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AIR RESOURCES BOARD

Advanced Clean Trucks Regulatory Workshop

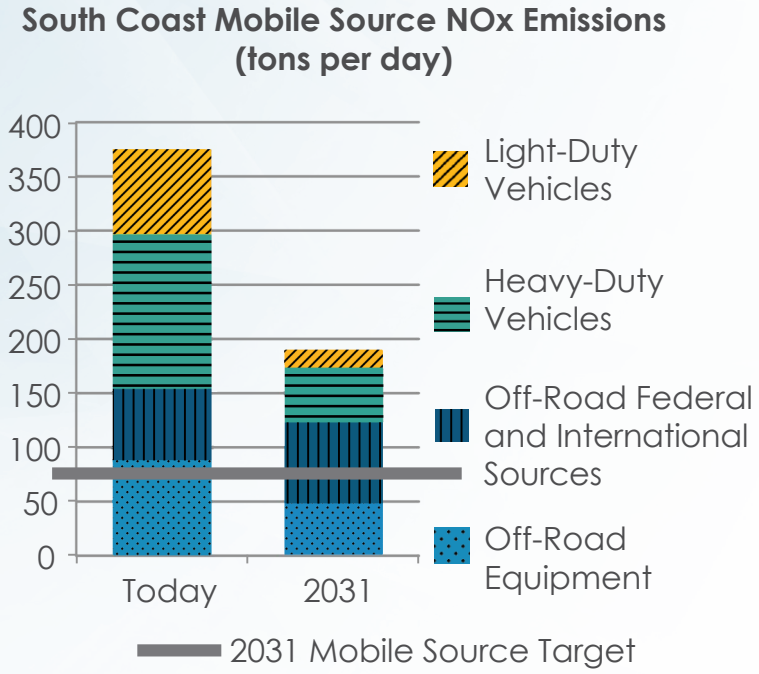
April 2, 2019

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



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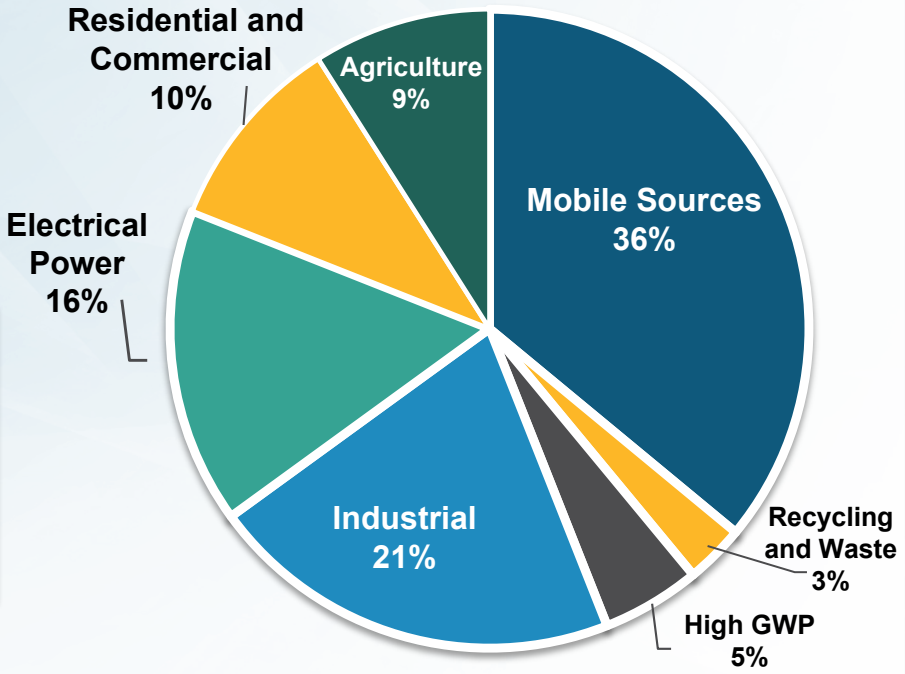
California's Climate Change Targets – Transportation Remains Largest GHG Source

