

February 11, 2022  
Liane Randolph, Chair California Air Resources Board  
1001 I Street  
Sacramento, CA 95814

**Re: Follow-Up Resources Supporting 100% Sales Target in 2036**

Dear Chair Randolph:

In our recent meeting with you, our coalition laid out the urgent need to strengthen the forthcoming Advanced Clean Fleets (ACF) rule to fulfill California's commitments to environmental justice, bold climate action, and clean energy job creation. Per your request, we are providing you and CARB Staff with our justification for a stronger rule, including the feasibility of better aligning the 100% ZE sales mandate with the Mobile Source Strategy by moving the date from 2040 to 2036.

Attached is a list of recent reports and announcements grouped by how they respond to common categories of concern (e.g., cost, operational suitability, infrastructure availability, manufacturer capacity, etc.) Together, they present a clear picture of the current status and trajectory of the zero-emission truck market and indicate that moving the 100% sales mandate to 2036 is imminently feasible.

By 2030, there is not a single truck category where zero-emissions trucks do not have a more favorable TCO than combustion. At that point, there is no reason why the lifesaving, climate-protecting alternative should not be required for every sale. Our request of CARB is more modest still, allowing an extra 5 years before new combustion sales would be phased-out.

Staff raised the concern that the needs of long-haul heavy-duty trucks make the 2035 date seem unrealistic. Notwithstanding CARB's duty to set technology-forcing mandates that move the market in line with breathable air and a safe climate, we think it is perfectly reasonable to expect this final category of trucks will also be zero-emission-ready more than a decade from now, given the multiple reports underscoring the feasibility of zero-emission long-haul trucking today.

The rate of progress in the last 2 years alone has been substantial, and it is certain to accelerate. In 2021, electrified transport was the fastest-growing segment of global investment in the low-carbon transition, growing at a "breakneck rate of 77%."<sup>1</sup> Any reasonable assessment of this trajectory should provide full confidence that we can meet the goals set by the Governor and Board. In the end, CARB's role is not to predict the future, but to enable it. We know a rapid, expansive transformation to zero-emission technology that is technically and economically

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<sup>1</sup> BNEF, Energy Transition Investment Trends 2022 (Jan 27, 2022)  
<https://assets.bbhub.io/professional/sites/24/Energy-Transition-Investment-Trends-Exec-Summary-2022.pdf>

feasible is the only viable answer to our air quality and climate crises. We hope the attached is useful. Please let us know if you have follow-up questions or would like any additional information.

Sincerely,

The Advanced Clean Fleets Coalition

## **Annotated Bibliography on Feasibility of Truck Electrification**

### **1. 100% ZE Truck Sales by 2040 Would Be Business-As-Usual**

#### **a. Global Drive to Zero, Memorandum of Understanding on Zero-Emission Medium- and Heavy-Duty Vehicles (November 2021)**

- i. At COP26 in Glasgow, California, along with 15 other countries, several subnational jurisdictions, and fleets such as Heineken and DHL, committed to work toward “100% zero-emission new truck and bus sales by 2040” with an interim target of 30% by 2030.
- ii. As the MOU text states, “the Participants are invited to Publicly share a higher ambition.” For California, which currently Chairs the global Transportation Decarbonisation Alliance under the leadership of Chair Randolph, the ACF is an ideal opportunity to commit to higher ambition.

#### **b. ACEA - PIK, Joint Statement - The Transition to Zero-Emission Road Freight Transport (December 2020)**

- i. In Europe, where emissions standards for trucks are already in place and new proposals for strengthening are anticipated, OEM announcements have been even bolder.
- ii. Daimler, Scania, MAN, Volvo, DAF, IVECO, and Ford (seven of Europe’s largest truck manufacturers) voluntarily committed to phasing out all diesel trucks by 2040: “Carbon-neutrality by 2050 at the latest implies that by 2040 all new commercial vehicles sold must be fossil free. And this is a pledge that the commercial vehicle industry is making now for the first time.”

