CALIFORNIA
AIR RESOURCES BOARD

Emissions Modeling, ZEV Programs, & Data Collection

CPUC, San Francisco

May 9, 2019

Outline

- Emissions modeling
  - Integrated transportation scenario planning – inputs and outputs
- Development of light-duty vehicle regulations
  - Advanced Clean Cars II (post 2025)
- Development of medium- and heavy-duty ZEV programs
  - Innovative Clean Transit
- Data collection

Tackling Clean Air

U.S. EPA

Sets & enforces national air quality standards

Regulates interstate transportation

Regulates national vehicle standards

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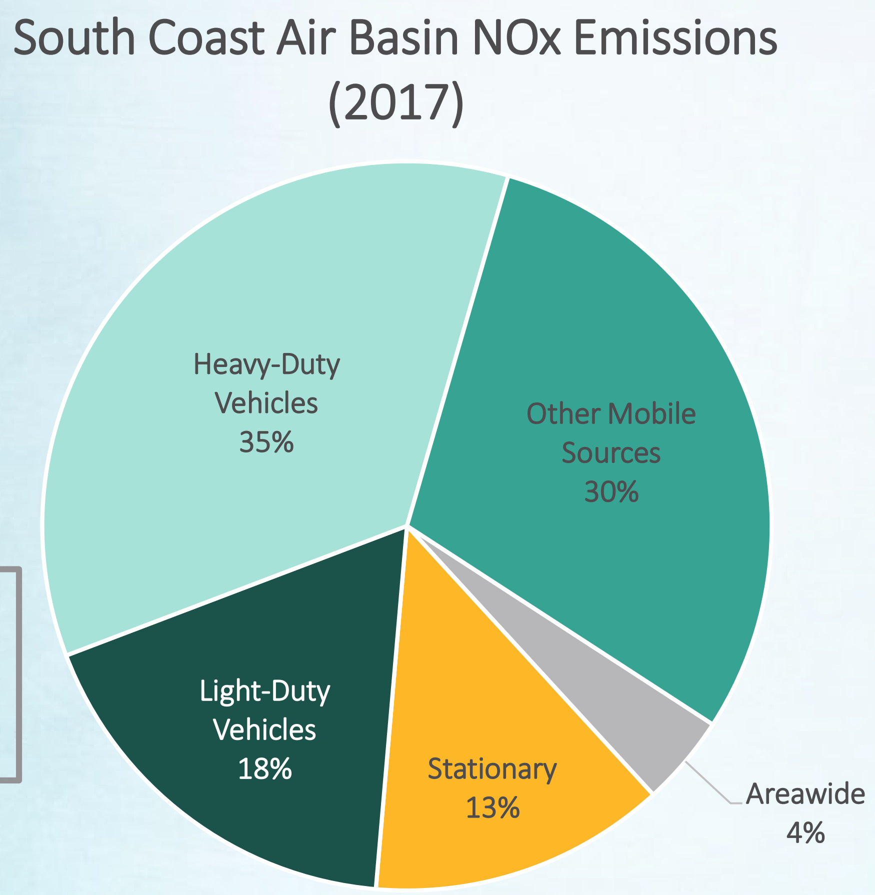
Regulates mobile sources of air pollution, greenhouse gases, and consumer products

