electrification" (webpage) (2025), available at https://www.cpuc.ca.gov/industries-and-topics/electrical-energy/infrastructure/transportation-electrification:

74 Bonnie May and John Friedrich, *City of Long Beach Blueprint for Medium- and Heavy-Duty Zero-Emission Vehicle Infrastructure*, California Energy Commission (2023), p.1–52, available at https://www.energy.ca.gov/sites/default/files/2023-09/CEC-600-2023-052_0.pdf

75 Center for Green Market Activation, "GMA Trucking Request for Proposal" (webpage) (2024), available at https://www.gmacenter.org/news/rfp/gma-trucking-request-for-proposal/

76 CARB, "Local Government Zero-Emission Vehicle Readiness" (webpage) (2025), available at https://ww2.arb.ca.gov/resources/fact-sheets/local-government-zero-emission-vehicle-readiness; U.S. Department of Energy, "Overview: Federal Fleet ZEV Ready Process" (webpage) (2025), available at https://www.energy.gov/femp/overview-federal-fleet-zev-ready-process

77 CTC, "SB 671 Clean Freight Corridor Efficiency Assessment" (webpage) (2023), available at https://catc.ca.gov/-/media/ctc-media/documents/programs/sb671/sb671-final-clean-freight-corridor-efficiency-assessment-dor.pdf

78 CTC, "Top 6 Freight Corridors Identified Under SB 671" (webpage) (2023), available at https://catc.ca.gov/-/media/ctc-media/documents/programs/sb671/092023-sb-671-top-6-freight-corridors-a11y.pdf

79 Catherine Ledna et al., *Assessing total cost of driving competitiveness of zero-emission trucks*, iScience, Volume 27, Issue 4, 109385 (2024), available at https://doi.org/10.1016/j.isci.2024.109385

80 CARB, "Low Carbon Fuel Standard" (webpage), available at https://ww2.arb.ca.gov/our-work/programs/low-carbon-fuel-standard

81 Ray Minjares, *A clean commercial vehicle sales incentive that costs nothing*, ICCT (2025), available at https://theicct.org/a-clean-commercial-vehicle-sales-incentive-that-costs-nothing-jul25/

82 CARB, *Report to Governor on Executive Order N-27-25 on Zero Emissions Vehicle Deployment*, (2025), available at https://ww2.arb.ca.gov/resources/documents/report-governor-executive-order-n-27-25-zero-emissions-vehicle-deployment

83 Ibid.

84 California Department of Motor Vehicles, "Registration fees" (webpage), available at https://www.dmv.ca.gov/portal/vehicle-registration/registration-fees/

85 U.S. EPA, "Learn About Federal Excise Tax Exemption" (webpage), available at https://www.epa.gov/verified-diesel-tech/learn-about-federal-excise-tax-exemption

86 Columbia Law School et al., "IRA section 13502 – advanced manufacturing production credit (for solar and wind manufacturers)," Inflation Reduction Act Tracker (webpage) (2025), available at https://iratracker.org/programs/ira-section-13502-advanced-manufacturing-production-credit-for-solar-and-wind-manufacturers/

87 Columbia Law School et al., "IRA Section 13403 – Clean Commercial Vehicle Credit," Inflation Reduction Act Tracker (webpage) (2025), available at https://iratracker.org/programs/ira-section-13403-clean-commercial-vehicle-credit/

88 Sidley Austin LLP, "The 'One Big Beautiful Bill' Act: Navigating the New Energy Landscape" (webpage) (2025), available at https://www.sidley.com/en/insights/newsupdates/2025/07/the-one-big-beautiful-bill-act-navigating-the-new-energy-landscape

89 However, these programs can be difficult to implement, primarily due to infrastructure limitations (e.g., limited space for providing dedicated lanes for zero-emission trucks) and technology and operational challenges (e.g., verification systems, integration with logistics software). Zero-emission trucks granted priority entry can also still face delays due to subsequent container pick-up and other queues, diminishing the advantage of their expedited entry.

