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

California Air Resources Board
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

South Coast Air Basin NOx Emissions (2017)

- Heavy-Duty Vehicles: 35%
- Other Mobile Sources: 30%
- Light-Duty Vehicles: 18%
- Stationary: 13%
- Areawide: 4%

Mobile Sources >80%

California GHG Emissions (2017)

- Industrial: 21%
- Electric Power: 16%
- Light-Duty Vehicles: 29%
- Residential & Commercial: 10%
- Agriculture: 9%
- High GWP: 5%
- Recycling and Waste: 3%
- All Other Transportation: 7%

Mobile Sources ~35%

Mobile sources represent ~50% of GHG inventory when including emissions from fuel production.
Vision Model: Scenarios for Emissions Targets

- Vehicle Sales by Technology Type
- New Vehicle Efficiency by Technology Type
- Vehicle Activity by Class
- Vehicle Fleet Model
  - Vehicle Emissions (TTW)
  - Energy Demand
  - Fuel Blends
  - Electricity Mix
  - Hydrogen Mix
  - Emission Factors
  - Energy Model
  - Upstream Emissions (WTT)
Current Scenarios for Emissions Targets

Passenger Vehicle Fleet

- Current Control Program
- ZEV+PHEV Sales
- ICE+HEVs
- BEV
- PHEV
- FCEV

Heavy Duty Truck Fleet

- 2025: 0.7M ZEVs, 1.7M ZEVs+PHEVs
- 2030: 1.7M ZEVs, 4.2M ZEVs+PHEVs
- 2050: 15M ZEVs, 24M ZEVs+PHEVs

CARB
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

Light-Duty ZEV Models

Model Offerings

Vehicle Model Year

85 Models Projected in MY 2021

Source: IHS Automotive Registrations, Assorted Trade Press Reports, OEM Discussions
Light-duty BEV Cost Trajectory: 2025-2035 Process

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

Determining ZEV Sales Trajectory
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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

Zero-Emission (ZE) Operation

Innovative Clean Transit ✓

2018
- CA GHG Phase 2 ✓
- Truck OBD ✓
- Truck Smoke Tests ✓

2019
- ZE Airport Shuttle
- Advanced Clean Trucks
- ZE ships at berth
- Rail yard idling
- ZE TRUs

2020
- Heavy-duty Omnibus
- Heavy-duty I/M
- Harbor craft

2021
- ZE forklifts
- Handbook-2 Ports, Rail
- Low-emission diesel fuel

2022
- ZE truck fleets
- ZE drayage trucks
- ZE cargo equipment
- Non-preempted locomotives

Lower Emissions
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
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

<table>
<thead>
<tr>
<th>Site Costs ($)</th>
</tr>
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<tbody>
<tr>
<td>Site assessment and design costs</td>
</tr>
<tr>
<td>Total permitting costs</td>
</tr>
<tr>
<td>Total rebate amount paid</td>
</tr>
<tr>
<td>Total EVSE procurement costs</td>
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<tr>
<td>Total EVSE installation costs</td>
</tr>
<tr>
<td>Total make-ready infrastructure and installation costs - utility side of meter</td>
</tr>
<tr>
<td>Total make-ready infrastructure and installation costs - customer side of meter</td>
</tr>
<tr>
<td>Other construction costs</td>
</tr>
<tr>
<td>Total cost of maintenance</td>
</tr>
<tr>
<td>Total cost of service (non-scheduled maintenance)</td>
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</tbody>
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