### **2. Electric Trucks Save Owners Money – Even Faster than Electric Cars**

#### **a. UC Berkeley School of Public Policy, 2035 Transportation Report – Appendix (June 2021)**

- i. The focus of the report is on the feasibility, economic savings, and climate and health benefits of 100% ZE light-duty sales by 2030, and 100% ZE medium-and-heavy duty sales by 2035.
- ii. The Appendix includes detailed cost breakdowns for 6 different vehicle classes (from Class 1 LDV to Class 7-8 HDT) and finds every truck class evaluated has (or will have prior to 2025) a lower lifetime cost per mile driven than its combustion equivalent.
- iii. By 2035, the total cost of ownership for a Class 7 or 8 tractor will be less than half of that for an ICE vehicle. (*See pages 37 - 39 in the Appendix download*)

- b. [CARB, Draft Advanced Clean Fleets Total Cost of Ownership Discussion Document \(September 2021\)](#)
    - i. CARB Staff presents a comprehensive TCO study of six different vehicle types across different truck classes, including costs associated with infrastructure investment, and excluding any rebates or incentives.
    - ii. The results show starting in 2025, many of the trucks already yield significant savings compared to diesel, and that by 2030, the zero-emission version of every truck class examined has superior TCO to the combustion equivalent - including Class 8 Sleeper Cabs.
  
  - c. [Lawrence Berkeley National Laboratory, Why Regional and Long-Haul Trucks are Primed for Electrification Now \(March 2021\)](#)
    - i. A detailed analysis using updated technical inputs on battery and renewable energy costs showing the technological feasibility and economic benefit of battery-electric trucks for long-haul and other duties.
    - ii. The report shows that by relying on current data, BEV long-haul trucks are already 13% cheaper to own than diesel, and savings widen over time.
- 3. New Financing and Business Models Will Help Overcome Upfront Price Barriers**
- a. [CALSTART, Zeroing in on Zero-Emission Trucks \(February 2022\)](#)
    - i. The CALSTART Report highlights how new business models such as Transportation-as-a-Service (TaaS) allow operators to avoid the upfront cost of fleet transitions.
    - ii. TaaS models allow operators to pay recurring subscription fees in exchange for full ZET fleet maintenance and/or charging installation and management.
    - iii. A growing number of companies have established around this business model to alleviate upfront capital costs for fleets while providing transition expertise.
    - iv. Some specifically focused on medium- and heavy-duty include [Zeem Solutions](#), [Forum Mobility](#), [WattEV](#), [AMPLY Power](#), and [Electrada](#).
  
  - b. [CALSTART, Taking Commercial Fleet Electrification to Scale: Financing Barriers and Solutions \(March 2021\)](#)
    - i. This report focuses on financing needs and solutions for scaling fleet electrification.
    - ii. It assesses the current state of financing markets and outlines the emerging financial and commercial solutions that are helping overcome barriers to allow for an accelerated transformation.
    - iii. The report also highlights emerging engagement by financial actors (both commercial and “green” public banks, equity investors, and finance companies) and turnkey infrastructure solutions within the industry, such as

the [Volvo LIGHTS project](#) and the [Proterra-Mitsui battery-finance model](#) – both of which are being replicated.

**c. [EDF, Financing the Transition - Unlocking Capital to Electrify Truck and Bus Fleets \(November 2020\)](#)**

- i. This report provides a framework for segmenting barriers to fleet electrification into actual versus perceived costs associated with MHD ZEVs, and actual versus perceived costs associated with switching to a new fleet.
- ii. The report also identifies financial instruments, policy supports, and technical tools for each kind of barrier that can be leveraged to smooth the transition.

**4. Much of the Existing Truck Fleet is Already Favorable for Electrification**

**a. [MJ Bradley, Market Medium- and Heavy-Duty Vehicle Market Structure and EV Readiness \(July 2021\)](#)**

- i. The report examines the in-use truck fleet to assess readiness for adoption of zero-emission trucks based on charging patterns, operating requirements, market status, and business case.
  1. It relies on the conservative cost assumptions in a [2019 ICF report](#).
- ii. The report finds that 66% of the in-use truck fleet indicates “strong potential for near-term [pre-2025] uptake.”