90 Deployment is slowed in part due to bottlenecks in the transmission and distribution equipment supply chain. Utilities could be encouraged to create a backstock of this equipment, enabling them to be more flexible to upgrade capacity when and where it is needed.

91 CPUC, "Transportation Electrification Proactive Planning" (webpage) (2025), available at https://www.cpuc.ca.gov/industries-and-topics/electrical-energy/infrastructure/transportation-electrification/transportation-electrification-proactive-planning

92 CARB, *Report to Governor on Executive Order N-27-25 on Zero Emissions Vehicle Deployment*, (2025), available at https://ww2.arb.ca.gov/resources/documents/report-governor-executive-order-n-27-25-zero-emissions-vehicle-deployment

93 Natural Resources Defense Council, "Powering Up Californians Act Is Signed into Law" (webpage) (2023), https://www.nrdc.org/bio/max-baumhefner/powering-californians-act-signed-law

94 CARB, "Low Carbon Fuel Standard" (webpage), available at https://ww2.arb.ca.gov/our-work/programs/low-carbon-fuel-standard

95 CEC, "Integrated Energy Policy Report" (webpage), available at https://www.energy.ca.gov/data-reports/reports/integrated-energy-policy-report-iepr

96 CTC, "Trade Corridor Enhancement Program" (webpage), available at https://catc.ca.gov/programs/sb1/trade-corridor-enhancement-program

97 National Renewable Energy Laboratory, "Distributed Energy Resource Management Systems" (webpage), available at https://www.nrel.gov/grid/distributed-energy-resource-management-systems

98 CARB, *Report to Governor on Executive Order N-27-25 on Zero Emissions Vehicle Deployment*, (2025), available at https://ww2.arb.ca.gov/resources/documents/report-governor-executive-order-n-27-25-zero-emissions-vehicle-deployment

99 Southern California Edison, *EV Infrastructure Rule 29 Fact Sheet*, (2022), available at https://www.sce.com/sites/default/files/2022-07/EV%20Rule%2029%20Fact%20Sheet%200622_WCAG%20(V2).pdf; Pacific Gas and Electric Company, *Electric Vehicle Infrastructure Rule 29*, (2025), available at https://www.pge.com/assets/pge/docs/clean-energy/electric-vehicles/electric-rule-29-fact-sheet.pdf

100 Southern California Edison, "Charge Ready Transport Program" (webpage), https://crt.sce.com/overview

101 Southern California Edison, "Take Charge: A Guidebook to Fleet Electrification and Infrastructure" (webpage), available at https://www.sce.com/sites/default/files/2020-07/Electrification%20%26%20Infrastructure%20Guidebook-Final_06.29.20.pdf

102 Karen Garcia, "Southern California electric bills are soaring. Here's how to save money," Los Angeles Times (Aug. 21, 2024), https://www.latimes.com/california/story/2024-08-21/california-electric-bills-how-to-reduce-the-cost

103 California Legislature, Senate Bill 254, available at https://legiscan.com/CA/text/SB254/id/3220315

104 IRS, "Alternative Fuel Vehicle Refueling Property Credit" (webpage), available at https://www.irs.gov/credits-deductions/alternative-fuel-vehicle-refueling-property-credit

105 Prologis, "Insights & News" (webpage), available at https://www.prologis.com/insights/success-stories

106 CARB, "Advanced Clean Trucks" (webpage), available at https://ww2.arb.ca.gov/our-work/programs/advanced-clean-trucks

107 The White House, "Statement by the President" (webpage) (2025), available at https://www.whitehouse.gov/briefings-statements/2025/06/statement-by-the-president/

108 CARB, "Clean Truck Partnership" (webpage) (2024), available at https://ww2.arb.ca.gov/clean-truck-partnership-home

109 Daimler Truck N. Am. LLC v. CARB, 2:25-cv-02255 (E.D. Cal. Aug. 22, 2025).

110 U.S. Department of Justice, "Justice Department Sues California to End Enforcement of Unlawful Emissions Standards for Trucks" (webpage) (2025), available at https://www.justice.gov/opa/pr/justice-department-sues-california-end-enforcement-unlawful-emissions-standards-trucks; Sharon Udasin, "FTC Declares California Truck Emissions Deal Unenforceable," The Hill (2025), available at https://thehill.com/policy/energy-environment/5450798-california-truck-emissions-ftc/

