Advanced Clean Trucks Regulatory Workshop

April 2, 2019
Today’s Overview

- Background
- Market outlook
- Fleet reporting
- Manufacturer sales
Major NOx Reductions Needed

• Nearly all trucks to have 2010 model year engines by 2023
• Action beyond current programs needed by 2031
  • Mobile source emissions reduced more than 50%
  • Truck and bus emissions reduced by nearly 70%
• Heavy-duty trucks and federal sources remain largest contributors
California’s Climate Change Targets – Transportation Remains Largest GHG Source

- Achieve 1990 GHG levels by 2020
  - 40% below 1990 levels by 2030
  - 80% below 1990 levels by 2050
- Cleaner electricity targets (SB 100)
  - 60% renewable by 2030
  - Zero carbon by 2045
- Carbon neutrality by 2045

CA GHG Emissions (2017)

- Mobile Sources 36%
- Industrial 21%
- Electrical Power 16%
- Agricultural 9%
- Residential and Commercial 10%
- High GWP 5%
- Recycling and Waste 3%

Note: Mobile sources represent ~50% of GHG inventory when including emissions from fuel production.
California’s Air Quality and Climate Goals

- Federal Air Quality Standards
- 100,000 Zero-Emission Freight Vehicles and Equipment
- Community Risk Reduction
- Greenhouse Gas Reduction Targets
- Petroleum Reduction Target
- 5 Million Zero-Emission Vehicles

Zero-Emission Solutions
**Suite of Mobile Source Measures**

**Zero-Emission (ZE) Operation**
- Innovative Clean Transit ✓
- ZE Airport Shuttle
- ZE truck certification
- Advanced Clean Trucks
- ZE ships at berth
- Rail yard idling
- ZE TRUs
- ZE forklifts
- ZE truck fleets
- ZE drayage trucks
- ZE cargo equipment

**Lower Emissions**
- CA GHG Phase 2 ✓
- Truck OBD ✓
- Truck Smoke Tests ✓
- Handbook-1 Warehouses
- Heavy-duty Omnibus
- Heavy-duty I/M
- Harbor craft
- Handbook-2 Ports, Rail
- Low-emission diesel fuel
- Non-preempted locomotives

Lower Emissions
Goals for Advanced Clean Trucks

• Accelerate first wave of zero-emission truck deployments in best suited applications
• Enable a large-scale transition to zero-emission technology
• Maximize the total number of ZEVs deployed
• Complement existing and future programs
• Provide environmental benefits, especially in disadvantaged communities
• Ensure requirements are technologically feasible and cost-effective
• Foster a self-sustaining zero-emission truck market
Advanced Clean Trucks Summary

- Manufacturer sales requirement
  - ZEVs as a percentage of sales - 2024-2030 model year
  - Revisit in 2025 for post-2030 action
- Fleet reporting requirement
  - Information about vehicles and contracted services
  - Future fleet rules, ZE truck standard, and/or other
Market Outlook
Emerging Zero-Emission Truck Market

- Manufacturers offering commercially available Class 3-8 electric trucks and vans
  - Bluebird, BYD, Chanje, Lightning Systems, Lion Electric, GreenPower, Kalmar Ottawa, Motiv, Phoenix Motorcars, OrangeEV, Workhorse Group
- Nearly all conventional OEMs have EV demonstrations or have announced plans for commercialization
- Announcements by several new entrants to market
  - Bollinger Motors, Nikola, Roush, Tesla, Thor Trucks
## Heavy-duty Electric Market Growing - 2016

<table>
<thead>
<tr>
<th>Commercial</th>
<th>2B-3</th>
<th>4-5</th>
<th>6-7</th>
<th>8</th>
</tr>
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<tbody>
<tr>
<td>Commercial</td>
<td><img src="#" alt="Zoomer" /></td>
<td><img src="#" alt="Connect21" /></td>
<td><img src="#" alt="Motive" /></td>
<td><img src="#" alt="Ameripride" /></td>
</tr>
</tbody>
</table>

*Excludes transit buses, not all models shown*
# Heavy-duty Electric Market Growing - Today

<table>
<thead>
<tr>
<th>2B-3</th>
<th>4-5</th>
<th>6-7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="2B-3 Electric Truck" /></td>
<td><img src="image2.png" alt="4-5 Electric Truck" /></td>
<td><img src="image3.png" alt="6-7 Electric Truck" /></td>
<td><img src="image4.png" alt="8 Electric Truck" /></td>
</tr>
</tbody>
</table>

*Excludes transit buses, not all vehicles shown*
Major Suppliers and Service Providers Entering Market