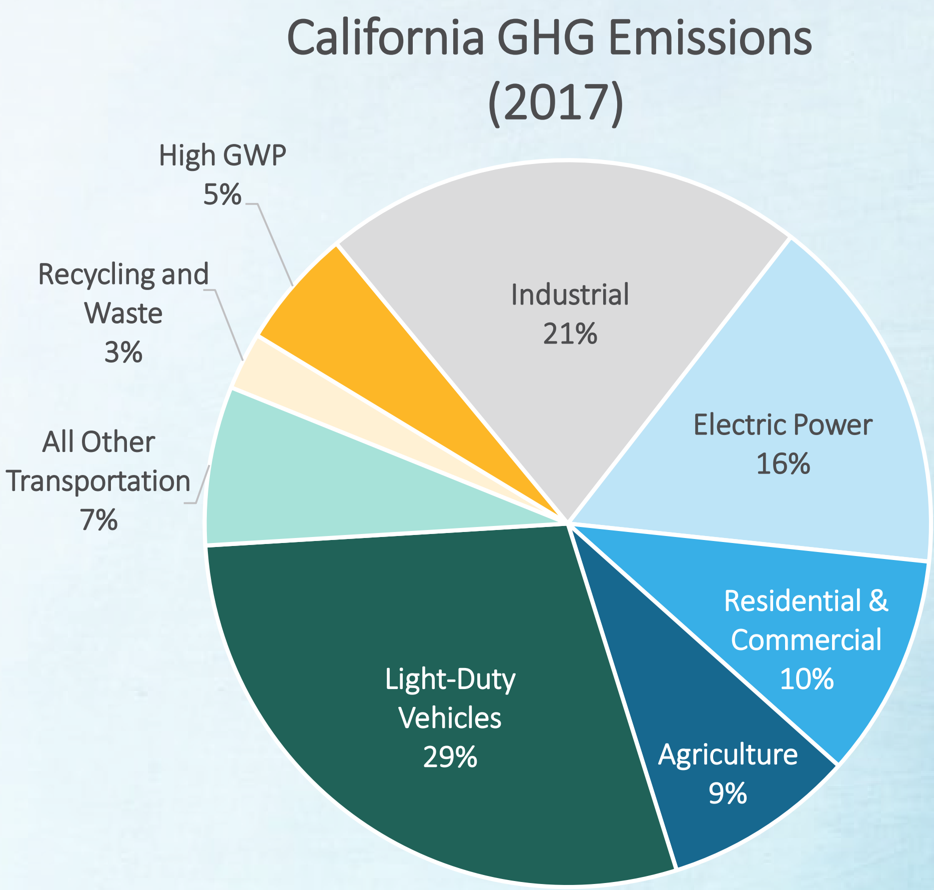
Local Air Districts

Regulates stationary & local sources of air pollution

Mobile Source Emissions in the Inventory



Mobile
Sources
>80%



Mobile
Sources
~35%

Mobile sources represent ~50% of GHG inventory when including emissions from fuel production

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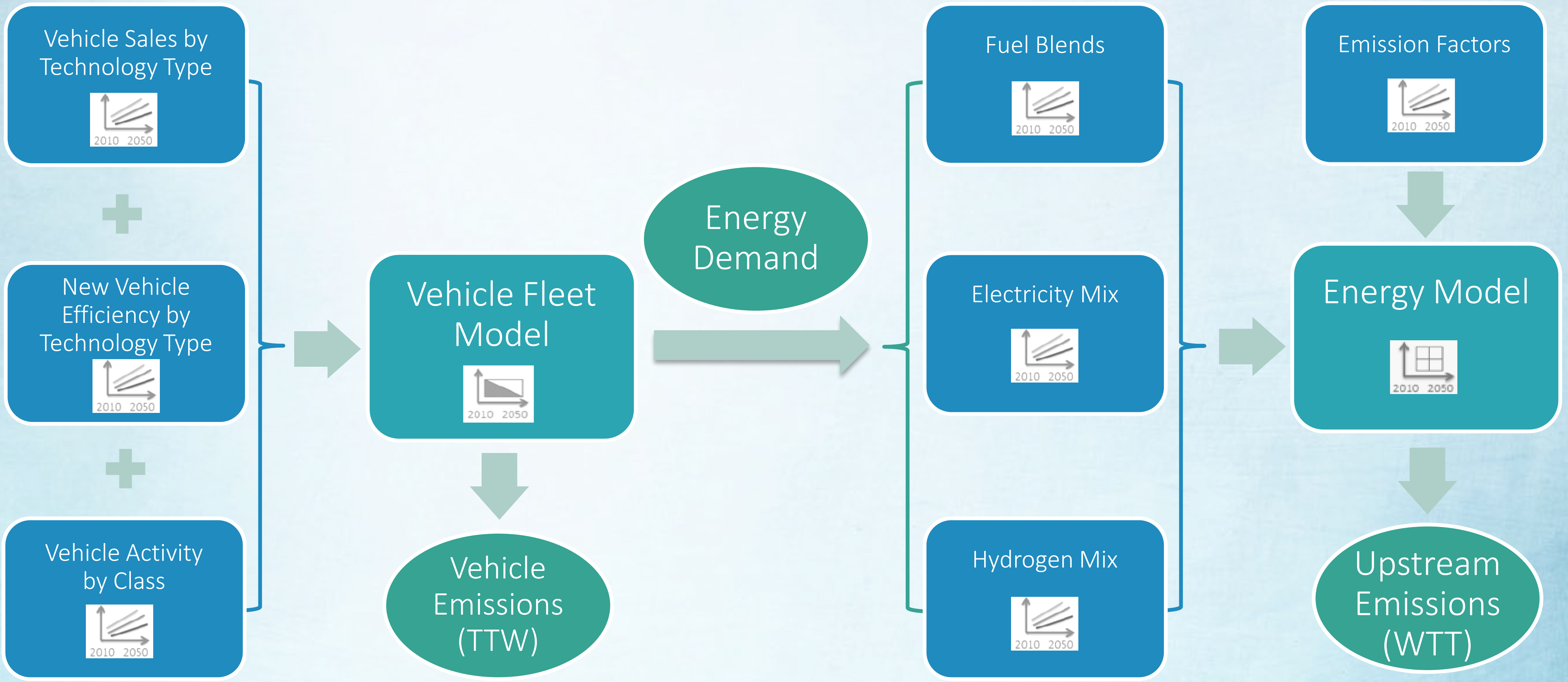
Vision Model: Scenarios for Emissions Targets



