Zero-Emission Heavy-Duty Drayage Truck Demonstration


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Project ID# VSS115

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Overview

Timeline

- Project start date: Oct. 2012
- Project end date: Sept. 2015

Barriers & Targets

- Promote market acceptance
- Evaluate infrastructure options
- Data collection and analysis

Budget

- Total project cost: $9,251,003
  - DOE share: $4,169,000
  - Cost share: $5,082,003
- Expenditure of DOE funds in:
  - FY 13: $235,000
  - FY 14: $614,082

Partners

- Project Lead - SCAQMD
- Balqon
- TransPower
- U.S. Hybrid
- Vision Industries
- NREL
- Total Transportation Services (TTSI)

Objective/Relevance

- Demonstrate zero-emission heavy-duty truck technologies in real world drayage operations
- Promote market acceptance through demonstration with fleet partners
- Measure and analyze data on performance and operating costs
- Evaluate different charging infrastructure and technologies to support drayage operations

Project Milestones
FY 13 and FY 14

From	To	Milestones	Status
4/13	11/13	Contract executions	Completed
4/13	4/14	System and components design	On-going
7/13	8/14	System and components fabrication	On-going
11/13	2/15	Vehicle integration	On-going
4/14	3/15	Vehicle validation	On-going
5/14	4/15	Vehicle delivery	Pending
7/14	6/16	Drayage service demonstration	Pending

Project Approach/Scope

- Develop four different types of zero-emission heavy-duty drayage truck technologies
  - Three types of BEVs
    - Balqon (3), TransPower (4), US Hybrid (2)
  - One FCEV technology
    - Vision Industries (4)
- Chassis dynamometer testing to validate and optimize vehicle performance
- Two-year demonstration in port drayage service with fleet partner, TTSI
- Evaluate different charging technologies to assess compatibility with drayage operations
- NREL to collect and analyze performance and operating cost data

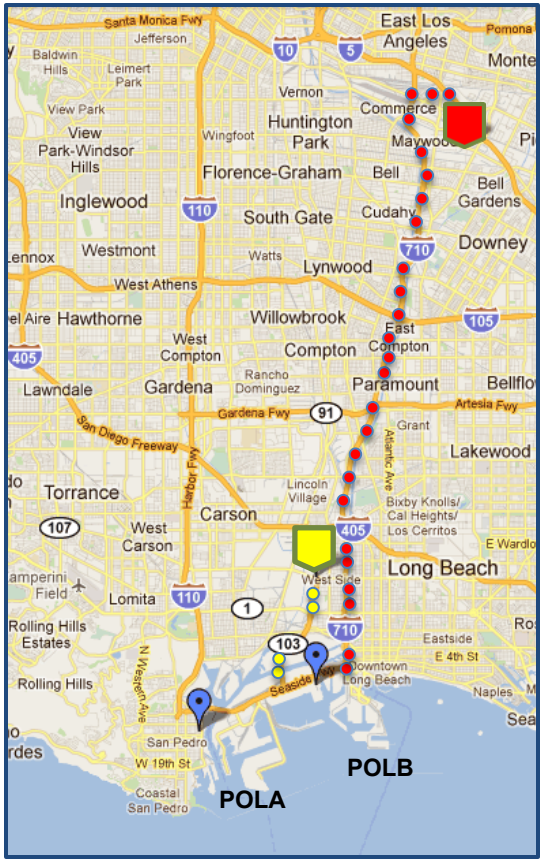
Zero Emission Trucks

What are the differences?

