February 11, 2019

Public Workshop:
Strategies to Reduce In-Use Emissions from Heavy-Duty Vehicles
Today’s Discussion

• Welcome and introductions
• Staff presentation
  • California’s emission challenges
  • CARB’s existing heavy-duty vehicle (HDV) programs
  • Future program goals
  • Potential heavy-duty vehicle inspection and maintenance (HD I/M) program elements
  • Research updates
  • Next steps
• Open discussion: stakeholder and industry ideas
• Webcast participants, submit questions to: HDVin-use@arb.ca.gov
California Faces Greatest Air Quality Challenges in U.S.
Emissions by Source in California

**NOx Emissions by Source 2019**
- Heavy-Duty Diesel Vehicles (14,001+ lbs.): 26%
- All Other On Road Vehicles: 19%
- Other Mobile Sources (Trains, Aircraft, Off Road etc): 33%
- Stationary Source: 22%

**PM2.5 Emissions by Source 2019**
- Heavy-Duty Diesel Vehicles (14,001+ lbs.): 19%
- Other Mobile Sources (Trains, Aircraft, Off Road etc): 69%
- All Other On Road Vehicles: 4%
- Stationary Source: 8%

Mobile source emissions: emission year 2019 using EMFAC 2017 model
Stationary source emissions: emission Year 2019 using CEPAM 2016 emissions tool
NOx and PM Emissions from On-Road Mobile Sources

On-Road NOx

- Heavy-duty Diesel Vehicles*: 58%
- All Other On Road Vehicles: 42%

On-Road Diesel PM 2.5

- Heavy-duty Diesel Vehicles*: 82%
- All Other On Road Vehicles: 18%

*Gross vehicle weight rating >14,000 pounds
Emission Year 2019 using EMFAC 2017 Model
CARB’s Heavy-Duty Vehicle Programs

Manufacturer Engine and Vehicle Requirements
- New engine standards
- Warranty and in-use compliance
- On-board diagnostics (OBD)

In-Use Truck Rules
- Retrofits
- Accelerated Vehicle Turnover

Vehicle Inspection Programs
- Heavy-Duty Vehicle Inspection Program (HDVIP)
- Periodic Smoke Inspection Program (PSIP)

Advanced Clean Technologies
- Advanced technology rules
- Advanced technology demos
- Financial incentive and loan programs
Increasingly Stringent Heavy-Duty Engine Standards

Emission Standards for New Heavy-Duty Engines Since 1990

- Reductions in new engines standards since 1990:
  - ~97% NOx
  - ~98% PM
- 2010+ MYs equipped with aftertreatment: selective catalytic reduction systems and diesel particulate filters
- Must ensure emission controls are working properly to maintain low emissions
Heavy-Duty Vehicle On-Board Diagnostics (OBD)

- HD OBD implemented starting with 2013 model year engines (vehicles > 14,000 lbs.)

- Intended as tool for inspection and maintenance
  - Monitors performance of emission control systems
  - Allows for quick identification of potential emissions issues and provides diagnostic information for repairs
Current Inspection Programs

**HDVIP:** Roadside inspections by CARB enforcement staff for excessive smoke and tampering

**PSIP:** Annual self-testing for California fleets of two or more vehicles

Requires vehicles to meet opacity limits to operate in California
Board Approved HDVIP and PSIP Amendments

- DPF-equipped vehicles:
  - 5% opacity
- Non DPF-equipped vehicles:
  - 20% - 40% opacity depending on model year and technology
- PSIP voluntary OBD submittal
  - Fleets can choose to submit a vehicle’s OBD data to CARB in lieu of performing annual PSIP smoke opacity test
- Changes effective mid-2019
In-Use NOx Emissions Remain High

- Many HD vehicles operate with malfunctioning emissions controls
  - NOx emissions well above engine certification standards
- More needs to be done to reduce in-use NOx emissions
Pattern of High Warranty Claims

- Relatively high rates of warranty claims show persistent design and durability issues
- Warranty claims over 4% can trigger recall requirements
Program to Ensure Timely Repairs Could Be Beneficial

- CARB’s roadside data collection
  - 11% of trucks had an illuminated Malfunction Indicator Light (MIL)
- Repairs are needed to keep emissions at certified level
  - UC Riverside study demonstrated
    - 50% - 75% NOx reductions achieved via repairs
Future Program Goals