- ✓ 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



Note: Mobile sources represent ~50% of GHG inventory

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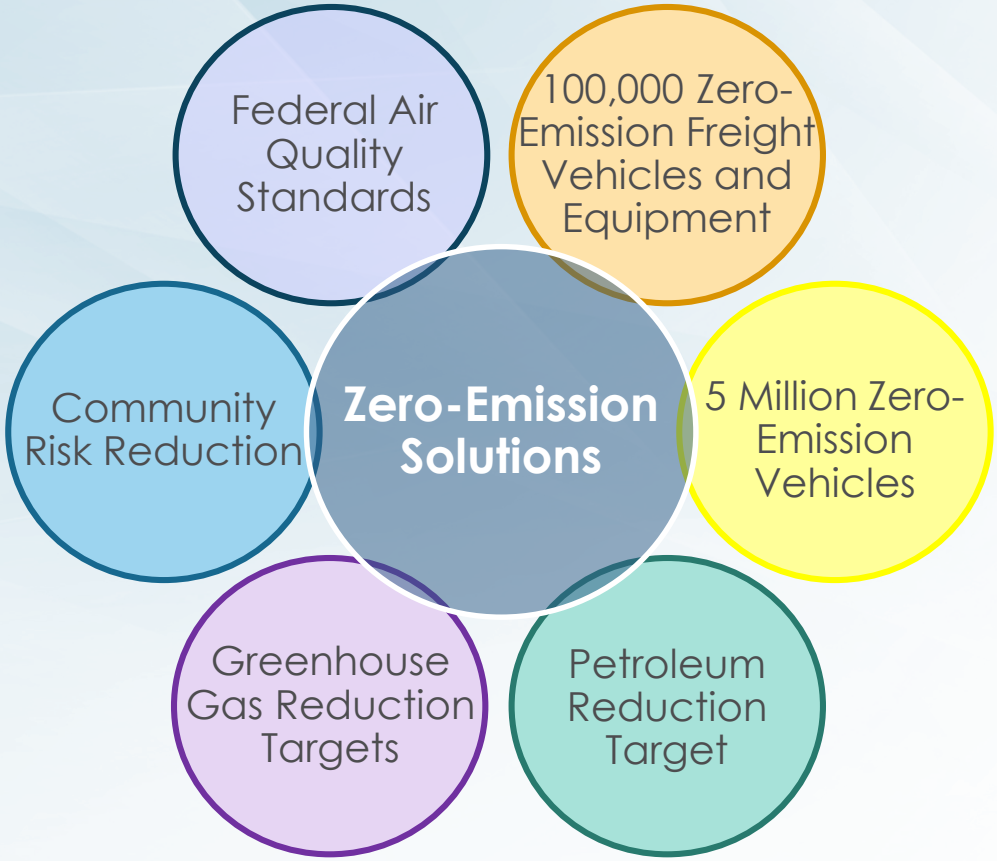
California's Air Quality and Climate Goals