- Established suppliers entering ZE truck supply chain
  - Partnering with existing ZE vehicle/drivetrain manufacturers
- Established service providers servicing, distributing, training, leasing ZE trucks
  - Ryder to provide service for Chanje, Workhorse, Nikola
  - Penske demonstrating Freightliner and Mitsubishi Fuso electric trucks
Standards Development Progressing

- Existing standards
  - J1772 CCS – AC charging up to 19 kW, DC up to 350 kW
  - J3068 – AC charging up to 166 kW
  - J2601 – Hydrogen refueling up to 10 kg
- High-powered charging
  - CharIN developing new standard for charging above 1 MW
    - Includes many manufacturers and EVSE providers
  - Hydrogen refueling protocol for heavy-duty trucks
    - MOU between Air Liquide, Hyundai, Nel Hydrogen, Nikola, Shell, and Toyota


Hydrogen MOU: [https://www.greencarcongress.com/2019/02/20190221-h2.html](https://www.greencarcongress.com/2019/02/20190221-h2.html)
HD ZE Vehicles Needed

- Innovative Clean Transit (adopted)
  - Transit buses, cutaway shuttles
  - Mobility with lighter ZE vehicles
- Zero-Emission Airport Shuttle Bus (pending)
  - Transit buses, cutaway shuttles, passenger vans
- Port’s Clean Air Action Plan (adopted)
  - Class 7 and 8 tractors
- AB 739 (signed)
  - Class 6-8 vocational trucks
Meetings Held to Date

- Initial rule proposal – April 2017
- Multiple fleet/manufacturer meetings in 2018
- Three workgroup meetings since initial rule proposal
- Discussion topics at workgroup meetings
  - Zero-emission truck suitability
  - Fleet total cost of ownership
  - Utility support and infrastructure considerations
  - Meeting materials available online¹

¹ https://ww2.arb.ca.gov/our-work/programs/advanced-clean-truck/act-meetings-workshops
ZEV Truck Suitability

• Most straight trucks average below 100 mi./day (VIUS, Cal-VIUS, EMFAC)

• Weight less of a concern in California
  • AB 2061 allows ZEVs and PHEVs to exceed weight limits by 2,000 lbs.

• Utility programs support and simplify infrastructure deployments at depots

• Technology improvements, battery density, and innovative designs expand opportunities

• Market segment analysis
  • Estimates sales numbers by segment
  • Consistent with other data sources
  • Graded for range, weight, infrastructure, space

Market segment analysis: https://ww2.arb.ca.gov/sites/default/files/2019-02/190225actmarketanalysis.xlsx
Total Cost of Ownership (TCO) Comparable in Right Duty Cycles

- Draft TCO discussion paper available for comment\(^1\)
- By 2024, BEVs* have favorable TCO versus diesel vehicles in many local or vocational applications
- By 2030, FCEVs* could approach TCO parity with diesel

Example: Stepvan TCO over 12 Years

<table>
<thead>
<tr>
<th>Year</th>
<th>Diesel</th>
<th>Battery Electric</th>
<th>Hydrogen</th>
</tr>
</thead>
<tbody>
<tr>
<td>2018</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2024</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2030</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\(^1\)Draft Fleet TCO paper: [https://www2.arb.ca.gov/sites/default/files/2019-02/190225tco_0.pdf](https://www2.arb.ca.gov/sites/default/files/2019-02/190225tco_0.pdf)
SB350 Transportation Electrification for Medium and Heavy Duty

- California utilities supporting site upgrades and design
  - $579 million approved through 2023 (PG&E, SCE)
    - Can fund charging of 15,000 ZE vehicles
  - Additional $107 million under review (SDG&E)
- Publicly-owned utilities developing programs
- New rates being designed to encourage electric vehicles

www.cpuc.ca.gov/sb350te/
Fleet Reporting
ZEV Fleet Rule Overview

• Develop future fleet rules for consideration in 2022
  • Initial implementation in 2024
• Last-mile delivery, public, utility, refuse fleets, drayage, other
  • No plans for school bus fleet rule
• Market-based strategies focused on large entities
  • A percentage of shipments with zero-emission vehicles
  • Company-owned vehicles and contracted services
  • Potential infrastructure requirements
Principles for Developing Fleet Rules

- Expand ZE truck market to meet air quality and GHG goals
- Provide benefits in disadvantaged communities
- Maximize the total number of ZEVs deployed
- Match vehicle capabilities with fleet operational needs
  - Initially, urban, stop-and-go driving, return to base
  - Support market expansion to other applications
- Expand infrastructure availability to enable new markets
- Ensure level playing field between types of fleet operators
- Support and enable workforce training
Who Will Be Reporting

