

Northeast Demonstration and Deployment of FCR_xNV200



Project ID# MT021

**P.I. and Presenter: Abas Goodarzi, Ph.D., PE.
US Hybrid**

DOE Vehicle Technologies Office Annual Merit Review, June 7, 2017

Timeline

- Project start date: Sept. 2016
- Project end date: Feb. 2022

Budget

- Total project cost: \$6,004,260
 - ✓ DOE share: \$2,849,760
 - ✓ Cost share: \$3,154,500



nationalgrid

Barriers & Targets

- Evaluate market viability
- Promote market acceptance
- Data collection and analysis

Partners

- Argonne National Lab
Leverage existing vehicle powertrain and energy management models
- Nissan North America
OEM Partner
- National Grid
Fleet deployment partner

Project Concept and Teams

- Fuel cell hybrid drivetrain significantly extends zero-emission driving range vs. battery only
- Project Team: US Hybrid (prime), Nissan, ANL, and National Grid (fleet operator)

Project Scope

- Phase 1: development phase to build & test prototype range-extended delivery van
- Phase 2: two-year demo of multi-unit fleets at host site under “real world” operating environments

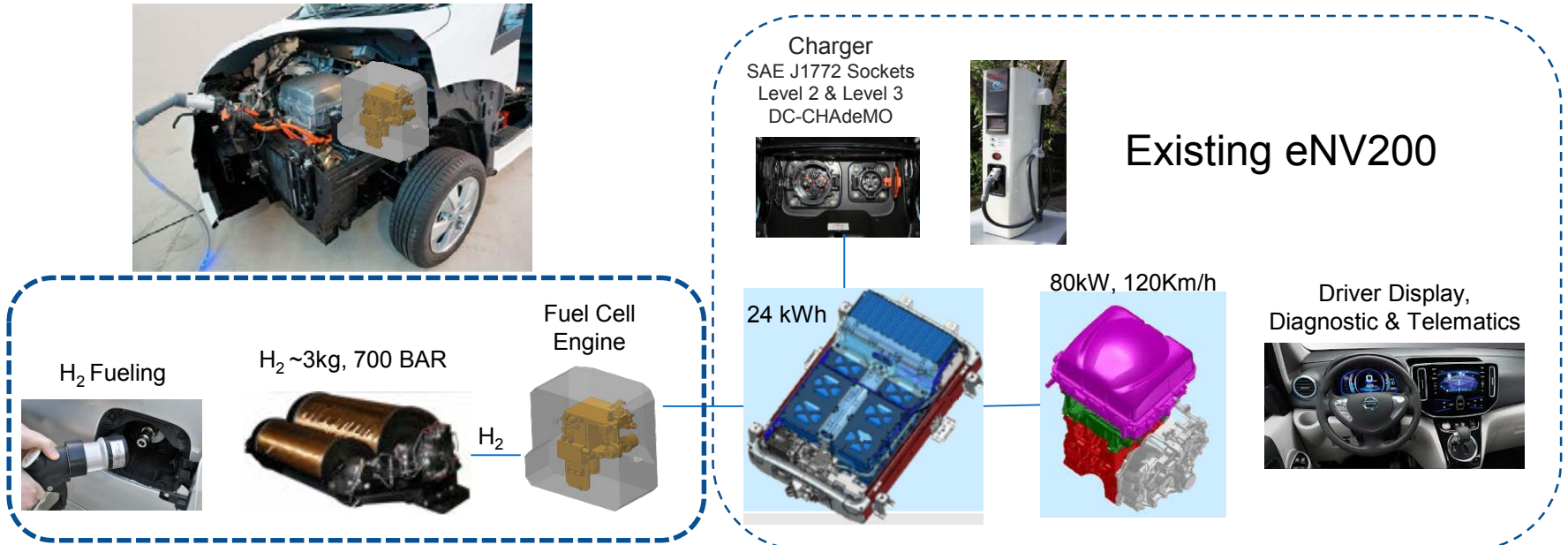
Proposed Technical Specifications:

- Nissan e-NV200 base vehicle platform
- 5 kW fuel cell powerplant
- 2-3 kg H₂ storage @ 700 bar
- 250 miles extended usable range (vs. BEV @ 100 miles)
- 24 kWh lithium-ion battery



1. Design and develop a FC range extender vehicle based on Nissan eNV200 utility van (FCRxNV200)
2. Fabricate a total of 21 utility Van (one-demonstration and 20 deployment)
3. Road operation testing to validate vehicle performance and operate the vehicles during demonstration and deployment
4. Collect and analyze performance and operational data

Fuel Cell Range Extender Tasks



Approach: Phase 1 Milestones

1. Project Management

Contracting and Subcontracting

Administrating & Quarterly Reports

2. Design & Development

Modeling & Optimization

FC & BOP Design

Vehicle Packaging

3. Fabrication & Performance Validation

Component Analysis

Component Procurement

4. Integration, Testing, & Demonstration

Vehicle Integration

Vehicle Testing

Customer Demonstration

Approach: Phase 2 Milestones



Objectives

Design, develop, test, and demonstrate one fuel cell range extended plug-in hybrid utility vehicle (FCRx200) at the operator's site

