

# Demonstration of Zero-Emission Technologies for Freight Operations at Ports: Fuel Cell Hybrid Electric Top Loader

The project team, led by Center for Transportation and the Environment (CTE), is building and will demonstrate an electric top loader with fuel cell range extension and wireless charging capability. The objective of this project is to promote future commercialization that will significantly transform the industry while achieving greenhouse gas, criteria pollutant, and toxic emission reduction. The demonstration will generate performance data that will be analyzed to determine the project's effectiveness in meeting its objectives.



The electric top loader is being built and integrated by Hyster-Yale Group; two 45-kW fuel cell engines are being built by Nuvera Fuel Cells, LLC; 250-kW wireless charging equipment is being built by Wireless Advanced Vehicle Electrification (WAVE); and IGX Group will provide hydrogen fuel via mobile refueler. Fenix Marine Services will demonstrate the electric top loader in regular container handling service at the Port of Los Angeles for 8 months.

**Dates:** 05/03/2018 – Spring 2021  
**Grantee:** CTE  
**Partners:** Hyster-Yale Group, Nuvera Fuel Cells, WAVE, Fenix Marine Services, IGX Group

**Grant Amount:**  
CARB Contribution: \$6,508,543  
Matching Funds: \$2,366,159  
Project Total: \$8,874,702



## Vehicles/Equipment Funded

Under the Demonstration of Zero-Emission Technologies for Freight Operations at Ports grant, CARB will be funding the following equipment:

- One (1) fuel cell hybrid electric top loader developed and built by Hyster-Yale Group.
- Two (2) 45-kW fuel cell engines developed and built by Nuvera Fuel Cells, LLC.
- One (1) 250-kW wireless charging systems developed and built by WAVE.
- One (1) hydrogen mobile refueler furnished by IGX Group.

This equipment will be delivered to and operated at the Port of Los Angeles by Fenix Marine Services for a period of 8 months.

## Lessons Learned

- The ability to accommodate for tire wear when charging wirelessly is an important design factor for large heavy-duty vehicles.
- Installing infrastructure in a port setting requires significant planning, effort, and coordination with local AHJs.
- Robust communication among all stakeholders is important for all phases of design, build, risk mitigation, issue resolution and deployment.

## Status Updates

- Vehicle assembly is complete, and full system validation was completed by end of March 2020.
- Final fuel cell engine assembly and validation is complete and integrated after two successful prototype iterations.
- Wireless charging system build is complete and commissioned before vehicle deployment in Q2 2020.
- Site design and construction is complete, and installation of wireless charging system and H2 mobile refueler was completed in Q2 2020.