Zero-Emission Truck Technologies and Regulations

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Technology Options

- Battery-electric – Electric vehicle using a battery as a power source
- Hydrogen fuel cell – Electric vehicle using a hydrogen fuel cell as a power source
- Plug-in hybrid – zero-emission operation with a internal combustion adding range
Developing the Technology

- Identify and leverage key early markets
  - Expand use in key early applications
    - Advance technologies, increase production volume, and reduce costs
  - Support growth of core supply chain
- Transfer technology to other applications
- Each succeeding market builds greater volume
CARB’s Suite of Projects

**Demonstration Projects**
- Zero-Emission Drayage Trucks
- Multi-Source Facility
- On-Road/Off-Road Advanced Technology

**Pilot Projects**
- Zero-Emission Truck and Bus Pilot Projects
- Zero- and Near-Zero Emission Freight Facilities (ZANZEFF)

**Commercialization**
- HVIP – Hybrid and Zero Emission Truck and Bus Voucher Incentive Program
- Volkswagen Beneficiary Trust
Transit Agencies Leading the Way

- Zero-emission buses
  - 153 in operation
  - 433 placed orders
  - 729 awarded funding or planned
- More than 50 transit agencies making ZEB purchases
- Competitive total cost of ownership today

Last updated August 2018.
Heavy Duty ZEV Market Growing

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*Not all vehicles pictured, excludes transit buses
SB350 – Transportation Electrification

- California Public Utility Commission directing investor-owned utilities to accelerate widespread transportation electrification
- California utilities planning to invest in electrical infrastructure – pay for all site upgrades and the charger itself
  - $579 million approved over the next 5 years, additional $151 million under review
- New rates being designed to encourage electric vehicles
Low Carbon Fuel Standard (LCFS)

• Lowers carbon intensity (CI) of California transportation fuels 20% by 2030
• Fleets can earn credits by dispensing H₂ or electricity
  • Higher credits for battery electric trucks start 2019
  • Valued at $0.13 per kWh (at $100/credit)

LCFS program: https://www.arb.ca.gov/fuels/lcfs/lcfs.htm
Fuel Cost Saving Opportunity

**Airport Shuttle**
- BEV vs Diesel: 15%
- with LCFS: 45%

**Package Delivery**
- BEV vs Diesel: 35%
- with LCFS: 75%

**Local Drayage**
- BEV vs Diesel: 50%
- with LCFS: 80%

Assumes $3.00/gal., $0.20/kWh, and LCFS credit price at $100
Many Trucks/Use Cases Have Potential for Electrification

100 miles a day – 25,000 mi./yr.

Advanced Vehicle Technology Regulations
Regulatory Strategies

• Increase penetration of first wave of zero emission heavy-duty technology
• Focus on near term candidates for zero emission technologies
  • Centrally fueled, low average speed, urban, stop-and-go duty cycles
• Experiences benefit the market for the same technologies in other HD applications to support commercialization
Zero Emission Regulations

• Innovative Clean Transit (2019)
  • Transition to zero emission buses 2023 to 2040
  • Low NOx and renewable fuels during transition
• Zero Emission Airport Shuttle Bus (2019)
  • Public and private fixed-route
  • All zero emission by 2036

Innovative Clean Transit: https://www.arb.ca.gov/msprog/ict/ict.htm
Zero-Emission Airport Shuttle Bus: https://www.arb.ca.gov/msprog/asb/asb.htm
ZE HD Powertrain Certification: https://ww2.arb.ca.gov/our-work/programs/zero-emission-powertrain-certification
Zero Emission Regulations (Cont’d)

- Zero Emission Powertrain Certification (2019)
  - Ensure reliability and performance for ZE trucks and buses
- Advanced Clean Trucks (2019)
  - Require zero emission truck sales
  - Class 2B and above
  - 2024+ model year or later
Zero Emission Regulations (Cont’d)

• Zero Emission Drayage Trucks (2022)
  • Fleet requirement expected 2026+
  • Fleet rule assessment
    • Purchase zero emission cars and trucks
    • First workshop August 30, 2018

Advanced Clean Trucks: https://www.arb.ca.gov/msprog/actruck/actruck.htm
ZEV Fleet Assessment Workshop: https://www.arb.ca.gov/msprog/zevprog/zevprog.htm
Conclusions

• California facing tough challenges to reduce GHG & NOx
• Zero-emission vehicles offer solutions to address both GHG and NOx simultaneously
• Technology adoption is advancing rapidly, business case is becoming viable
• CARB will pursue zero-emission regulations to send market signal and guarantee emission reductions
Reference Materials

- Short-lived Climate Pollutant Reduction Strategy [https://www.arb.ca.gov/cc/shortlived/shortlived.htm](https://www.arb.ca.gov/cc/shortlived/shortlived.htm)
- Incentive Programs [https://www.arb.ca.gov/ba/fininfo.htm](https://www.arb.ca.gov/ba/fininfo.htm)
- Innovative Clean Transit [https://www.arb.ca.gov/msprog/ict/ict.htm](https://www.arb.ca.gov/msprog/ict/ict.htm)
- Advanced Clean Trucks [https://www.arb.ca.gov/msprog/actruck/actruck.htm](https://www.arb.ca.gov/msprog/actruck/actruck.htm)
- Zero Emission Airport Shuttle Bus [https://www.arb.ca.gov/msprog/asb/asb.htm](https://www.arb.ca.gov/msprog/asb/asb.htm)