	Balqon	TransPower	US Hybrid	Vision
Transmission	Automatic	Automated Manual Transmission	Automated Manual Transmission	Direct Drive two-speed rear end
Battery Pack/ Fuel Cell	380 kWh $LiFePO_4$	269 kWh $LiFePO_4$	300 kWh Li-ion	130 kWh $LiFePO_4$/ 33 kW PEM FC
Charger	Off-board 160 kW with 500 kWh energy storage unit	On-board Two 70 kW Inverter-Charger Units (ICUs)	Off-board 120 kW	Level 2 charger
Recharge/ Refuel Time	3 hrs (160 kW)	4 hrs (70 kW ICU)	3 hrs (120 kW)	8 hrs (Level 2)/ 10-15 min H_2
Range	100 miles	70-100 miles	100 miles	200 miles

Project Approach Demonstration

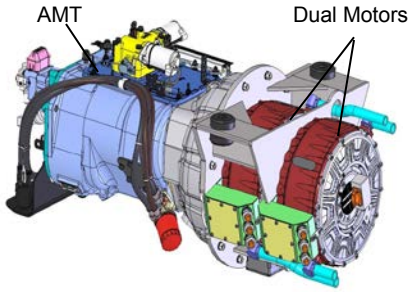
- 13 trucks (9 BEVs and 4 FCEVs) to be deployed in actual port drayage service with TTSI in the South Coast Air Basin
  - Near dock operation: Two to six miles in length to nearby container yards including Intermodal Container Transfer Facility
  - Local operation: Six to twenty miles from the ports to local warehouses, truck terminals, and the Hobart rail yard
  - Regional operation: 20+ miles from the ports to large warehouses
- TTSI to operate up to three baseline diesel trucks with similar loads and routes for comparison analysis

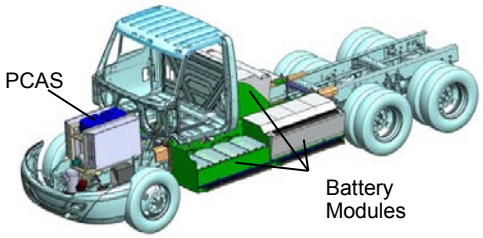


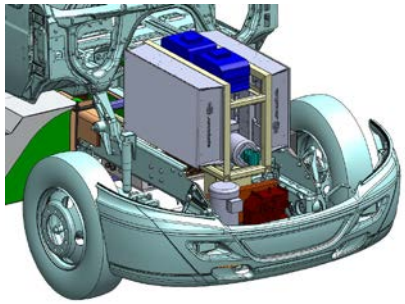
I-710 Corridor

Technical Accomplishments
TransPower

- Design improvements
  - Automated manual transmission with proprietary software to precisely match powertrain gearing to torque requirements for higher performance and efficiency
  - Larger and more rugged battery enclosures with much fewer wiring and connectors
  - New BMS to balance cells faster and more efficiently
  - Pre-integration of power control and accessory components for savings in assembly time and costs
  - Expected to improve operating efficiency and reduce assembly costs by approximately 25%





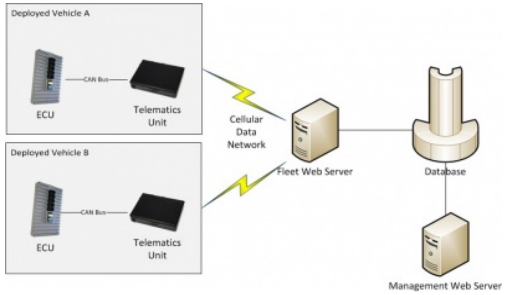


Technical Accomplishments
TransPower

- Vehicle assembly
  - EDD-1, first of four BEVs, completed
  - EDD-1 to be in demonstration by 7/14
  - EDD-2 assembly to be completed by 5/14
  - EDD-3 & EDD-4 to be completed by 8/14

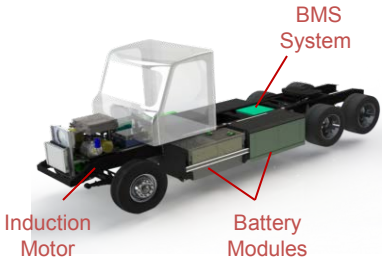
EDD-1

- Data collection plan
  - Developed a data set to collect in collaboration with NREL and TTSI
  - On-board data (40+ parameters) to be reported on daily basis
  - O&M activities and costs reported monthly

