California Initiatives Part 1:
Air Resources Board

Projecting Transportation Demand for Electricity

CPUC SB 350 Workshop
April 29, 2016
Outline and Panel Members

• Intro: ARB’s Mobile Source Electrification Programs
  • Analisa Bevan
• Mobile Source Vision
  • Cody Howard
• Light Duty Vehicle Electrification
  • Analisa Bevan
• Heavy Duty Vehicle Electrification
  • Tony Brasil
CALIFORNIA CLIMATE STRATEGY

An Integrated Plan for Addressing Climate Change

VISION

Reducing Greenhouse Gas Emissions to 40% Below 1990 Levels by 2030

SB 350 → 2030 GHG reductions in transportation sector; Role for electricity

GOALS

- 50% reduction in petroleum use in vehicles
- 50% renewable electricity
- Double energy efficiency savings at existing buildings
- Carbon sequestration in the land base
- Reduce short-lived climate pollutants
- Safeguard California
Meeting goals will require cleaner technology, fuels and increased transportation efficiencies.
The Transportation Sector
An Interwoven Transportation “System”

- EV Chargers
- Infrastructure
- Electricity for Chargers and H2 Stations
- Electric Vehicles (LDV, HDV, Off-Road)
- Vehicle Technology
- Fuel Use

SB 350 Scope
Existing Transportation Policies for GHG Reductions Through 2020

- LDV: Advanced Clean Cars (LEV GHG, ZEV)
- HDV: Phase 1 vehicle GHG standards
- HDV: Advanced Clean Transit rule
- HDV: Zero emission airport shuttles, last mile delivery
- LDV & HDV Incentive programs, demonstrations, etc
- Marine: Anti-idling at ports

Note – numerous other policy actions enacted to address regional ozone and local pollutants
Mobile Source Emission and Electricity Projections

Cody Howard
Current program successes provide a blueprint for future policies.

Technology assessments that identify technology performance, market readiness and costs form foundation of this analysis.

Scenario analysis explores the scope and timing of technology, fuels, and transportation efficiencies necessary to meet goals.

Results helped inform development of the SIP measure concepts.
Vision Model Framework for Scenario Analysis

Vehicle Sales by Tech Type
New Vehicle Efficiency, Tech Type
Vehicle Activity by Class

Fuel Blends
Electricity Mix
Hydrogen Mix

Energy Demand

Emission Factors

Vehicle Emissions (TTW)
Upstream Emissions (WTT)
2030 Benefits from ARB Mobile Source Strategy CTF Scenario *

* http://www.arb.ca.gov/planning/sip/2016sip/2016mobsrc.htm
Passenger Vehicle Transformation
## Transformation of Passenger Vehicle Fleet

<table>
<thead>
<tr>
<th>Technology/Fuel/System</th>
<th>Today</th>
<th>2030</th>
<th>2050</th>
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</thead>
<tbody>
<tr>
<td>Population of ZEVs/PHEVs/FCEV</td>
<td>200k</td>
<td>4.3 million</td>
<td>24 million</td>
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<tr>
<td>Fuel Economy</td>
<td>24 mpg</td>
<td>49 mpg</td>
<td>121 mpg</td>
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<tr>
<td>Renewable Energy Generation</td>
<td>27%</td>
<td>50%</td>
<td>75%</td>
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Light Duty Vehicle Electrification

Analisa Bevan
Existing ARB Light Duty Vehicle Electrification Programs

Regulations: *Advanced Clean Cars Rules to 2025*
- Criteria Emission Fleet Standards: 70% reduction in NOx *
- GHG Emission Fleet Standards: 25% reduction in GHG *
- Zero Emission Vehicle (ZEV) Mandate: ~15% New Sales

Incentives and Consumer Education:
- DriveClean- Consumer Buying Guide
- Vehicle Purchase Rebates
- Pilot Projects in Disadvantaged Communities

Partnerships:
- California, Multi-State, International Activities
- Public-Private Partnerships for Market Acceleration

* 2012 to 2025
Currently Available ZEVs

**FCEV**
- Fuel Cell Electric Vehicle
- Range: ~ 100 miles

**BEV**
- Battery Electric Vehicle
- Range: ~ 100 miles
  - Car
- Range: ~ 200 miles
  - SUV
- Range: ~ 250 miles
  - Minivan

**PHEV**
- Plug-in Hybrid Electric Vehicles

ARB ZEV Regulation Likely Compliance Scenario and Current Sales in CA

Current ZEV Sales (BEV/FCEV+PHEV)

Current PHEV Sales

## ARB Vehicle Regulation ZEV Mid-Term Review

### Technology

- Update technical and cost assumptions for ZEV technologies
- Analyze vehicle manufacturer provided trip and charging data
- In-house PHEV testing
- Household vehicle usage and charging study

### Emissions/Driving Behavior

- Analyze vehicle manufacturer provided trip and charging data
- In-house PHEV testing
- Household vehicle usage and charging study

### Consumers

- New car buyer surveys
- Examining California’s ZEV market factors
- Used ZEV market and buyer study

### Sales Trends

- Continued analysis of various data sources for California and multi-state MOU partner States

### Infrastructure

- Evaluation of existing and projected needs for ZEV technologies in California
EV Infrastructure Usage

**Charging Patterns today:**
Dominated by home base, then workplace, with small amount at public locations (including DCFC)

**Will this change?**

- How many apartments will have charging?
- Longer trips in “200 mi” BEVs: More DCFC?
- Less charging at work when “not free”?
- Will longer AER PHEVs use workplace charging more or less?