- Entities with California gross receipts > $50 million annually
- Motor carriers, freight forwarders, and brokers that own or dispatch 100 or more trucks
- Port terminal operators
- Federal, state, county, and city fleets
- Utilities, refuse/recycling services
Company/Entity Information

• Contact person, DOT number, type of business, number of trucks, and list of California terminals
• Amount and type of freight moved
  • Need appropriate metric
• Passenger transportation services
  • Employee shuttles, other
• Provide or contract for other services
Vehicle and Terminal Information

- Company/entity owned vehicles
  - Make, model, weight class, model year, year added to fleet, body type, odometer reading, own/rent/lease
  - Duty cycle, weight/volume limited, where parked overnight, on-site vs. off-site fueling, and maintenance
- Terminal information
  - Location, own vs. lease, utility provider, space for infrastructure
Manufacturer Sales Requirement
Proposal Concept

• Increasing percentage of chassis/vehicle sales in California must be zero-emission from 2024-2030
• Three vehicle groups
  • Class 2B-3 (GVWR: 8,501 – 14,000 lb.)
  • Class 4-8 vocational (GVWR: 14,001 lb. or greater)
  • Class 7-8 tractor (GVWR: 26,001 lb. or greater)
• Zero-Emission Powertrain certification required starting 2024
• Credit system to encourage early action and for flexibility
• Return to the board around 2025 for post-2030 action
Regulated Party

- All manufacturers who certify more than 500 Class 2B-8 chassis or complete vehicles with combustion engines for sale in California
  - Chassis manufacturer (incomplete vehicle)
  - Complete vehicle manufacturer
  - Excludes transit bus manufacturers
- Based on average of 2021, 2022, and 2023 MY sales
- Zero-emission chassis or vehicle manufacturers may opt in to earn credits, no regulatory requirements
Regulated Party (Continued)

Vehicle Manufacturer
Pickups, vans, tractors

Chassis Manufacturer
Vocational vehicles
Factors In Setting Sales Targets

• Achieve California carbon neutrality by 2045 (E.O. B-55-18)
• Maximize criteria emission reductions to meet air quality goals and protect communities
• Support ICT, ZE ASB, AB 739, port plans, future drayage rule
• 100% zero-emission pickup and delivery fleet goal by 2040
• Technology suitability today and market developments
• Incremental cost, range, weight, space constraints to improve
• Infrastructure support programs and expansion potential
## Percentage Schedule

### Sales Percentage Requirement

<table>
<thead>
<tr>
<th>Model Year</th>
<th>Class 2B-3*</th>
<th>Class 4-8 Vocational</th>
<th>Class 7-8 Tractors</th>
</tr>
</thead>
<tbody>
<tr>
<td>2024</td>
<td>3%</td>
<td>7%</td>
<td>0%</td>
</tr>
<tr>
<td>2025</td>
<td>5%</td>
<td>9%</td>
<td>0%</td>
</tr>
<tr>
<td>2026</td>
<td>7%</td>
<td>11%</td>
<td>0%</td>
</tr>
<tr>
<td>2027</td>
<td>9%</td>
<td>13%</td>
<td>9%</td>
</tr>
<tr>
<td>2028</td>
<td>11%</td>
<td>24%</td>
<td>11%</td>
</tr>
<tr>
<td>2029</td>
<td>13%</td>
<td>37%</td>
<td>13%</td>
</tr>
<tr>
<td>2030</td>
<td>15%</td>
<td>50%</td>
<td>15%</td>
</tr>
</tbody>
</table>

*Excludes pickups until 2027 MY
Sales Numbers- Special Cases

- Class 2B-3 vehicles originally sold with a pickup bed
  - Excluded from sales number until 2027 MY
  - ZEVs may generate credits
- Standard transit buses, double-deckers, articulated, and motor coaches are excluded from requirements
  - ZEVs may not generate credits
- School buses and cutaway shuttles included in sales totals
  - ZEVs may generate credits
Credit System Provides Flexibility

• One credit represents one zero-emission vehicle
• Awarded to manufacturer of record
• Can use credits to match requirements with product rollout timelines
• Plug-in hybrids (PHEV) earn partial credit
• Credits may be banked or traded
Credit System (Continued)

• Oldest credits used first – first in, first out
• Credits may be generated starting 2021 MY
• Credits for vehicles sold in 2021, 2022, and 2023 MY expire 2030 MY
• Credits for 2024 MY and later sales have a 5 year life
• Class 2B-3 vehicles that generate optional credits for the light-duty ZEV program may not generate credits in Advanced Clean Trucks (ACT). Class 2B-3 vehicles generating credits in ACT may not earn credits in the light-duty ZEV program.
Credit Transfers Between Vehicle Groups

