Emerging Opportunities & the Opportunity For Near Zero and Zero Emission Buses

Climate Adaptation Planning for Transit and Fleet Operators
CALSTART Unique Position: Supports All Clean Fuels/Tech (partial member list)
Mission Statement

CALSTART is a unique national, non-profit, member-supported organization dedicated to the growth of an advanced transportation technologies industry that will:

» Create high-quality jobs;
» Clean the air;
» Reduce dependence on foreign oil; and
» Prevent global warming
Driving Forces

» Green House Gas Reductions
  » CA AB32 and E0 requiring 80% CO2 reduction by 2050
  » Recent three year study on M-HD Vehicles by the CalHEAT Research Center shows confirms feasibility and provide a 66 step pathway

» South Coast and San Joaquin regions are in severe non attainment with unhealthy levels of NOx emissions
  » Present EPA Stds require 82% reduction of NOx in South Coast
  » Pending EPA regulations will require 88% reductions

» Solutions
  » Near Zero Emission Engine Technology for NZEB’s and
  » Zero Emission Buses
Current GHG Paths Miss Ozone Goals

Source:
Curves based on CARB Vision for clean air Scenario 3 in CARB vision model, available at http://www.arb.ca.gov/planning/vision/vision.htm
SCAQMD Needs More Emission Reductions, and Much Sooner

- Carrying capacity for 80 ppb ozone standard = 115 tpd NOx
- Carrying capacity for 75 ppb ozone standard = 80 tpd NOx

- 82% reduction
- 88% reduction

624 TPD in 2010
Near Zero Emissions Technology

» CARB providing draft regulatory language for review (8-07-13) on optional reduced emission standards for heavy-duty engines and vehicles. [http://www.arb.ca.gov/msprog/onroad/optionnox/optionnox.htm](http://www.arb.ca.gov/msprog/onroad/optionnox/optionnox.htm)

Optional Low NOx Exhaust Emission Standards for 2015 and Subsequent Model Year (grams per brake-horsepower-hour or g/bhp-hr)

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<th>CO</th>
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» Optional Standards combined with AB-118 like incentives likely to facilitate market commercialization and adoption

» CEC/SCAQMD/SCG RFP to develop near zero HD engines
  » Multiple proposals presently under review
Near Zero Emissions Technology

» Two Pathways for NZEB obvious

» Natural Gas engine makers- Projecting 75% NOx Reduction in two years

» Turbine Power Plants as range extenders on battery buses
FTA National Fuel Cell Bus Program

» CALSTART led Fuel Cell Bus coalition leading to $92.3 M Federal Funding + 50% match

» CALSTART National Fuel Cell Bus Projects Include
  » AC Transit Accelerated testing of UTC PureMotion
  » SunLine and Chicago TA American Fuel Cell Bus (AFCB)- low and high temperature testing
  » SunLine (AFCB) Advanced Generation Ballard Fuel Cell
  » San Francisco MTA (MUNI) BUS 2010 – Near zero Fuel cell APU
  » US Hybrid – Bi-Directional DC-DC and High Voltage Air-Conditioning Converter
  » UTC-Next generation Fuel cell-half Size and Cost
  » New Flyer-Con Transit –UTC/US Hybrid Advanced American Fuel Cell Bus
  » Nation Wide Fuel Cell Market Study

» National FCB Program Investments In Place Leading To
  » $1,000,000 Fuel Cell Buses in the near term in quantities of 20-50
    » A drop from $2-2.5 million
  » Fuel Cell durability of 20,000 hours or close to 6 years
    » as compared to the 4,000 hours at the beginning off the program
  » Bus performance similar to the conventional bus in pull out and drivability
Next Generation Fuel Cell UTC Pure motion Design PC 58 to be Fabricated/Integrated by US Hybrid Torrance CA