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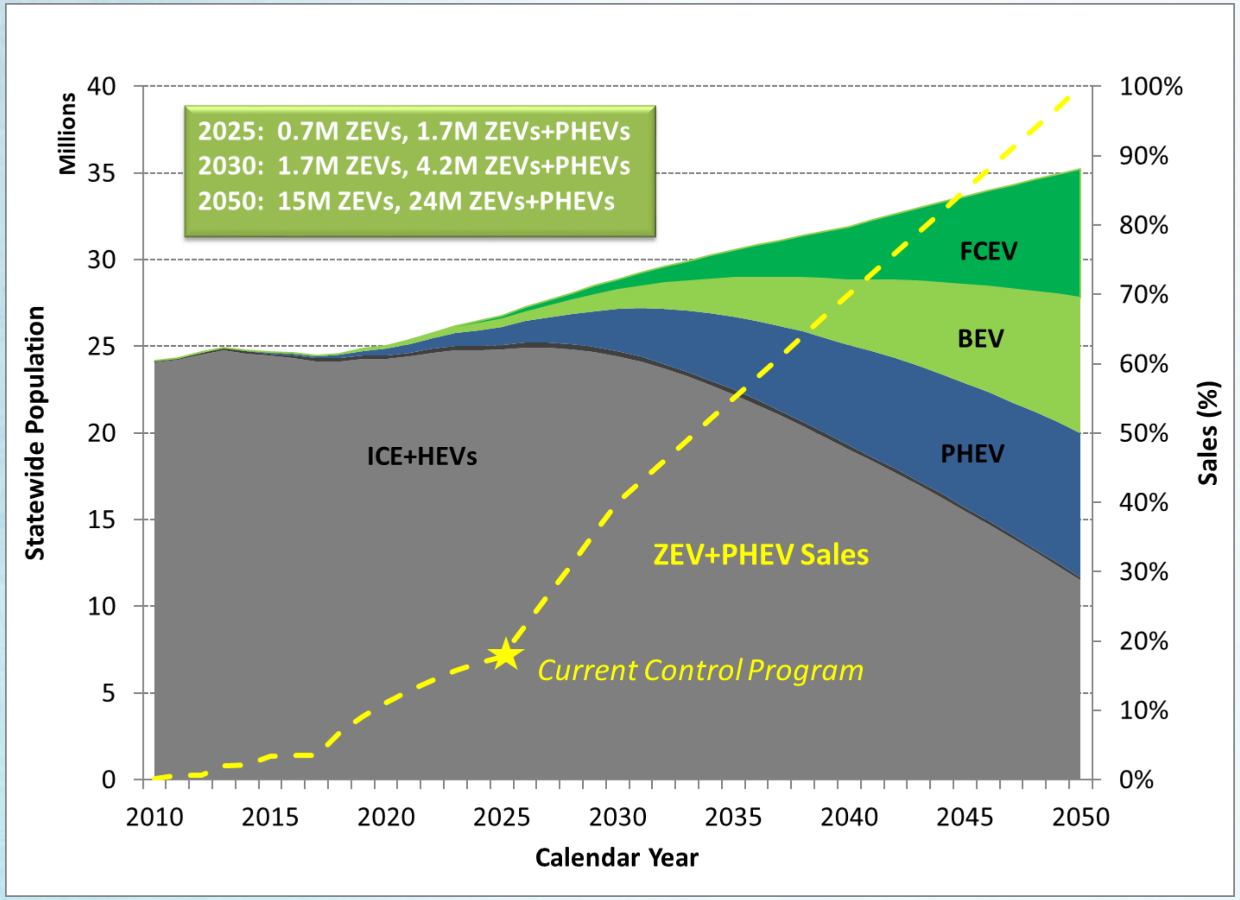