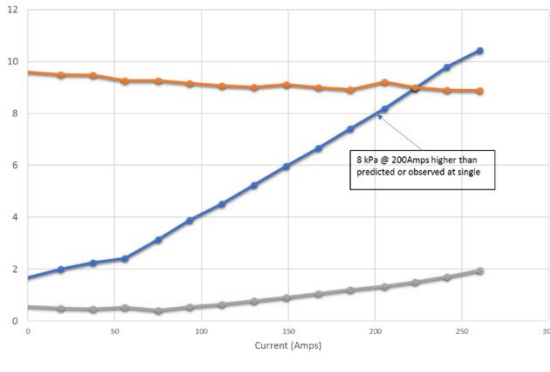
Given a DOE "Go" approval, deploy and operate a minimum of 20 FCRx200s for at least 5,000 hours per vehicle at the operator's site

Conduct an economic assessment, including a payback analysis, cost per unit, and payback time concerning the use of H₂-fueled fuel cells for range extenders used in commercial operations

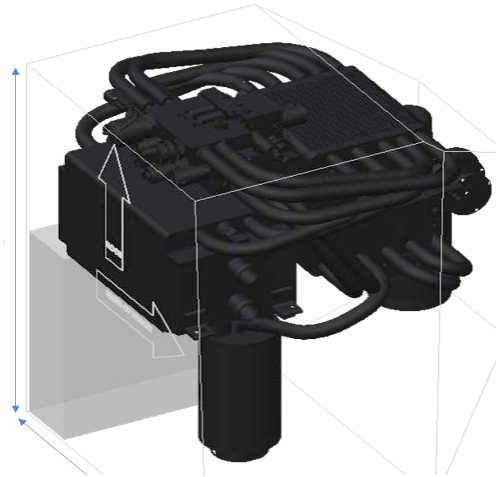
- Developed model for powertrain optimization
- Designed Fuel Cell Stack and BOP
- Finalized concept for CSA prototype & validated testing
- Performed short stack performance testing
- Defined the vehicle packaging boundaries
- Tested the initial scaled Isolated dc-dc converter



FC Stacks at Test Stand



Preliminary Stack Test Results



Power Plant Concept



Thermal Management

Remainder of Q3-Q4 2017

- Complete Fuel Cell power plant design
- Initiate final procurement of all system components
- Develop vehicle model
- Receive vehicle CAD files and CAN data
- Release vehicle system interface (mechanical, Electrical and communications)
- Electronic packaging of the integrated Isolated dc-dc converter
- BOP components design, packaging and testing
- FC Engine controller
- FC engine vehicle packaging
- Hydrogen Storage tanks selection and integration
- Hydrogen fill interface
- Hydrogen sensors and safety system

FY 2018

- Complete design and integration of prototype vehicle
- Validate vehicles performance
- Demonstrate FCRx200 at operator's site

Any proposed future work is subject to change based on funding levels

- First project presentation

- ANL to develop the vehicle model and energy management controls using driving cycle input provided by US Hybrid, Nissan and National Grid and conduct drive cycle testing.
- US Hybrid to develop the vehicle model and control to implement and validate ANL results.
- Nissan North America to provide the supporting vehicle specification, CAD models and CAN messages for energy flow management and data collection and conduct on-road vehicle validation.
- US Hybrid to coordinate the project team and integrate the fuel cell engine and vehicle packaging.
- ANL will provide technical and economic assessments including comparisons of lifetime GHG and fleet ownership costs.

Objective/Relevance

- The project’s goals are to; (1) test and demonstrate one FCRx200 at the operator’s site;
- (2) given a DOE “go” approval, deploy and operate a minimum of 20 FCRx200s for at least 5,000 hours per vehicle at the operator’s site; and
- (3) conduct an economic assessment, including a payback analysis, cost per unit, and payback time concerning the use of H2-fueled fuel cells for range extenders used in commercial operations.

Approach

- Design, Develop a FC range extender vehicle based on Nissan eNV200 utility van.
- fabricate a total of 21 utility Van (one-demonstration and 20 deployment)
- Road operation testing to validate vehicle performance and operate the vehicles during demonstration and deployment.
- Collect and analyze performance and operational data

Technical Accomplishments

- US Hybrid Contract in place and fuel cell stack has been designed, built and tested
- ANL Contract in place
- Nissan North America, Contract executed (Hopefully by June 7)

Future Work

- Develop vehicle model
- Receive vehicle CAD files and CAN data
- Release vehicle system interface (mechanical, Electrical and communications)
- Isolated dc-dc converter, Fuel Cell engine, hydrogen storage and Vehicle packaging