Part 1: Advanced Clean Trucks

Last Mile Delivery and Local Service Trucks

November 1, 2016

Sacramento, California

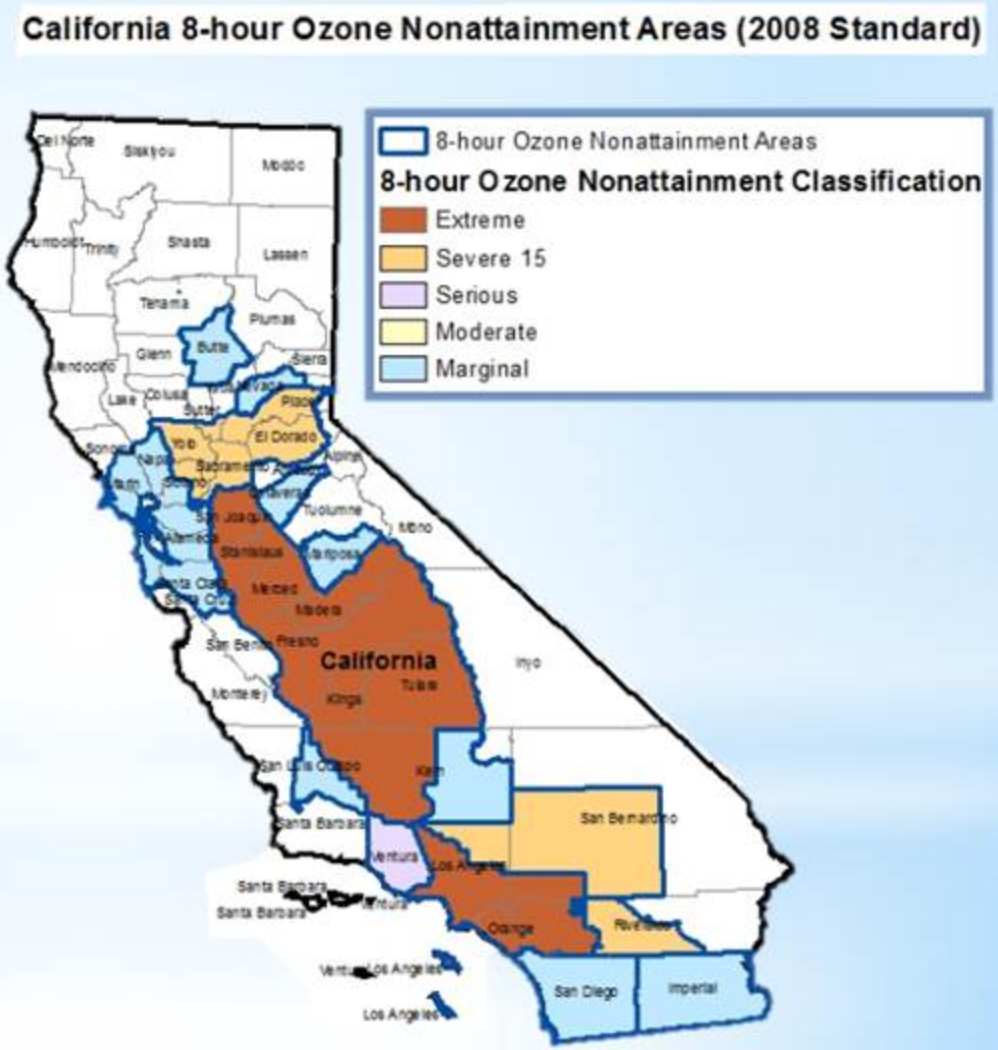
Mobile Source Control Division

California Environmental Protection Agency

Air Resources Board

California's Air Quality Needs

- California has the worst air quality in the nation
- Many major population centers are in non-attainment of federal air quality standards
- Failure to improve air qualities to levels mandated by the Clean Air Act could result in federal sanctions against California



Long-term Transformation for Mobile Sources

"Transporting freight reliably and efficiently by zero emission equipment everywhere feasible, and near-zero emission equipment powered by clean, low-carbon renewable fuels everywhere else. "

--California Sustainable Freight Action Plan, July 2016

Where are Zero Emission Opportunities?

- First wave in local and short distance trucking
- Primarily evaluating class 2B to 7
  - Should we consider any local class 8 trucks?
- What are existing fleet practices, operational costs and needs?
- What zero emission vehicles are available?
- What is current experience with zero emission trucks?
- How does current and expected total costs of ownership compare?
- How to evaluate other zero emission capable technologies?
- How to accelerate a self-sustaining market?

Concept Overview

Advanced Clean Truck Concept

- Increased penetration of advanced technology over the next 10-15 years.
- Natural fleet replacement rate (not accelerated)
- Zero-emission operation where suitable
- Low NOx and renewable fuels where available
- Complement other efforts

Regulatory Concepts

- Manufacturer sales requirement
  - Similar to the light-duty Advanced Clean Cars regulation
- Fleet purchase requirement
  - Phase-in purchases of advanced technology trucks
- Combination of both
- Other ideas

Considerations

Health and Environment Benefits

- Protect public health
- Reduce NOx, PM, GHG emissions
- Reduce other environmental risks

Regulatory Structure and Incentives

- Support existing programs
- Promote new actions , no double counting
- Equity among different companies
- Ensure measure is implementable, enforceable, and quantifiable
- Impacts on funding opportunities

Disadvantaged Community (DAC)