• Maintain low emissions throughout a vehicle’s life
• Ensure emissions control systems are functioning properly
• Ensure proper maintenance practices are followed
• Ensure quick and adequate repair of malfunctioning parts
Possible Program Elements to Discuss

• Periodic inspections
• Measurement of real world emissions
• Training and education to diagnose and repair emissions systems
• Improving enforceability

Together, these could comprise a new HD I/M Program
Inspection Methods Under Exploration

• Periodic scans of the engine’s OBD system for malfunctions

• Remote sensing devices (RSD) / Plume capture

*OBD and RSD / plume capture can work together*
OBD System Inspection Options

- **Kiosks**
  - Drive up, plug in, and transmit data

- **Station-based**
  - Testing at a physical station

- **Dongles**
  - Transmit data via the cellular network

- **Telematics**
  - Fleet/vehicle software subscription service
  - Many fleets already enrolled in a telematics program

- **Mobile inspectors**
  - Third-party verifiers go to fleet facilities
  - Possibly via a state contractor
Remote Sensing Devices (RSD) and Plume Capture Technologies

- Emissions snapshot in real-time
- Potential uses
  - “Dirty Screen” – identify high emitters when coupled with Automatic License Plate Recognition (ALPR)
  - Program validation – monitor real-world emissions; gauge program success
Current Technologies

• RSD
  • Uses light source, light reflection, light signal detection, and signal analysis algorithm to determine emissions
    • HEAT’s EDAR system (Differential Adsorption LIDAR)
    • University of Denver’s FEAT system, or similar (IR, UV)
    • OPUS

• Plume capture
  • Exhaust is pulled through a sampling inlet to a manifold connected to analytical instruments
    • PEAQS (CARB in-house system)
    • UC Berkeley’s “overpass” system
    • On-highway measurement system (University of Denver’s HD “tent”)
Training and Education

• Fleet Owners
  • Establish education and training programs on preventative maintenance
    • Encourages fleet owners to implement best maintenance practices and perform timely repairs of malfunctioning equipment

• Mechanics/Technicians
  • Ensure that technicians are trained to diagnose and repair emissions systems for complete and durable repairs
Program Elements We Could Develop Now

- Require periodic OBD data submission from fleets
  - Several options for OBD data collection and transmittal
- RSD / plume capture for “dirty screening” and program validation
- Require Certificate of Compliance to operate in California
- Hold DMV registration for non-compliant vehicles
Heavy-Duty Vehicle Research

• UC Riverside/CE-CERT HD I/M Research Project
  • Confirms emission reductions can be obtained through a more comprehensive HD I/M program

• Internal CARB Repair Durability Study
  • Assessing ability of repair facilities to accurately diagnose/repair HDVs and whether repairs are durable
  • Initial results indicate that repairs are durable with proper maintenance

• $1M HDV Repair Assistance Pilot Program in San Joaquin Valley
  • Determine whether repair assistance is needed for low income truck owners

• Starting in 2019
  • Pilot demonstration at southern California ports: OBD data submission options
  • RSD and plume capture pilot study
  • ALPR statewide demonstration – better characterize out-of-state truck traffic coming into California, refine CARB’s emission inventory
Next Steps

• External workgroup meetings

• More workshops moving forward

• Potential Board adoption of HD I/M program
  • 2020+ timeframe
Stay Connected to HD In-Use 
Program Development Activities

• Krista Fregoso, Air Pollution Specialist, Strategic Planning and Development Section, MSCD
  • (916) 445-5035 and krista.fregoso@arb.ca.gov
• James Goldstene, Vehicle Program Specialist, ED
  • (916) 229-0637 and james.goldstene@arb.ca.gov
• Visit CARB website at: https://ww2.arb.ca.gov/our-work/programs/heavy-duty-inspection-and-maintenance-program
Open Discussion

Webcast Participants Submit Questions to:
HDVin-use@arb.ca.gov
Questions to Start the Discussion

- What are the best method(s) to ensure that vehicles are kept well maintained and operated as designed?
- Are there ways to leverage how fleets already operate to implement a program efficiently and cost effectively?
- Should mechanics/technicians be licensed to perform inspections, diagnoses, and repairs?
- Would education and training programs on preventive maintenance strategies be useful?