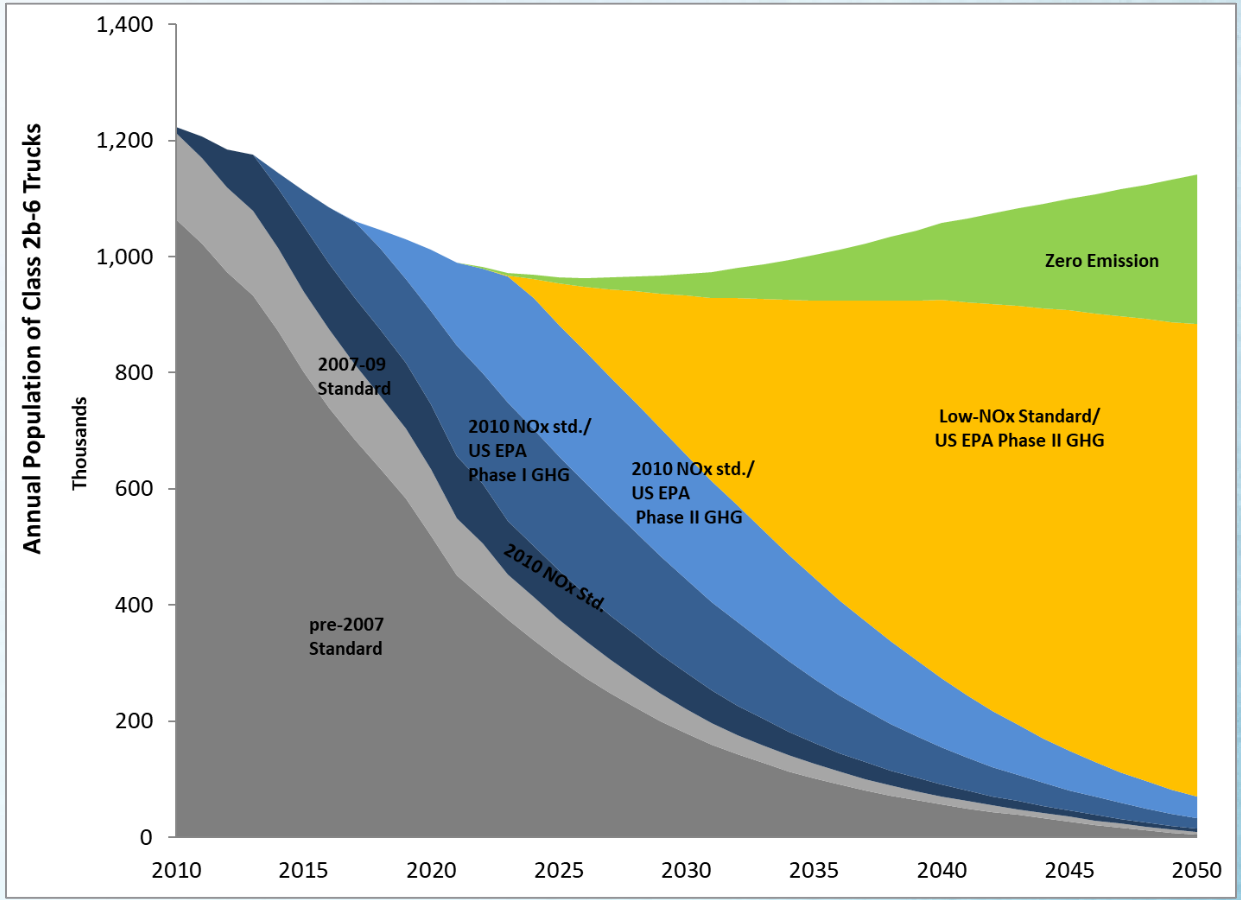
Current Scenarios for Emissions Targets