- Ensure equitable benefits distribution

Fleet Operators

- Ensure operational capability
- Stability for long-term decisions
- Robust service network
- Meet daily service needs

Manufacturers

- Support zero and near zero technologies
- Need clear market signal
- Build economies of scale
- Support transition to other truck categories

Complementing Existing Programs

- Achieve NOx and GHG reductions beyond existing programs
  - Engine emission standards (normal replacements)
  - Low Carbon Fuel Standard (LCFS)
  - GHG Phase 2 Impacts
- Emission reductions from new measures must be real, quantifiable, verifiable, and enforceable

Low Carbon Fuel Standard

- Fuel producers and importers must reduce carbon intensity of transportation fuels or must buy credits
  - Reduces GHG emissions and dependence on petroleum
- Credits for cleaner alternatives to diesel or gasoline
  - Goes to producer of renewable diesel, renewable natural gas (RNG), hydrogen
  - Goes to vehicle owner that dispenses CNG or uses electricity
    - Electricity credit worth $0.06/kWh at $100/credit
- Reporting required to earn credits
- Can update efficiency and credits with additional data

LCFS program https://www.arb.ca.gov/fuels/lcfs/lcfs.htm

Existing Market for Zero Emission Trucks

Truck Manufacturing

- Chassis, engine, and body manufacturers are typically separate companies – production is not vertically integrated
- The same chassis can be used in multiple dissimilar applications

Manufacturers Already Offer Zero Emission Technologies

Zero-Emission Battery Electric

- Range from Class 2B-8
- A battery as the sole power source propels the vehicle
- 60-120 mi. on a full charge
- Expected fuel and maintenance cost savings
- Infrastructure and higher initial capital investments
- Fuel efficiency up to 3-4x diesel efficiency

Plug-in Hybrid Electric

- Zero emissions until battery depleted, then switches to ICE
- Increased fuel economy
- Potential fuel and maintenance cost savings
- No range anxiety issues
- Lower upfront cost compared to pure battery-electric truck
- Geofencing may be used to limit emissions in disadvantaged communities

Hydrogen Fuel Cell

- Combines hydrogen and oxygen to produce electricity
  - Only emission is water
- Same range and fueling time as an ICE
- Fuel efficiency is up to 2x diesel
- Significant vehicle and infrastructure capital cost
- Few truck deployments to date
- Can be range extender for shorter haul
- Promising long haul freight potential

Electric Power Takeoff (ePTO)

- Allows auxiliary equipment to draw power from battery with engine off
- Export power capability
- Lower fuel use and lower emissions
- Quiet operation while stationary

Near-Zero Emissions

- Low NOx engines
  - CNG 6.7L and can achieve 50% NOx reductions
  - CNG 8.9L can achieve 90% NOx reductions
  - Diesel engines not yet available
- Renewable Fuels
  - GHG reductions are already counted under LCFS so no new reductions
  - Long-term supply issue

Companies Already Investing in Zero Emission Technologies

Advanced Technology Trucks and Buses in the US

Vehicle Type	In Service	On Order
Battery-Electric Bus	~240 (109 in CA)	188 in CA
Battery-Electric Delivery Van/Step Van	500-1000	~40
Battery-Electric Drayage Truck	~10	~25
Battery-Electric Yard Tractor	~10	~60
Electric Trolley Bus	578 (301 in CA)	?
ePTO Systems	3000+ (1000+ in CA)	?
Fuel-Cell Electric Bus	~36 (20 in CA)	35 in CA
Fuel-Cell Electric Truck	~2	37
Plug-in Hybrid Delivery Van	~60	~340

How Do Costs Compare?

- Seeking data to better understand costs
  - Upfront capital cost
  - Infrastructure upgrades
  - Annual fuel use
  - Annual maintenance
  - Other costs such as payload, fueling time…
- Develop comprehensive cost model by truck type

Discussion Topics

- Transportation electrification role of SB 350 (utilities)
- Low Carbon Fuel Standard
- Workforce training
- Vehicle service network
- Innovative technology certification
- Economies of scale and cost reduction
- Charging/fueling standardization
- Role of funding and incentives

Transportation Electrification

- SB 350 sets principal goal of the California Public Utility Commission (CPUC) to encourage transportation electrification and remove barriers
- Close coordination with ARB and California Energy Commission to accelerate transportation electrification
- Investor owned utilities to submit proposals to implement their plan January 2017
- Coordination meeting set for Monday, November 14th
  - Fleet owners, utilities, CPUC and interested parties

Join Advanced Clean Truck Workgroup

- Select membership from diverse stakeholder groups
  - Manufacturers, fleet owners, environmental groups, utility providers, others
  - Meet every 2-3 months in person
  - Provide data, review meeting summaries, and materials
- Meetings to be open to all interested parties
- Materials and meeting recordings to be available online
- Send a brief outline of your background and how you can contribute as a member to paul.arneja@arb.ca.gov
  - Send in applications by November 18th

Next Steps

- Continue to seek comments and ideas
- Form workgroup and set first meeting
  - Develop a better understanding of operational needs
  - Evaluate cost information for variety of vehicles
- Collect vehicle fuel/electricity use data
  - Update vehicle efficiency for Low Carbon Fuel Standard
- Meet on November 14, 2016 to discuss barriers to transportation electrification with utilities

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Web Page: http://www.arb.ca.gov/msprog/actruck/actruck.htm

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