**b. [NACFE, Electric Trucks Have Arrived, Documenting A Real-World Electric Trucking Demonstration \(January 2022\)](#)**

- i. Report summarizes the positive results of a 3-week on-road demonstration of 13 trucks in four market segments that support the following conclusion: “The event proved that four market segments – vans and step vans, medium-duty box trucks, terminal tractors, and heavy-duty regional haul tractors – are ready to go electric.”
- ii. Over 45 subject matter experts on a variety of critical aspects of trucks, and 2,500 industry stakeholders, took part in the study.

**c. [Bjorn Nykvist and Olle Olsson, The Feasibility of Heavy Battery Electric Trucks \(April 2021\)](#)**

- i. This study disputes earlier findings that battery-electric trucks are not feasible for many applications by showing that access to expected levels of fast charging slashes range requirements and significantly increases their favorability.

## 5. There is Already a Large and Growing Availability of ZE Trucks

### a. [CARB HVIP, All Eligible Vehicles \(As of January 2022\)](#)

- i. CARB's HVIP website lists 144 ZEV vehicles eligible for HVIP incentives today, including step vans, panel trucks, box trucks, refuse trucks, transit buses, Class 8 semi-trucks and many more types.
- ii. There are also multiple vehicles available in each class from Class 3 to 8.

### b. [CALSTART, Zeroing in on Zero-Emission Trucks \(February 2022\)](#)

- i. Since 2019, the number of zero-emission truck models has increased 625%.
- ii. There are now 145 models available for purchase across 30 manufacturers, with several dozens more expected prior to 2024.
- iii. CALSTART's [Zero-Emission Technology Inventory](#) tool offers a real time update of ZEV vehicles globally and in North America that are currently available or announced for introduction soon.

### c. [ZETA, Medium and Heavy-Duty Electrification: Weighing the Opportunities and Barriers to Zero-Emission Fleets \(January 2022\)](#)

- i. Electric models currently available can meet up to 60% of operational needs.
- ii. Trucks capable of traveling 370 miles are expected by the end of 2022, and trucks capable of traveling more than 620 miles are expected after 2023.
- iii. A year before ACF goes into effect, these ranges will cover the requirements of around 90% of trucks in use on a single charge.

## 6. Surging Demand from Fleets, Cities, States, and the Public

### a. [EDF, Electric Fleet Deployment and Commitment List \(As of January 2022\)](#)

- i. EDF maintains a running list of electric truck and bus deployments and fleet commitments to electrification.
- ii. The spreadsheet demonstrates both the strength of interest from government and corporate fleets and the breadth of vehicles, covering virtually all truck types from cargo vans to Class 8 tractors, that are already deployed.
- iii. It also collects major commitments from fleets, like FedEx, which have committed to 100% carbon-free logistics by 2040.

### b. [CERES, 70+ Companies Want Faster Adoption Of Zero-Emission Trucks \(September 2021\)](#)

- i. Fleets are pushing for stronger manufacturer commitments nationwide.
- ii. Over 70 companies wrote a letter urging governors nationwide for faster adoption of California's Advanced Clean Truck rule, arguing the rule will help bring down costs for ZEVs by "requiring manufacturers to increase model availability to meet the needs of fleet operators and driving investment in clean transportation research and development."
- iii. Signatories include IKEA Unilever, eBay, and Etsy.

- c. [Bloomberg, How Zero-Emission Laws Will Reshape US Trucking \(January 2022\)](#)
  - i. The U.S. trucking industry is set to be transformed by a handful of states that have adopted zero-emission vehicle requirements.
  - ii. Oregon, Washington, New York, New Jersey, and Massachusetts followed California in approving the Advanced Clean Truck (ACT) rule late last year, requiring a growing percentage of all medium- and heavy-duty trucks sold to be zero-emission starting in 2025.
    - 1. Together, the six states adopting the rule account for 20% of the nation's trucking fleet.
    - 2. Manufacturers must increase their zero-emission truck sales in those states to between 30 and 50 percent by 2030, and 40 and 75 percent by 2035.
  - iii. Other states may follow soon: Maine has taken steps to adopt the ACT rule in 2022, while Colorado, Illinois, Connecticut, and Vermont have signaled plans to weigh the new regulations as well.
  - iv. Bold commitments from these leading states can serve as the catalyst to keep the rate of market development accelerating, getting more electric and fuel cell trucks onto roads and making diesel obsolete.
  