Passenger Vehicle Fleet



Heavy Duty Truck Fleet



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Sources of Inputs to Scenario Process for ZEVs

2020-2025	Automaker plans, regulation compliance estimate, market trends, purchasing behavior
2025-2035	Vehicle & fuel supply technology assessment, cost projections
2035-2050	Extrapolate trends, but accelerate EV sales and clean fuels to meet emissions targets

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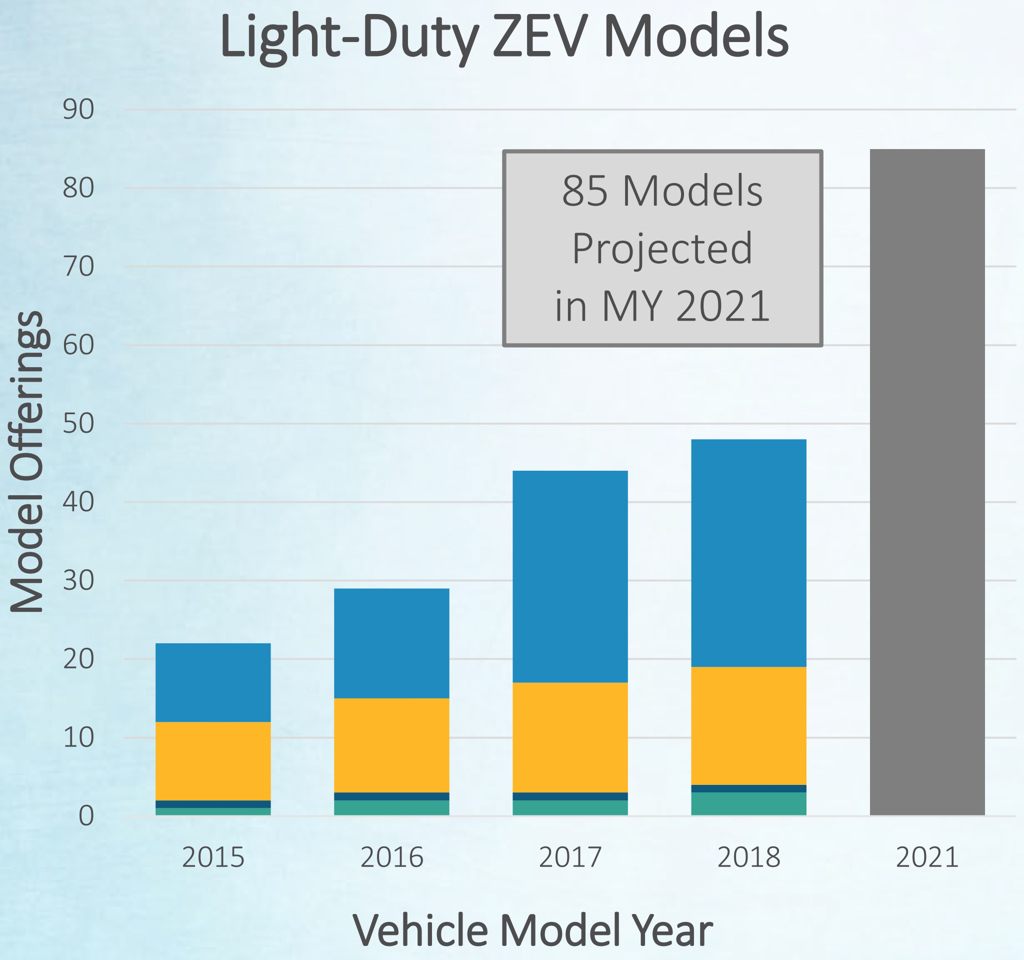
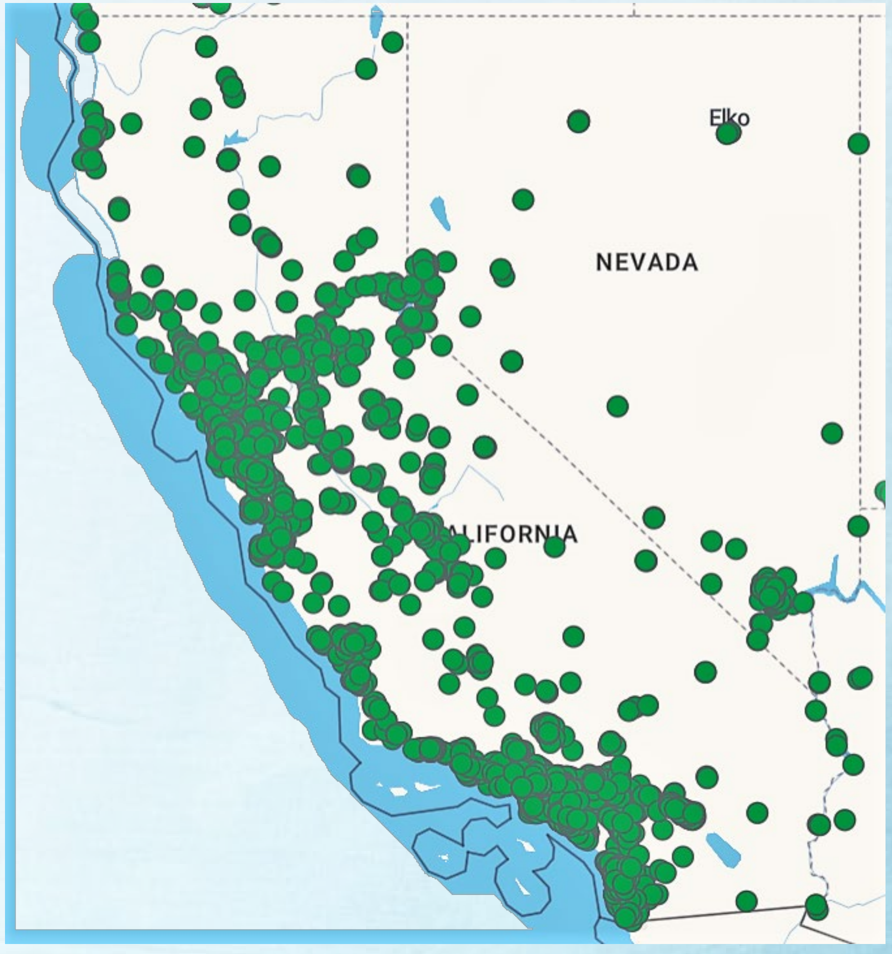
Light-duty ZEV Choices and Infrastructure: 2020-2025 Process