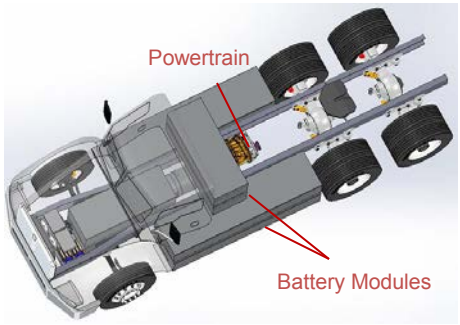


Technical Accomplishments

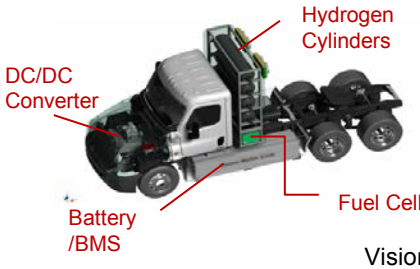
- Balqon
  - System design to be completed in 4/14
  - Vehicle integration to start in 7/14
- US Hybrid
  - Completed system and components design
  - System fabrication in process
  - Vehicle integration to start in 5/14
- Vision Industries
  - Completed system design and optimization
  - System validation in process
  - Components procurement in process
  - Vehicle integration to start in 5/14



Balqon



US Hybrid



Vision

Responses to FY2013 Reviewer Comments

- One reviewer commented that “the project approach and scope of developing four types of zero-emission drayage trucks for testing in the field for two years will provide outstanding set of information to evaluate the technology.”
  - Response: We agree that the project will provide valuable information and data to evaluate how well the technologies match up to support heavy-duty drayage operations. We’ll work with TTSI to ensure that the demonstration trucks are applied in diverse drayage operations for realistic assessment.
- One reviewer suggested that “it is essential to keep a focus on the overall durability of the systems and total cost of ownership.”
  - Response: We agree that the trucks will need to demonstrate a satisfactory level of durability and reliability for the technology to be accepted by the industry. It is also important to demonstrate operating cost savings to gain wider acceptance. This project will collect and analyze O&M activities and costs of demonstration trucks to help us evaluate their durability as well as total cost of ownership.

Collaboration and Coordination

- Four EV manufacturers to develop and demonstrate four types of zero-emission drayage trucks
  - Balqon, TransPower, US Hybrid, Vision Industries
- NREL to analyze vehicle performance and operating cost data during demonstration
- University of California, Riverside to perform chassis dynamometer testing to validate the performance of demonstration vehicles
- Fleet partner, Total Transportation Services, to deploy demonstration vehicles in drayage service for two years along with baseline diesel trucks

Proposed Future Work

- Remainder of FY 14
  - Balqon to complete system design and optimization
  - TransPower to complete EDD-2 by May
  - Chassis dynomometer testing for EDD-2 in June
  - EDD-1 and EDD-2 to be delivered to TTSI by June/July
  - Begin field demonstration in July
  - US Hybrid and Vision to start vehicle integration in May
  - Balqon to start vehicle integration in July
- FY 15
  - TransPower to complete vehicle integrations by Q1
  - The rest to complete vehicle integrations by Q2
  - NREL to provide performance and costs analysis reports on quarterly basis

Summary

Objective/Relevance

- Demonstrate zero-emission drayage trucks in real world drayage service to promote market acceptance, and analyze performance and cost data

Approach

- Develop 13 zero-emission drayage trucks based on
  - Three types of BEVs (Balqon, TransPower, US Hybrid)
  - One FCEV technology (Vision Industries)
- UCR to perform chassis dynamometer testing to validate vehicle performance
- Two-year demonstration in drayage service with TTSI
- Baseline diesel trucks with similar loads and routes for comparison analysis

Summary (2)

Technical Accomplishments

- Mostly completed system design and optimization
  - TransPower expects to improve operating efficiency and reduce assembly costs by approximately 25%
- Developed a data collection plan for BEVs
- First demonstration truck, EDD-1, completed in 4/14
- TransPower to complete EDD-2 by 5/14

Future Work

- Chassis dynamometer testing to start in 6/14
- Begin drayage service demonstration in 7/14
- Complete vehicle integrations by Q2 FY15