Source: Argonne National Laboratory, 2013
Non-Home EV Charger Installations

Currently Installed Stations *

<table>
<thead>
<tr>
<th>Stations</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Workplace, Level 2 (L2)</td>
<td>1,775</td>
</tr>
<tr>
<td>Public charging, Level 2 (L2)</td>
<td>5,998</td>
</tr>
<tr>
<td>DC Fast Chargers</td>
<td>618</td>
</tr>
</tbody>
</table>

* As of September 2015.

Note: a Station can have multiple chargers

** Low and high range from NREL/CEC #600-2014-003
State Agency Actions Help Close the Charger Gap

• PUC Actions with Electric Utility Investments (SB 350) and NRG Settlement
• CEC Actions with public infrastructure grants and loan loss reserve
• Supporting private investments by charging companies, automotive manufacturers, and NEDO
• BSC/ARB Actions requiring infrastructure in new building construction
Heavy Duty Vehicle Electrification

Tony Brasil
Long-term Transformation for Mobile Sources

- Zero emission equipment everywhere feasible, and near-zero emission equipment powered by clean low-carbon renewable fuels everywhere else.
  - Freight movement
  - Off-road equipment
  - Passenger transportation
Near Term Focus on Zero Emissions Heavy Duty Vehicles

- Advanced Clean Transit
- Last mile delivery
- Airport shuttles and equipment
- Other
Advanced Clean Transit
A New Approach

• Achieve additional NOx and GHG emission reductions
• Encourage zero emission bus purchases
  • Full transformation from 2018 to 2040
• Flexibility for regional collaboration between metropolitan planning organizations and transit fleets
• Opportunity to recognize greater efficiencies and zero-emission modes of moving passengers
Coordination Efforts

- Collaborating with transit and regional agencies
- Working closely with funding programs and partners
- Monitoring fueling/charging standards development
- Engagement with technology and bus manufacturers
- Coordination with utilities (SB 350)
- Coordination with other programs
  - Sustainable Communities Strategies (SB 375)
  - Sustainable Freight Strategies
  - Low Carbon Fuel Standard
Transit Fleet Electrification Characteristics

- Large utility customers
  - Subject to demand charges
- Distributed fast charging (500 kW) or
- Fueling/charging at central yards or depots
- Predictable charging patterns
- Directly claim Low Carbon Fuel Standard Credits
Fuel Cell Electric Buses

- Fueled at night like conventional buses
- Performance, range, and availability same as conventional
- Hydrogen can be produced on site
  - Electrolysis
  - Steam methane reformation
- Hydrogen stored on site
Battery Electric Bus
Slow Charge

- Fully charge in 4 to 5 hours
  - Plug in overnight at bus depot (80 kW)
  - Can plug in mid-day for commuter routes or peak service
- About 120 to 190 miles per charge
- Extend range with inductive charging at strategic locations
Battery Electric Bus

Fast Charge

- Charge on route for about 3 to 10 minutes
  - 500 kW charger
- Charge multiple times during day
- Unlimited range
- Chargers distributed at various locations
- Up to 6 buses per charger
First Utility/Transit Workgroup Meeting

- Held on April 8, 2016 at ARB
- Supports Advanced Clean Transit program
- Presented idea to CPUC on how to promote heavy duty transportation electrification
- Discussed barriers, challenges, and opportunities
- Improve communication between transits and utilities to further deployment of zero emission buses

Meeting summary and materials [http://www.arb.ca.gov/msprog/bus/actmeetings.htm](http://www.arb.ca.gov/msprog/bus/actmeetings.htm)
Outreach and Communication

- Opportunities to improve information sharing among ARB, utilities and fleet owners
- Transit agencies would like a dedicated liaison at the utility who understands transit electrification
- ARB willing to facilitate information sharing between fleets and utilities
- Plan to continue transportation electrification workgroup meetings
Electricity Rate Structure

- Long term zero emission bus deployment strategies influenced by electricity price signals
- Need statewide policies ensuring clarity and predictability for electricity cost
- Temporary rates without demand charges are useful for transit fleets to get familiar with electric bus operation
- Existing rates have uncertainty with 5 minute demand charge option for electric vehicles
  - Issue for fast charging strategies
Third Party Energy Storage

- Can reduce demand charges
- Could be managed by transit fleet
  - Optimize for avoiding demand charges
  - Adds financing and operational complexity
- Potential for utility ownership and/or operation
  - Gain ability to manage daily grid fluctuations
    - Peak shaving and excess renewable
  - Could share cost benefits with transit fleet
  - Could result in benefits rate payers
  - More zero emission vehicles and air quality benefits
Other Comments

- Clarify that hydrogen production and compression is in scope of transportation electrification efforts
- Streamline and simplify review process for cap-and-trade consignment auction proceeds for zero emission transit buses and infrastructure
- Explore opportunities for utilities to own and operate charging or hydrogen infrastructure
Thank you
BACKGROUND MATERIAL
Significant Benefits from Advanced Clean Cars

- Reduce Urban Air Pollution
- Reduce GHG Emissions
- Commercialize ZEVs
  - Battery, plug-in hybrid, and fuel cell vehicles
  - Significant well-to-wheel emission benefits
  - Will lower cost of ZEVs for all consumers
- Benefits to Consumers
  - Lower cost of operation than current vehicles
  - Net benefit to economy
2015 ZEV Market Growth Outpacing PHEVs

Source: IHS Automotive, Polk new vehicle registrations for CY2010-2015 as of August 2015.
Aligning State Agencies: California ZEV Action Plan

- Coordination Across Government Agencies
  - Consumer Awareness
  - Enable Infrastructure
  - Transform Fleets
  - Grow Jobs and Investment

- 2016 Action Plan Currently in Final Review
  - Promote Broad Access
  - Expand Use in Rail, Freight, HD
  - Support National and International Deployment