Source: IHS Automotive Registrations, Assorted Trade Press Reports, OEM Discussions

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Light-duty BEV Cost Trajectory: 2025-2035 Process

Source: ICCT, 2019. Update on electric vehicle costs in the United States through 2030

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Analysis for Post-2025 Model Year ZEV Regulation

- Update electric vehicle technology assumptions, including EV range
- Continue studies of consumer acceptance
- Re-examine role of PHEVs
- Consider electrification requirements on AVs
- Assess other market factors
  - Sufficiency of fueling infrastructure
  - Total cost of operation

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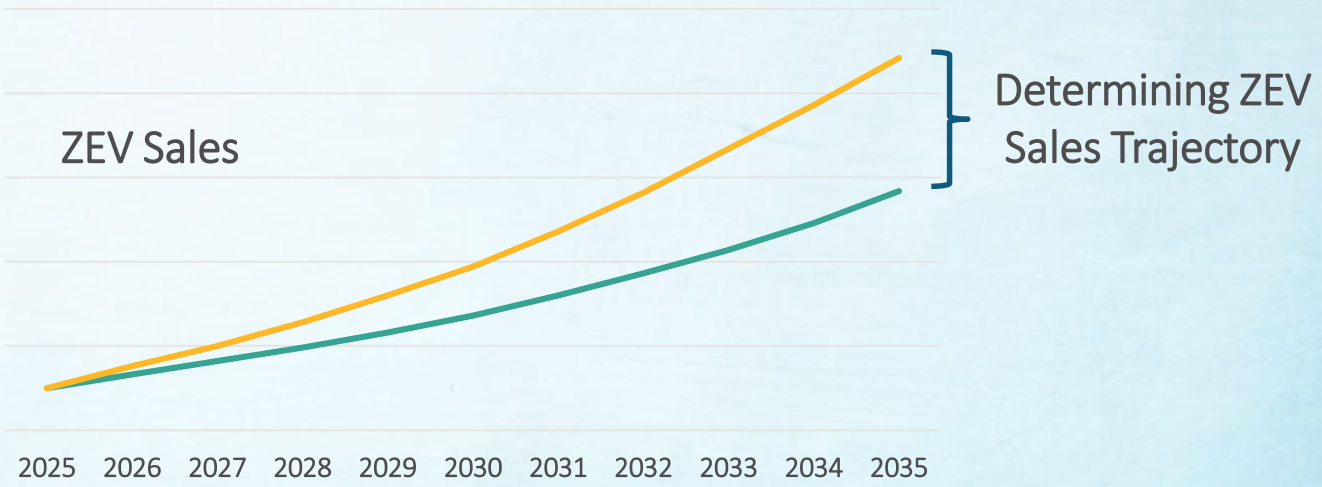
Leveraging EVSE Data for Future Efforts

- Infrastructure costs – impact on PEV operating costs
- Types of chargers used as battery size increases
- Deployment timing and barriers
- Payment type to support open access rulemakings
- Sector-specific charger utilization – study charging behavior
- Site location details to track charger targets and gaps