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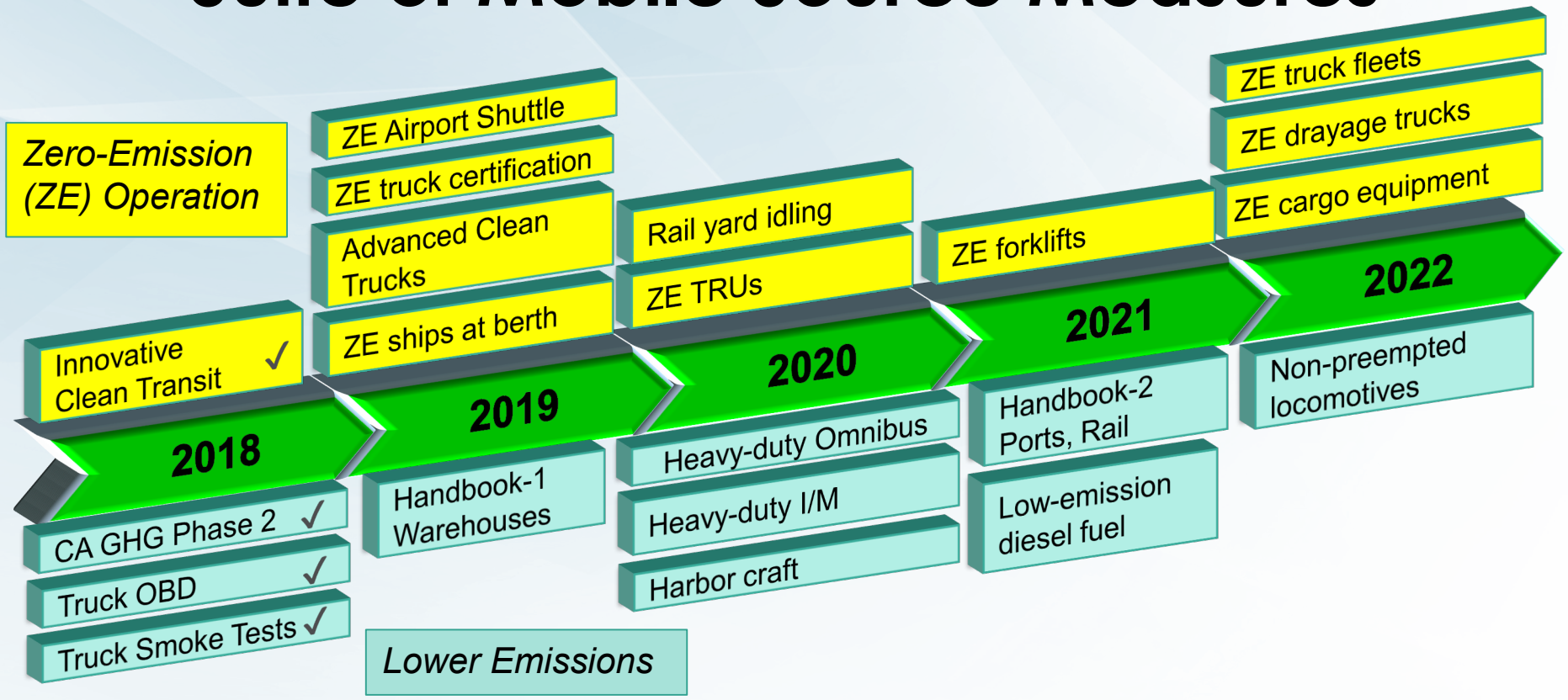
Suite of Mobile Source Measures



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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

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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

	2B-3	4-5	6-7	8
Commercial	     			
Demonstrations				

*Excludes transit buses, not all models shown

Heavy-duty Electric Market Growing - Today

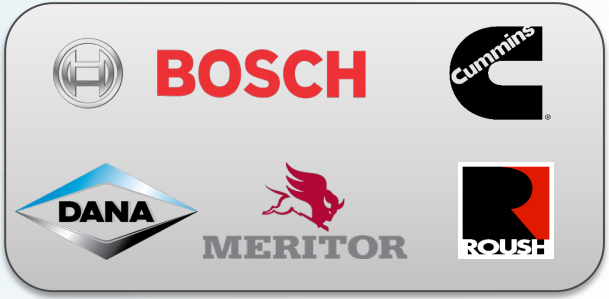
	2B-3	4-5	6-7	8
Commercial Today				
Commercial Soon				
Demos				

*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

Electric Powertrain Providers



Service, Support, Training

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

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High-powered charging: https://www.charinev.org/news/news-detail-2018/news/charin-is-publishing-a-solution-for-high-power-charging-of-tucks-and-busses-beyond-1-mw/
Hydrogen MOU: 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

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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 online[1]

