Heavy-Duty Technology and Fuels Assessment: Overview

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California Environmental Protection Agency

Air Resources Board

Purpose of Technology Assessment

- Inform policy decisions that support technology development and use
- Assess emerging technologies and fuels
  - Trucks and buses, locomotives
  - Marine, cargo handling equipment
  - Airport sources
  - Fuels

Technology Assessment Elements

- Sector overview
- Technology description
- Technology development status
- Current capital costs, projected costs at widespread deployment (if available)
- Emissions reduction potential
- Deployment opportunities and challenges

Zero Emission Technologies

- Commercially available in some applications
- Feasible in many applications
- On-going work needed
  - Reduce upfront cost
  - Develop fueling infrastructure
  - Extend range
- Lower fuel and maintenance costs
- Need to continue demonstrations and incentives

Commercially Available

Electric forklift

Electric gantry cranes

Airport electric baggage tug

Early Commercialization

Fuel cell electric transit bus

Fuel cell lift trucks

Electric plug-in transport refrigerator

Battery electric transit bus

Demonstration

Battery electric and fuel cell drayage trucks

Electric or Fuel cell delivery van

School bus with V2G capability

Battery electric switcher locomotive

Hybrids and Other Zero Emission Enabling Technologies

- Pathway technologies
  - Hybrids providing zero emission miles
  - Electric propulsion with range extender
  - Help commercialize ZEV components
- Other technologies
  - Electrify accessories while parked, at berth
  - Smaller engines that increase efficiency
  - Mild hybrids that electrify auxiliary systems

Example Hybrid Applications

Hybrid electric van with pure electric range

Diesel electric hybrid ferry with solar & wind assist

Locomotive battery or fuel cell tender

Technologies that Reduce Main Engine Use

Aircraft Taxi Assist

Jet Bridge Ground Power for Aircraft

TRU Power at Distribution Centers

Vessel Shore Power

Example Near-Zero Emission: Trucks

- Characteristics
  - Diesel or natural gas combustion
  - Certified to lower NOx standards
  - Use renewable / low carbon fuels
- Status
  - Research and development
  - Lower NOx natural gas available in 1-4 years
  - Fueling infrastructure may be needed

Reducing Emissions from Current Technology

- Enhanced emissions standards / testing requirements for on and off-road
  - Achieve lowest emissions in-use
  - Provide durability protections and robust warranty
  - Inspection and maintenance programs
- Potential reductions from rail, marine, and off-road engines with aftertreatment

Transition to Low or No Carbon Fuels

- Bio and Renewable fuels are important
  - Being demonstrated and expanded
  - Provide immediate reductions
- Power to gas and vehicle to grid integration potentially transformative
  - Store excess renewable energy until needed
  - Can feed energy to grid during peak demand
  - Fuel zero and near-zero vehicles

Improving Efficiencies and Fuels

- Trucks
  - Engine, drivetrain, and vehicle improvements, hybridization, engine downsizing
- Aircraft
  - Engine and aircraft design, biofuels
- Ships
  - Hull and propeller design, coatings, LNG
- Connected/automated vehicles
  - Platooning, terminal automation

Preliminary Observations

- Many promising zero and near-zero emission technologies
- Major vehicle, engine, and operational efficiency improvements are possible
- Renewable fuels provide deep GHG reductions

Next Steps

- Draft overview report will be released for public comment
  - Report: http://www.arb.ca.gov/msprog/tech/report.htm
  - Comments: rlittaua@arb.ca.gov
- Sector-specific draft documents will be released spring 2015 for public comment
- Complete assessments in 2015, will be used for key planning efforts