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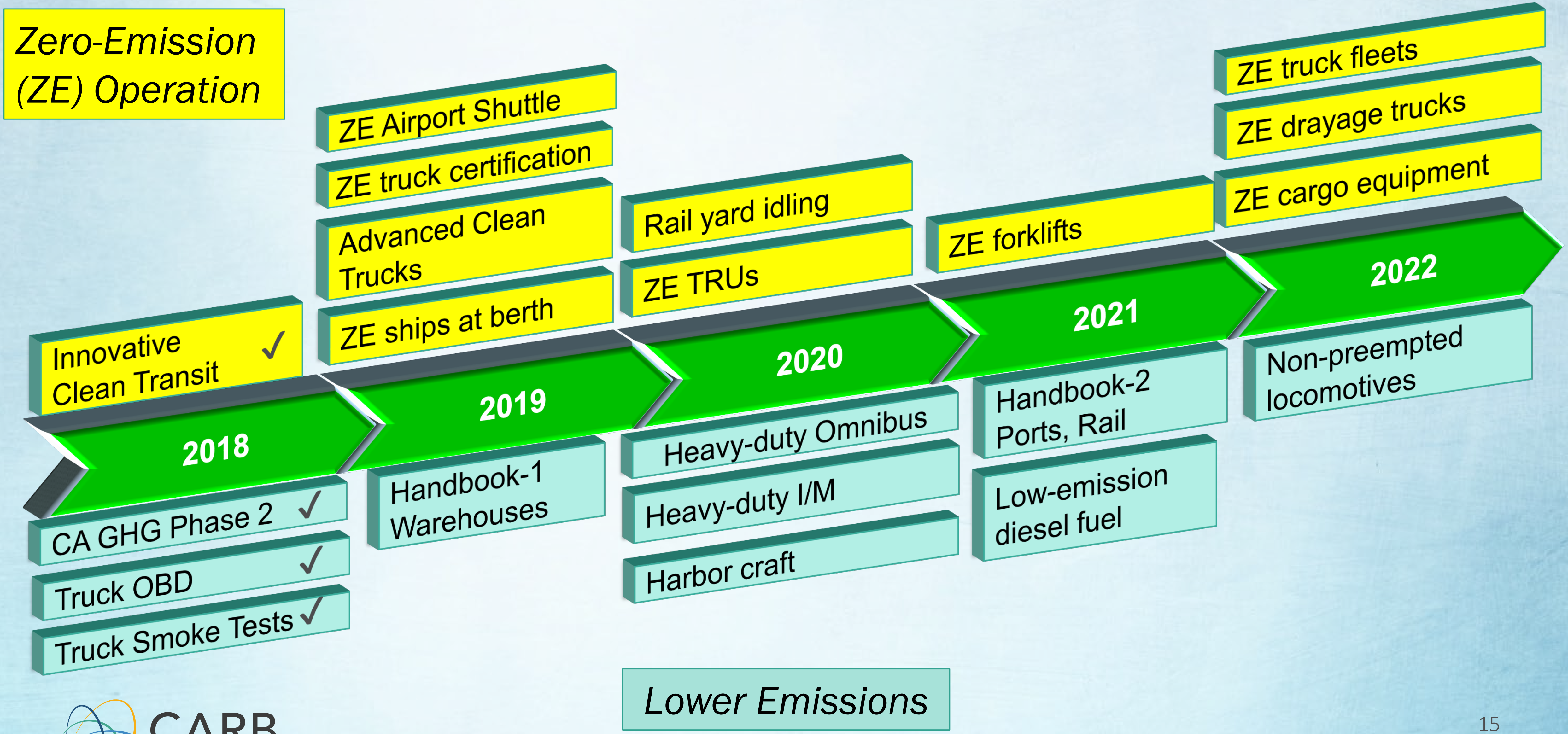
Transportation Electrification (TE) in the MD-HD Sectors Is Important but Complicated

- TE in the MD-HD vehicle sector is important
    - Small vehicle population, high total energy consumption
- The challenges in TE in the MD-HD sector are quite different from the LD sector
    - Power consumption and load requirements can be large at a single site
    - Vehicle charging timeframe is different than personal vehicles
    - Scaling-up is yet to be done
- A holistic approach is needed for a widespread deployment
    - Incentives
    - Regulations
    - Other policy drivers

Medium- and Heavy-Duty ZEV Programs



Innovative Clean Transit (ICT) Regulation

- Zero-emission Bus (ZEB) purchase requirements paired with individual ZEB Rollout Plan—Planning is important
  - Identify a goal of 100% conversion by 2040
  - Identify the ZEB technologies, bus purchase schedule, infrastructure construction and upgrade
  - Plan on how to deploy ZEBs in DACs
  - Workforce training plan & schedule
  - Identify funding sources
- Joint group compliance option—Better infrastructure utilization
- Comprehensive review on program readiness
- Annual update