- d. [CALSTART, Review of Commitments for Zero-Emission Medium and Heavy-Duty Vehicles \(December 2021\)](#)
  - i. Several market share leading makers of MHD vehicles have made commitments for 100% fossil free new vehicle sales by 2040 or sooner including Ford, Volvo, Paccar (Kenworth and Peterbilt), and Daimler Group.
    - 1. Daimler Group has committed to 100% carbon neutral in driving operation in Europe, North America, and Japan by 2039.
    - 2. GM Group has committed to 100% carbon neutral in global products and operations by 2040.
  
- e. [Teslarati.com, Ford Boasts Over 167 Percent Growth in EV Sales, Announces Wal-Mart's 1,100 E-Transit Order](#)
  - i. "Walmart placed an order for 1,100 Ford E-Transits that will be used to support our growing in-home delivery service. As we continue to build our last mile delivery fleet, we're interested in working with electric van providers that help us achieve our goal of operating a 100% zero-emissions logistics fleet by 2040."

## **7. Infrastructure to Support Full Electrification is Achievable**

- a. [H.R. 3684, Federal Funding through the Infrastructure Investment and Jobs \(Bipartisan Infrastructure\) Act \(November 2021\)](#)
  - i. \$2.5 billion in grants for specifically for publicly accessible medium- and heavy-duty charging

- ii. \$2.25 billion in funding for Port electrification, including “infrastructure for drayage, and medium or heavy-duty trucks and locomotives that service the port and related grid upgrades.”
  - iii. \$5 billion in formula funding for a national public charging network of over 500,000 chargers that would serve both individuals and commercial fleets.
  - iv. \$6.4 billion in carbon reduction projects in transport, including “projects to reduce the environmental and community impacts of freight movement, as well as projects to support deployment of alternative fuel vehicles and reduce transportation emissions at port facilities.”
  
- b. **Office of Governor Gavin Newsom, Governor Newsom Outlines Historic \$10 Billion Zero-Emission Vehicle Package to Lead the World’s Transition to Clean Energy, Combat Climate Change (January 2022)**
  - i. 2021-2022: \$1.2 billion in total funds specifically devoted to Heavy-Duty ZEVs and supporting infrastructure.
  - ii. 2022-2023 (Proposed): An additional \$3.93 billion in total funds specifically for medium- and heavy-duty zero-emission vehicles and their supporting infrastructure, including \$400 million specifically for electrifying ports, and a separate \$475 million for drayage trucks and their infrastructure.
  
- c. **California Public Utilities Commission, Utility Funded Infrastructure Program (June 2021)**
  - i. Investor-owned utilities in California have already been approved to spend over \$700 million between now and 2024 on installing make-ready and charging infrastructure to support a minimum of 18,000 medium and heavy-duty vehicles.
  - ii. The Utilities are also permitted to invest up to an additional \$80 million each through a streamlined advice letter process to achieve M/HD vehicle electrification goals.
  
- d. **Next-Gen Transportation News: Daimler, NextEra Energy, BlackRock Commit to U.S. Public Charging Infrastructure (January 2022)**
  - i. These three partners just signed an MOU making an initial commitment of \$650 million to build the nation’s first national public network of chargers for medium and heavy electric vehicles beginning in 2023.
  
- e. **AB Volvo, “Volvo Group, Daimler Truck, and the Traton Group Sign Joint Venture Agreement for European High-Performance Charging Network” (December 2021)**
  - i. This example from Europe serves to support our belief that the “chicken-egg” problem of ZEV infrastructure and ZEV manufacturing can be broken by setting clear future commitments that mobilize OEMs to build enabling infrastructure.