111 CARB, "CARB adds flexibility to truck fleet requirements with amendments to help owners continue zero-emission progress" (webpage) (2025), available at https://ww2.arb.ca.gov/news/carb-adds-flexibility-truck-fleet-requirements-amendments-help-owners-continue-zero-emission

112 CARB, "Advanced Clean Fleets" (webpage), available at https://ww2.arb.ca.gov/our-work/programs/advanced-clean-fleets/about

113 Office of the Governor of California, Executive Order N-27-25: CRA Response, (2025), available at https://www.gov.ca.gov/wp-content/uploads/2025/06/CRA-Response-EO-N-27-25_-bl-formatted-GGN-Signed-6-11-954pmFinal.pdf

114 CARB, Report to Governor on Executive Order N-27-25 on Zero Emissions Vehicle Deployment, (2025), available at https://ww2.arb.ca.gov/resources/documents/report-governor-executive-order-n-27-25-zero-emissions-vehicle-deployment

115 CARB, "Low Carbon Fuel Standard" (webpage), available at https://ww2.arb.ca.gov/our-work/programs/low-carbon-fuel-standard

116 CARB, "LCFS ZEV Infrastructure Crediting" (webpage) (2025), available at https://ww2.arb.ca.gov/resources/documents/lcfs-zev-infrastructure-crediting

117 CARB, "Heavy-Duty Omnibus Regulation" (webpage) (2020), available at https://ww2.arb.ca.gov/rulemaking/2020/hdomnibuslownox

118 CARB, "Innovative Clean Transit (ICT) Regulation Fact Sheet" (webpage) (2019), available at https://ww2.arb.ca.gov/resources/fact-sheets/innovative-clean-transit-ict-regulation-fact-sheet

119 CARB, "The California Sustainable Freight Action Plan" (webpage), available at https://ww2.arb.ca.gov/our-work/programs/california-sustainable-freight-action-plan

120 California Transportation Commission (CTC), "Senate Bill 671 (SB 671) Program" (webpage) (2023), available at https://catc.ca.gov/programs/sb671

121 CTC, *Clean Freight Corridor Efficiency Assessment* (2025), p.1–48, available at https://catc.ca.gov/-/media/ctc-media/documents/programs/sb671/sb671-final-clean-freight-corridor-efficiency-assessment-dor.pdf

122 Federal Highway Administration, "Biden-Harris Administration Releases First-Ever National Strategy to Accelerate Deployment of Zero-Emission Infrastructure for Freight Trucks" (webpage) (2024), available at https://highways.dot.gov/newsroom/biden-harris-administration-releases-first-ever-national-strategy-accelerate-deployment

123 Kang-Ching Chu et al., *National Zero-Emission Freight Corridor Strategy*, Joint Office of Energy and Transportation (2024), p.1–36, available at https://driveelectric.gov/files/zef-corridor-strategy.pdf

124 CARB, "Zero-Emission Vehicle Incentives and the Advanced Clean Fleets Regulation" (webpage) (2024), available at https://ww2.arb.ca.gov/resources/fact-sheets/zero-emission-vehicle-incentives-and-advanced-clean-fleets-regulation

125 California HVIP, "HVIP Hits Record Growth as Zero-Emission Truck and Bus Market Expands" (webpage) (2025), available at https://californiahvip.org/news/hvip-hits-record-growth-as-zero-emission-truck-and-bus-market-expands/

126 California HVIP, "Clean Truck and Bus Voucher Incentive Project" (webpage) (2025), available at https://californiahvip.org/

127 CARB, "Innovative Small E-Fleet Program" (webpage) (2025), available at https://ww2.arb.ca.gov/our-work/programs/innovative-small-e-fleet

