Update on California’s Heavy-Duty Truck Program: Past, Present, and Future

October 24, 2014
Diamond Bar, California
Today’s Presentation

• Introduction
• Current Program
• Recent Program Evaluation
• Achieving Additional Criteria Reductions
• New Phase 2 Standards
• Driving Towards Zero Emissions
Heavy-Duty Trucks in California

• Many weight classes and applications
• Millions on the road in California
• Predominately diesel powered
• Class 8 trucks are largest emissions contributor
• Class 2b/3 have highest sales volume
Heavy-Duty Trucks Remain a Significant Source of Emissions*

- 33% of Statewide NOx
- 26% of Statewide diesel PM
- 8% of Statewide GHG emissions
  - 21% of Transportation GHG

*Tank to wheel emissions
California’s Issues are National Issues

- Today’s federal $O_3$ nonattainment areas for current standard: 75 ppb
- If U.S. EPA lowers standard to: 60 to 70 ppb*
- Expected in December


*Turquoise, yellow, and orange dots represent potentially new nonattainment areas for ozone
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Current Heavy-Duty Vehicle/Engine Program

- New engine standards
  - NOx/PM
  - GHG
- In-Use Requirements
  - Diesel fleet rules
  - Tractor/trailer GHG program*

*Tractor-Trailer GHG Regulation also includes some requirements for new tractors and trailers
Current NOx and PM
New Engine Requirements

• Certification requirements
  – Engine standards harmonized with U.S. EPA
  – Not-to-Exceed limits (NTE)
  – Durability testing requirements
  – Warranty requirements
  – On-Board Diagnostics (OBD)

• ARB optional NOx standards
Reducing Emissions from the Legacy Fleet

- Fleet rules
  - Turnover and retrofit requirements
- Idling restrictions
- Inspection and maintenance requirements
- Incentive programs
  - Carl Moyer
    - $69M in annual State funding
    - $12M in annual air district funding
  - Proposition 1B
    - $150M in 2013
MATES IV* Data Show We are Successfully Reducing Diesel Risk

2005 Risk

2012: Risk Greatly Reduced

*Risk values do not reflect pending update to OEHHA Health Risk Assessment Guidance
Current GHG Requirements

- ARB Tractor-Trailer GHG Regulation
  - AB32 early action item
- U.S. EPA Phase 1 Standards

* g CO2/ton-mile Phase 1 standards for Class 8 high-roof sleeper cabs

![Graph showing CO2 emissions over time]

- Baseline
- 2014-2016
- 2017+

Over 20% reduction
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Staff Evaluated Existing Heavy-Duty Program

- Inspection of over 1,000 trucks
- Stakeholder discussions/surveys
- Review of warranty, emissions and maintenance data
- Three main areas of focus:
  1. Diesel particulate filters
  2. Engine durability
  3. In-Use NOx emissions
Data Show Filters Work

- Properly functioning filter virtually eliminates PM emissions
- Monitoring studies validate reductions
- Warranty claims low for retrofits and most factory installed filters
- End-users must monitor and maintain filters and engines
Engine Durability is a Concern

• Engine component malfunctions affect filters
• Engine warranty claims relatively high
  – On average, more than one claim per engine for some model years
  – Warranty only covers small fraction of useful life
• Need to hold manufacturers more accountable
• Need better tools to ensure durability
In-Use NOx Control Needs Improvement

• Selective-catalytic reduction (SCR) achieves substantial NOx control
  – Effective under vehicle cruise condition
  – Requires minimum operating temperature
  – Excess emissions observed under low-temperature and low engine loads

• Better control needed for broader range of engine operation modes
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Opportunities to Improve Current Emissions Performance

• Improved in-use compliance testing
• Expanded preventive maintenance
  – Work with stakeholders to identify most beneficial maintenance procedures
• Potential new inspection/maintenance requirements
Looking Forward to Lower Criteria Pollutant Emissions Standards

- Staff working to lay technical foundation
- Continue coordination with U.S. EPA
- Three goals:
  1. Lower NOx standard
  2. Stronger durability and warranty requirements
  3. Broader in-use NOx and PM control
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DOE SuperTruck Program Shows Potential for Class 8 Tractor Trailers

- $115 million in DOE funding awarded
  - $155 million in private-industry investments
- Four participating teams
- Demonstrate major improvements in engine, drivetrain, and vehicle efficiencies
- Substantial benefits possible using incremental improvements to conventional technologies
Many Opportunities for Efficiency Improvements

Aerodynamic Losses: 85kWh  21%

Engine Losses: 240kWh  60%

Auxiliary Loads: 15kWh   4%

Drivetrain Losses: 9 kWh  2%

Rolling Resistance Losses: 51 kWh  13%

Based on Data from U.S. DOE (21st Century Truck Partnership). 2006
Phase 2 HD GHG Standard Development

• Jointly being developed by U.S. EPA, National Highway Traffic Safety Administration, and ARB

• Notice of Proposed Rulemaking expected in early 2015
  – Federal rule adoption in March 2016
  – ARB rule adoption in mid-2016

• Further fuel economy improvements and GHG reductions for 2018+ model years
  – NAS and UCS/ACEEE agree additional 13-25% CO2 reduction beyond Phase 1 possible*

* Phase 1 benefits ~6-24%, depending on vehicle category
Many Options for Phase 2 Compliance

- Combustion and after-treatment optimization
- Engine downsizing
- Hybridization
- Reduced friction and optimized gear ratios in transmissions
- Auxiliary load reduction
- Aerodynamics
- Low-rolling resistance tires
Lower NOx and GHG are Achievable

- Systems integration is important
  - Engine and vehicle efficiency measures simultaneously reduce NOx and GHG
  - Optimize operations/control for in-use performance and emissions

- Advanced technologies are key
  - Hybridization
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Beyond Phase 2: Zero and Near-Zero Technologies

- Technology assessment evaluating commercialization pathways

- Need to address
  - Technology development and deployment
  - Well to wheel emissions
  - Infrastructure
Incentives Help Develop Markets for Zero-Emission Trucks

- On-going major public investments
  - $200M annually
  - Cap and Trade
  - Other incentive funds

- Diverse portfolio
  - Demonstrations
  - Pilot deployments
  - Infrastructure
  - Renewable fuels
Move Forward with Comprehensive Strategy

- Existing programs have been effective, but further improvements possible
- Encourage technologies that advance pathways to zero emissions
- Milestones:
  - Phase 2 Standards
  - Technology Assessments
  - SIP Development