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Heavy-Duty ZE Projects Funded with Low Carbon Transportation (LCT) Grants

- Between FY 2014/15 and FY 2018/19, CARB funded more than 30 HD advanced technology (including ZE) pilot and demonstration projects with a total of $360 million
  - School buses and transit buses
  - Delivery trucks
  - Drayage trucks
  - Off-road vehicles and equipment (e.g., top handlers, electric tractors, yard trucks, service trucks)
- The Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project (HVIP) – the Legislature appropriated $125 million for FY 2018-19

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Data Collection for the LCT Funded Projects

- Evaluate the performance of the advanced technologies
  - For each area of vocational application, assess the practicality and economic viability of wide-spread adoption of advanced clean technologies
  - Identify the barriers or challenges to adoption of the advanced technology vehicles by fleet
- Evaluate the cost-effectiveness of the funded projects
- Evaluate the emission reduction benefits of the funded projects

Data Fields Collected for the FY 2014-15 LCT Projects

- Projects funded both vehicle and infrastructure
- Data collection fields include:
  - Vehicle and engine activity data
  - Vehicle drive and duty cycles
  - Vehicle performance and safety (e.g., vehicle availability)
  - Fuel/energy consumption & cost, charging/fueling pattern
  - Maintenance (preventative and unscheduled)
  - Capital and operating & maintenance (O&M) costs for vehicles, charging/fueling infrastructure and vehicle maintenance infrastructure
  - User/fleet experience survey
  - Others

Cost-Effectiveness (C/E) Calculation Considerations

- C/E is easier to calculate when the project boundary and life is well defined (e.g., engine repower)
- C/E calculation in a TE infrastructure project involves many factors and deserves careful data interpretation
    - Infrastructure may not be fully utilized during project life
    - Infrastructure life normally outlasts vehicle life
    - Both infrastructure life and vehicle life outlast project life
    - Current investments will help drive down future costs
    - Possible higher vehicle downtime in early deployment stage
- Current project analysis on early investments focuses more on the learning curve

Lessons Learned (1)

- Project planning is critical and can help control budget
  - Assess what technologies are better suited before vehicle procurement
  - Early consultation with fuel providers (e.g., utility) for infrastructure needs and installations, associated permitting, and timeframe
- The length of project life matters
  - Project life needs to consider planning, infrastructure assessment-construction-permitting, and vehicle procurement timeframe (normally 1-2 years)
  - Soft deployment (1-3 months)
  - A minimum of two-year vehicle operation is essential to gain meaningful operating experience
- Workforce training is important for safety, efficiency, and confidence

Lessons Learned (2)

- Redundancy planning is important to avoid service disruption
- A steep learning curve is expected
  - On both vehicle technologies and infrastructure installations
- Timely, periotic review on real project cost is needed
  - A wide range of cost variance among projects sites
    - e.g., building age, site shape and size, etc.
  - Complexity at sites with high load and power or multiple vocational applications

Holistic TE Planning Considerations

- Optimize infrastructure scale up in long-term planning
  - Particularly for the heavy-duty sector, where a single site may have a large power demand and infrastructure installation might be phased in
  - Need long-term ZEV deployment assurance (e.g., through state policies and regulations) for continued TE investments
  - Project optimization vs. long-term location optimization
  - How can long-term planning and location optimization be carried out under the SB 350 TE implementation
- Redundancy planning can reduce service interruption and SB 350 implementation costs
  - E.g., on-site energy storage

Data Collection to Support Holistic TE Planning

- Infrastructure scale-up
  - Infrastructure costs, types of chargers used as battery size increases or as fleet size expands
- Infrastructure deployment timelines
  - Need to align with vehicle roll-out
- State policies and regulation to implement TE
  - e.g., data on payment type can support future open access rulemakings
- Optimization of charging infrastructure
  - Sector-specific charger utilization helps in understanding charging patterns and behavior
- Location optimization
  - Mapping of site locations to ensure complementary program investments

Thank You

Back-up

Data Template Discussion - Example

- Separate on-going maintenance costs and capital costs
- Maintenance – scheduled and non-scheduled
- Labor hour and cost, component costs
- Which party is responsible for which part of the infrastructure maintenance

Site Costs ($)	Site assessment and design costs
	Total permitting costs
	Total rebate amount paid
	Total EVSE procurement costs
	Total EVSE installation costs
	Total make-ready infrastructure and installation costs - utility side of meter
	Total make-ready infrastructure and installation costs - customer side of meter
	Other construction costs
	Total cost of maintenance
	Total cost of service (non-scheduled maintenance)

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