- ii. Following regulatory discussions regarding potential updates to CO2 standards for trucks as part of the [EU's "Fit for 55" climate package](#), three of the largest truck OEMs in Europe signed a Joint Venture to invest \$570 million USD as part of a continent-wide truck-charging network, with implementation beginning in 2022.
- f. [\*\*Advanced Clean Fleets Coalition, Summary of Key Activities in California to Advance Electric Vehicle Charging Infrastructure Development \(September 2021\)\*\*](#)
- i. This document summarizes the extensive planning, programs and funding sources contributing to the development of charging infrastructure in California as of September 2021.
  - ii. It goes beyond dollars invested to highlight State and Private progress on installation streamlining, workforce availability, charging cost management, and grid readiness for MHD charging.
  - iii. Many additional significant developments have been announced since then including some of those referenced above.
- g. [\*\*Edison Electric Institute, "Electric Companies Join Together to Form National Electric Highway Coalition" \(December 2021\)\*\*](#)
- i. The National Electric Highway Coalition announced in December 2021, that its 50+ members of major utilities across the nation would seek to build a national network of DC fast chargers along major corridors within their territories by the end of 2023.
  - ii. Collectively, they already have \$3.4 billion in approved funding for this effort and more than an additional \$1 billion will be available pending regulatory approval.
- h. [\*\*U.S. Federal Highway Administration, National Highway Charging Collaborative - Alternative Fuel Corridors \(March 30, 2021\)\*\*](#)
- i. EVSE provider, ChargePoint and The National Association of Truck Stop Operators (NATSO), announced significant progress in the first year of the National Highway Charging Collaborative, an initiative that will leverage \$1 billion in public and private capital to deploy charging at more than 4,000 travel plazas and truck stops serving highway travelers and rural communities nationwide by 2030.
  - ii. In its first year, the public-private Collaborative successfully funded more than 150 DC fast charging spots.

## 8. Increasing Manufacturing Capacity of Batteries to Meet Demand

### a. [White House, FACT SHEET: The Biden-Harris Electric Vehicle Charging Action Plan Including support for the Battery Supply Chain \(December 2021\)](#)

- i. The program includes more than \$7 billion in funding to accelerate innovations and facilities across the battery supply chain from battery materials refining, processing, and manufacturing to battery manufacturing, including components, to battery recycling and reuse.
- ii. In June, the Biden-Harris Administration released 100-day reviews of the supply chains of four critical products, including high-capacity batteries and critical minerals and materials.
  1. The reviews made dozens of recommendations across Federal agencies securing a reliable and sustainable end-to-end domestic supply chain for advanced batteries.
- iii. The DOE Loan Programs Office (LPO) published new guidance and a fact sheet for the approximately \$17 billion in loan authority in the Advanced Technology Vehicles Manufacturing Loan Program (ATVM) to support the domestic battery supply chain.

### b. [InsideEVs, “US: Over 10 New Battery Plants To Be Launched In 2022-2025” \(December 2021\)](#)

- i. Thirteen new battery plants are being built by major vehicle OEMs including Ford, General Motors, Stellantis, VW and Toyota.
- ii. The total manufacturing output for these new plants will be more than 300 GWh per year by 2025, not including a potentially very large project - Tesla's 4680-type cylindrical cell gigafactory in Texas which could be a three-digit number of GWh.
- iii. “As far as we know, basically all battery manufacturers and automotive groups are considering investments in more battery plants. It could be Chinese companies (like the Gotion High-Tech rumored recently), Panasonic (they are working on Tesla's 4680-type cells and with Toyota) or all-new start-ups.”
- iv. “One thing is sure, the EV battery industry might expand by 10 times within less than 5 years”.

## 9. Manufacturer Commitments and Announcements

### a. [MJ & Bradley, Electric Vehicle Market Status - Update \(Apr. 2021\)](#)

- i. The report summarizes the current status of electric vehicle manufacturing investments and announcements in the United States (as of Q1 of 2021). Some highlights for the medium and heavy-duty sector include:
  1. Ford announced it would commit \$22 billion to electrification (nearly twice what it had previously announced) and said specifically for commercial vehicles, they expect 2/3s of sales to be battery-electric or plug-in hybrid by 2030.