128 CARB, "Low Carbon Transportation Incentives and Air Quality Improvement Program" (webpage) (2025), available at https://ww2.arb.ca.gov/our-work/programs/low-carbon-transportation-incentives-and-air-quality-improvement-program

129 CARB, "Carl Moyer Program: Apply" (webpage) (2025), available at https://ww2.arb.ca.gov/carl-moyer-program-apply

130 CARB, "On-Road Heavy-Duty Voucher Incentive Program" (webpage) (2025), available at https://ww2.arb.ca.gov/our-work/programs/road-heavy-duty-voucher-incentive-program

131 CEC, "Clean Transportation Program" (webpage) (2025), available at https://www.energy.ca.gov/programs-and-topics/programs/clean-transportation-program

132 CEC, "Energy Infrastructure Incentives for Zero-Emission Commercial Vehicles (EnergIIZE Commercial Vehicles)" (webpage), available at https://www.energy.ca.gov/programs-and-topics/programs/clean-transportation-program/energy-infrastructure-incentives-zero

133 CARB, "Low Carbon Transportation Incentives and Air Quality Improvement Program" (webpage) (2025), available at https://ww2.arb.ca.gov/our-work/programs/low-carbon-transportation-incentives-and-air-quality-improvement-program

134 CALMATTERS, "AB 1207: Climate change: market-based compliance mechanism: extension" (webpage) (2025), available at https://calmatters.digitaldemocracy.org/bills/ca_202520260ab1207

135 Alejandro Lazo and Jeanne Kuang, "Lawmakers send Newsom a high-stakes energy overhaul tied to wildfires, utilities and oil," CALMATTERS (2025), available at https://calmatters.org/environment/2025/09/climate-change-package-legislature/.

136 CTC, "Trade Corridor Enhancement Program" (webpage) (2025), available at https://catc.ca.gov/programs/sb1/trade-corridor-enhancement-program

137 U.S. Department of Transportation (DOT), "Charging and Fueling Infrastructure Grant Program" (webpage) (2024), available at https://www.transportation.gov/rural/grant-toolkit/charging-and-fueling-infrastructure-grant-program

138 U.S. DOT Federal Highway Administration, "Fact Sheets. National Electric Vehicle Infrastructure Formula Program" (webpage), available at: https://www.fhwa.dot.gov/infrastructure-investment-and-jobs-act/nevi_formula_program.cfm

139 Environmental Defense Fund, "The National Electric Vehicle Infrastructure Program is back on the road" (blog post) (2025), available at https://blogs.edf.org/energyexchange/2025/08/21/the-national-electric-vehicle-infrastructure-program-is-back-on-the-road/

140 U.S. EPA, "Clean Heavy-Duty Vehicles Program" (webpage) (2025), available at https://www.epa.gov/clean-heavy-duty-vehicles-program

141 Columbia Law School et al., "IRA Section 13403 – Clean Commercial Vehicle Credit," Inflation Reduction Act Tracker (webpage) (2025), available at https://iratracker.org/programs/ira-section-13403-clean-commercial-vehicle-credit/

142 Columbia Law School et al., "IRA Section 13502 – Advanced Manufacturing Production Credit (for Solar and Wind Manufacturers)," Inflation Reduction Act Tracker (webpage) (2025), available at https://iratracker.org/programs/ira-section-13502-advanced-manufacturing-production-credit-for-solar-and-wind-manufacturers/

143 Sidley Austin LLP, "The 'One Big Beautiful Bill' Act: Navigating the New Energy Landscape" (webpage) (2025), available at https://www.sidley.com/en/insights/newsupdates/2025/07/the-one-big-beautiful-bill-act-navigating-the-new-energy-landscape

144 Ibid.

145 Internal Revenue Service (IRS), "Alternative Fuel Vehicle Refueling Property Credit" (webpage) (2025), available at https://www.irs.gov/credits-deductions/alternative-fuel-vehicle-refueling-property-credit

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