- Credit transfers between groups require a weighting factor
- Weight have no effect if manufacturers meet the percentage requirements in each vehicle group
- Class 2B-3 and Class 4-8 Vocational Truck requirements may be met with any credits
- The tractor requirement must be met with tractor credits

<table>
<thead>
<tr>
<th>Vehicle Class</th>
<th>Class 2B-3</th>
<th>Class 4-8 Vocational</th>
<th>Class 7-8 Tractors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight Factor</td>
<td>0.5</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

Manufacturer Requirement
Credit Transfers (Continued)

- Flexibility allows companies to identify most effective compliance path for their situation
  - Can synchronize ZEV launches with product refreshes
  - Opportunity for lower costs
- Tractor provision
  - ZE tractors necessary to support drayage goals
  - Rule requires small number of tractor sales – allowing transfer into tractor category may eliminate requirements
  - Action required to electrify potentially difficult segment
## Example – Credit Transfer

### 2027 Scenario – Manufacturer A

<table>
<thead>
<tr>
<th></th>
<th>Class 2B-3</th>
<th>Vocational</th>
<th>Tractors</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Sales</td>
<td>1,000</td>
<td>1,000</td>
<td>1,000</td>
<td>3,000</td>
</tr>
<tr>
<td>ZEV Percentage</td>
<td>9%</td>
<td>13%</td>
<td>9%</td>
<td></td>
</tr>
<tr>
<td>Credit Requirement</td>
<td>90</td>
<td>130</td>
<td>90</td>
<td>310</td>
</tr>
</tbody>
</table>

### ZEV Sales Flexibility – Multiple Compliance Options

<table>
<thead>
<tr>
<th>Number of ZE Sales</th>
<th>Class 2B-3</th>
<th>Vocational</th>
<th>Tractors</th>
<th>Total ZEVs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scenario 1</td>
<td>90</td>
<td>130</td>
<td>90</td>
<td>310</td>
</tr>
<tr>
<td>Scenario 2</td>
<td>0</td>
<td>0</td>
<td>178</td>
<td>178</td>
</tr>
<tr>
<td>Scenario 3</td>
<td>0</td>
<td>175</td>
<td>90</td>
<td>265</td>
</tr>
<tr>
<td>Scenario 4</td>
<td>350</td>
<td>0</td>
<td>90</td>
<td>440</td>
</tr>
</tbody>
</table>
PHEV Credit Generation

- PHEV equivalent to 1/3 of ZEV
- Same PHEV definition as CA GHG Phase 2
- Up to half of the annual requirement can be met by PHEV credits

Manufacturer Requirement

<table>
<thead>
<tr>
<th>Vehicle MY</th>
<th>Slow-charge AER (Miles)</th>
<th>Fast-charge* AER (Miles)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2021-2023</td>
<td>10+</td>
<td>10+</td>
</tr>
<tr>
<td>2024-2026</td>
<td>20+</td>
<td>15+</td>
</tr>
<tr>
<td>2027+</td>
<td>35+</td>
<td>20+</td>
</tr>
</tbody>
</table>

*Fast-charge PHEV’s must be able to 1) charge from 15% to 85% state-of-charge in under half an hour and 2) demonstrate that typical operating time is eight times typical charging time
Sales Reporting

• Under GHG Phase 2 past 2021, manufacturers are required to report projected CA sales and follow up with actual CA sales for vehicle families
  • ACT will use same sales numbers
• Online system for tracking credits, transactions, and requirements
  • Similar to Advanced Clean Cars
• Sales, ZEV and PHEV sales, and credit bank publically available
GHG Phase 2
Advanced Technology Multiplier

• GHG Phase 2 contains an Advanced Technology Multiplier that gives additional credit for PHEV, BEV, and FCEV technologies until the end of 2027 MY
• Concerns about giving extra credit for required ZEV sales
• Potential double counting GHG emission benefits
• Staff is considering options to mitigate issues
Alternate Proposal Considered

- Require 100% ZE percentage on specific applications/use cases
  - Last-mile delivery, public, utility, and drayage fleets
- Several challenges with narrow segment identified
  - Manufacturer responsible to track usage of trucks
  - 100% ZE target not feasible until available ZEVs meet all daily needs
  - California requirements already require diverse types of ZE vehicles
    - AB 739 – State ZEV purchases of Class 6-8
    - Innovative Clean Transit regulation and proposed Airport Shuttle Regulation require ZE cutaway shuttles and passenger vans
- State and utility fleets have wide variety of trucks and use cases
- Port plans and upcoming drayage regulation require ZE tractors
- Not consistent with maximizing transportation electrification goals
Next Steps

• Send cost survey to manufacturers
• Workgroup meetings to discuss fleet reporting requirements
• Scheduled for December Board Hearing
  • First of two board hearings, second in 2020