2. Volvo committed to have 50% of European truck sales be zero-emission and created a new business area dedicated to accelerating medium and heavy-duty electrification, focused on battery supply chain circularity and providing customer solutions for charging infrastructure.
  3. New zero-emission factories for heavy duty vehicles have been announced in Colorado, Indiana, and North Carolina.
  4. Mercedes is investing \$60 million in South Carolina to develop their eSprinter vans.
  5. Navistar's new San Antonio plant will now also produce electric trucks.
  6. Arrival said their South Carolina "microfactories" can produce up to 10,000 vans per year.
- b. [\*\*Teslarati.com, GM's Chevrolet Silverado EV gets over 110k reservations \(February 2022\)\*\*](#)
- i. "GM recently announced an investment of \$7 billion to expand battery cell and EV assembly capacity in the United States. Since 2020, General Motors has invested more than \$14 billion in 10 sites across North America to increase EV production capacity to 1 million+ electric vehicles annually by 2025"
- c. [\*\*Teslarati.com, Ford Plans for Major Restructuring of its EV Playbook with \\$20B budget: Bloomberg \(February 2022\)\*\*](#)
- i. Ford is planning for a major restructuring of its electric vehicle offensive with a massive budget of up to \$20 billion.
  - ii. The additional \$10 to \$20 billion investment will supplement the already \$30 billion investment that Farley detailed for Ford earlier.
  - iii. This investment will help Ford accelerate its EV commitment through 2024.
- d. [\*\*ChargedEVs.com, Lion Electric to Build its First US Manufacturing Facility in Illinois \(May 2021\)\*\*](#)
- i. The Lion Electric Company, a Canadian manufacturer of all-electric medium- and heavy-duty vehicles, has announced plans to build a new manufacturing plant in Illinois.
  - ii. The facility is expected to come online in the second half of 2022, with a production capacity of 20,000 vehicles per year.
  - iii. The new 900,000-square-foot facility will help Lion respond to increasing demand in the marketplace for Made in America zero-emission vehicles, while bringing production closer to its customers
- e. [\*\*Nikola Corporation Reports Third Quarter 2021 Results \(November 2021\)\*\*](#)
- i. "We have begun our Nikola Tre BEV pre-series builds in Coolidge (AZ). Trucks are on the assembly line and in process. As we are building our pre-series trucks, we are concurrently expanding the Phase 1 assembly

expansion area to enable our total production capacity in 2022 of 2,400 trucks per year on two (2) shifts. We anticipate the expanded Phase 1 will be completed in January 2022, and the construction of Phase 2 will begin immediately after that. Phase 2 is expected to be completed in early 2023, at which time our assembly hall will be fully built out with an installed process capacity of 20,000 units per year. The facility will be capable of building the Nikola Tre BEV and FCEV trucks on the same line...”

- ii. “On December 17, 2021, [Nikola Corporation](#) delivered the first [Nikola Tre](#) battery-electric vehicle “*pilot trucks*” to Total Transportation Services Inc., a California port drayage company. The vehicles (two, we assume) will be used at the ports of Los Angeles and Long Beach.”
  1. These trucks have a 350-mile range and have now been approved as HVIP eligible.

## **10. Transportation Electrification is Leading to Significant Investments and Job Growth in California**

- a. [EDF, Charged-Up, California Case Study: Analysis of Jobs, Investments, and Companies in the Zero Emissions Medium and Heavy Duty Vehicle Supply-Chain Economy \(October 2021\)](#)
  - i. The assessment of California’s MHD ZEV industry catalogs the significant number of new market entrants, and the progress made by existing businesses adapting their offerings to MHD ZEV products.
  - ii. The report finds California leads the nation with 128 companies (86 headquartered in-State) with over 44,000 employees and \$3.8 billion of announced corporate investment across manufacturing, infrastructure, and research and training.
  - iii. The majority of business locations, employees, and investments are all associated with manufacturing, followed by infrastructure installation.