[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

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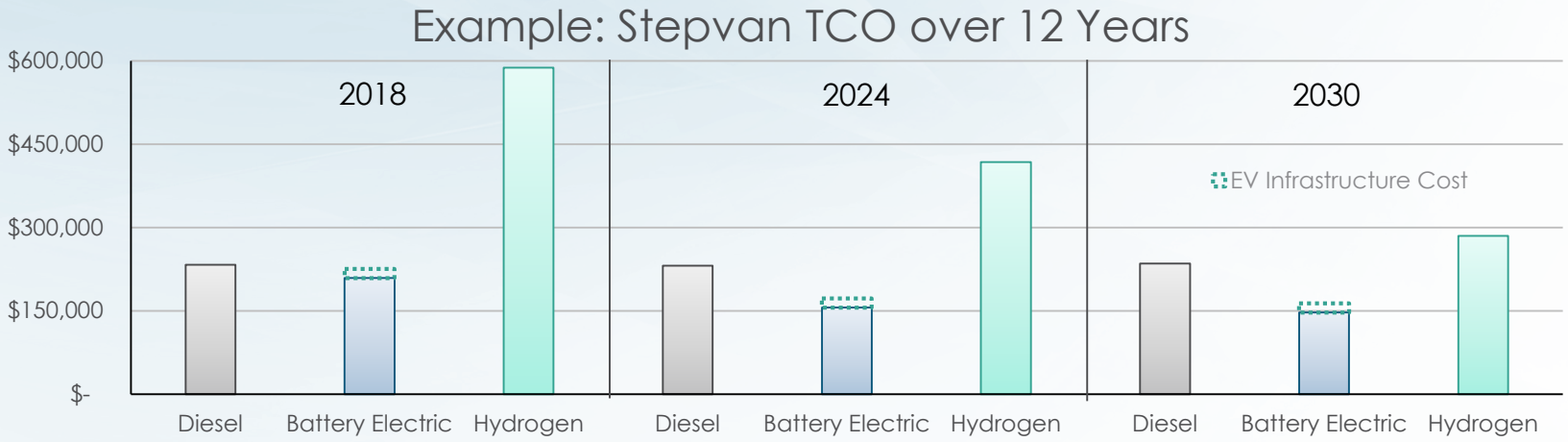
Market segment analysis: https://ww2.arb.ca.gov/sites/default/files/2019-02/190225actmarketanalysis.xlsx

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

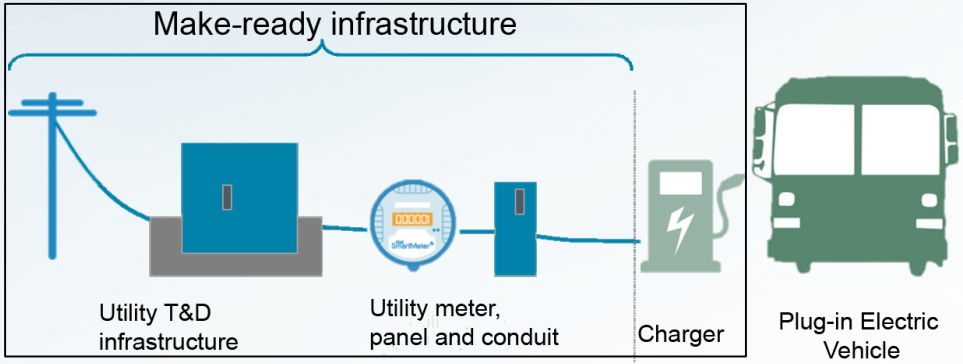


*BEV – Battery electric vehicle, FCEV - Fuel cell electric vehicle

[1]Draft Fleet TCO paper: https://ww2.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



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Transportation Electrification (SB 350) 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

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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

Model Year	Class 2B-3*	Class 4-8 Vocational	Class 7-8 Tractors
2024	3%	7%	0%
2025	5%	9%	0%
2026	7%	11%	0%
2027	9%	13%	9%
2028	11%	24%	11%
2029	13%	37%	13%
2030	15%	50%	15%

*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

Vehicle Class	Class 2B-3	Class 4-8 Vocational	Class 7-8 Tractors
Weight Factor	0.5	1	2

- 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

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

	Class 2B-3	Vocational	Tractors	Total
Total Sales	1,000	1,000	1,000	3,000
ZEV Percentage	9%	13%	9%	
Credit Requirement	90	130	90	310

ZEV Sales Flexibility – Multiple Compliance Options

Number of ZE Sales	Class 2B-3	Vocational	Tractors	Total ZEVs
Scenario 1	90	130	90	310
Scenario 2	0	0	178	178
Scenario 3	0	175	90	265
Scenario 4	350	0	90	440

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

CA PHEV Minimum All-Electric Range (AER) Requirement

Vehicle MY	Slow-charge AER (Miles)	Fast-charge* AER (Miles)
2021-2023	10+	10+
2024-2026	20+	15+
2027+	35+	20+

*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