- Buy America Compliant sourcing & assembly
- PureMotion® 120 (similar) vehicle interfaces
  - US Hybrid Intentions to make it backwards compatible to support US fleets of Van Hool Fuel Cell buses
- Improved fuel cell stack durability (10-50%) up to 20,000 Hrs.
- Reduce size (30-50%)
- Reduce cost (25-40%)
Integrated into SunLine operations much like any new fixed route bus
- AFCB Availability 83% > CNG buses
- Operators/techs training simpler than other FCBs even with innovative e-doors, e-dashboard, e-accessories
- Service Trials Complete

» Body by ElDorado Coach
» Ballard Fuel Cell System (up to 20,000 hrs warranty)
» BAE Hybrid Electric Drivetrain
No and Low Emission Bus Program MAP-21

» CALSTART and CTE Leading ZEB coalition to foster a ZEB research and deployment program under the follow-on to the Transportation Bill

» MAP-21 Authorized a $70,000,000/year Program to invest in
  » “Research”,
  » “Innovation and Development”
  » and “Deployment” including a significant Zero and low emission bus element of 65%

» $35,000,000 allocated by Continuing resolution

» CALSTART continuing to work with ZEB coalition working to obtain full funding

» $24.0 Million NOFA anticipated EO Sept
  » Deployment funding for Zero Emission Buses
  » Targeting full performance –full range
  » Requires team members with very strong Zero Emission Bus experience
CALSTART/Proterra Electric Bus Project with Overhead Rapid Charging System

Project Partners
Proterra was founded in 2004 for the purpose of developing advanced technology transit buses. Proterra developed the world’s first full-size battery electric-drive transit bus capable of fully charging in under 10 minutes.

San Joaquin Regional Transit District, the regional transit provider for San Joaquin County, provides public transit services in the Stockton Metropolitan area as well as intercity, inter-regional and rural transit services countywide.

CALSTART works with business, fleets, and government to develop and implement clean, efficient transportation solutions.

California Energy Commission administers the Alternative and Renewable Fuel and Vehicle Technology Program, designed to fund projects that accelerate the adoption of alternative fuels.

Fast Facts
Prior EcoRide™ demonstration buses have achieved between 17 and 29 MPG-e, six times greater than diesel and CNG buses.

Replacement of a CNG or diesel bus with an EcoRide™ BE-35 will result in a reduction of more than 270,000 pounds of carbon per year.

In full operation, the EcoRide™ would save more than $45,000 in fuel costs annually.
**CALSTART Zero Emission Propulsion “ZEPS” Demonstration in Washington State Cooperative Agreement CA26-7075**

**Project Partners**

- **Complete Coach Works** (CCW) is the nation’s largest bus remanufacturing and retrofit company with over twenty five years of experience in the transportation and transit sectors.

- **Ben Franklin Transit** provides public transportation, vanpool, and ridesharing services to the Richland/Tri-Cities region of Washington State, carrying nearly 5 million passengers annually.

**Fast Facts from CCW**

- The bus costs about **half the price** of new electric buses and just 30% more than a new diesel bus.

- The bus has a targeted **range of 100 miles**, a targeted charge time of 5.5 hours, and a target equivalent of 15.8 MPG.

- The vehicle carries a 213kwh battery pack, capable of charging at 40kw.

- This project will demonstrate the feasibility of purchasing and operating a remanufactured battery-electric bus, which will have dramatically lower up-front costs compared to new BEBs. This approach could rapidly accelerate BEB adoption.
Thoughts on Climate Adaptations
Power Could Flow from Electric Bus to Sustain the Grid

» Increasing amounts of violent weather conditions predicted
» Electrified buses could be designed and deployed to provide emergency backup power
» Battery pack from Electric or Hybrid Electric bus can provide power during an emergency for
  » Maintaining telecommunications
  » 4 to five homes
  » Consider the possibilities
» Example
  » CCW ZEPS battery Pack 240kWhrs
  » CCW can design inverter system to provide 40 kW for 6 hours or 20kW for 12 hrs or 10kW for 24 hrs
  » Fuel Cell and Hybrid buses may be able to use the onboard fuel and maintain grid for twice these amounts
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Questions?

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