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# Clean Energy Supply Chain and Manufacturing Competitiveness Analysis for Hydrogen and Fuel Cell Technologies

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#### Subcontractors:

- Connecticut Center for Advanced Technology, East Hartford, Connecticut
- DJW Technology, Inc., Dublin, Ohio
- National Renewable Energy Laboratory, Golden, Colorado
- National Fuel Cell Research Center, Irvine, California

Project Start Date: September 1, 2015  
Project End Date: March 31, 2019

## Overall Objectives

- Objective 1. Establish regional Technical Exchange Centers to increase communication between original equipment manufacturers (OEMs) and hydrogen and fuel cell component and subsystem suppliers.
- Objective 2. Establish a readily web-accessible database containing inputs from suppliers and OEMs along with supplier contact lists.
- Objective 3. Standardize component and subsystem component specifications.
- Objective 4. Develop strategies for lowering cost, increasing performance, and improving durability of components and subsystem components.

## Fiscal Year (FY) 2018 Objectives

- Continue operation of the four regional Technical Exchange Centers and host

supplier/OEM/informational events in the various regions.

- Plan the 2018 Ohio Fuel Cell Symposium, scheduled for October 2–3, 2018, at Stark State College in North Canton, Ohio. A supply chain exchange and networking event will be held during the symposium.
- Finalize working groups, which will assist with the projections of cost reduction and initiation of component fabrication based on standardization of specifications, and determine components to be standardized. The objective is to identify components common to multiple designs of fuel cell systems that can be manufactured in high volume by Tier 1 and Tier 2 suppliers.
- Continue evaluation of organizations/companies for potential event participation and database inclusion.
- Conduct a National Supply Chain Exchange at the Fuel Cell Seminar and Energy Exposition in November 2017.

## Technical Barriers

This project addresses the following technical barriers from the Fuel Cells section of the Fuel Cell Technologies Office Multi-Year Research, Development, and Demonstration Plan<sup>1</sup>:

- Durability
- Cost
- Performance.

This project also addresses the following technical barrier from the Manufacturing R&D section of the Fuel Cell Technologies Office Multi-Year Research, Development, and Demonstration Plan:

- Lack of Standardized Balance-of-Plant Components.

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<sup>1</sup> <https://www.energy.gov/eere/fuelcells/downloads/fuel-cell-technologies-office-multi-year-research-development-and-22>

## **FY 2018 Accomplishments**

- Held the Colorado CleanTech Manufacturing Forum and Rocky Mountain regional supply chain event with almost 90 participants; also hosted a successful ride and drive and made quality connections.
- Held the Northeast Hydrogen Highway Summit with partner Proton OnSite at their facilities in Wallingford, Connecticut. There was an unveiling and ribbon cutting of the first retail hydrogen refueling station on the East Coast and a panel discussion and meeting to explore how to lay the foundation for building the Northeast Hydrogen Highway.
- Planned and executed a National Supply Chain Exchange at the Fuel Cell Seminar and Energy Exposition in Long Beach, California.
- Coordinated arrangements for finalizing the agenda and events surrounding the 2018 Ohio Fuel Cell Symposium, to be held October 2–3, 2018, at Stark State College in North Canton, Ohio; speakers include industry leaders from DOE, LG Fuel Cell Systems, Plug Power, FuelCell Energy, and the National Fuel Cell Research Center, and the OFCC will host a supply chain exchange during the symposium.
- Completed a supply chain brochure detailing this project and listing OEM needs; the brochure will be given to suppliers to better match their capabilities with the OEMs needs.
- Completed identification and initial mapping of the supply chain for hydrogen fueling stations.
- Made progress in establishing OEM working groups and efforts toward component standardization.
- Continued meeting and discussions to broaden the Midwest Technical Exchange Center for supply chain and manufacturing, including possible relationships in the Michigan and Pennsylvania areas.

## INTRODUCTION

The project goal is to facilitate the development of a robust supply chain for fuel cell and hydrogen systems that will benefit manufacturing and the supply chain with accelerated mass production, cost reduction, and improved performance and durability of these systems. The project will identify and address the critical gaps in the needs and capabilities of the fuel cell supply chain. This will contribute to the United States maintaining a competitive advantage and global leadership in the industry.

This project builds on existing manufacturing infrastructure to help reverse the decline in and/or create new manufacturing jobs, and it acts as an economic lever for additional technology development. The benefits that will be gained from addressing the manufacturing barriers (cost, performance, and mass production) and product standardization will facilitate commercialization of hydrogen and fuel cell technologies and promote energy efficiency and renewable energy.

## APPROACH

Our Technical Exchange Centers continued to research and catalog company and product information for our regional and national database. We have begun marketing our supply chain assistance and resources more formally than just word-of-mouth. We are having companies and organizations reach out to us with their needs. We promote the communication between suppliers and OEMs through a number of avenues—industry events, one-on-one interactions, and addressing the needs and capabilities of the fuel cell supply chain.

While a longer process than anticipated, we have identified and reached out to acquire participants for our OEM and supplier working groups and to obtain their recommendation for components and subsystems to be standardized. Emphasis remains on North American companies related to automotive, stationary power, and motive applications with respect to polymer electrolyte membrane fuel cells. We developed a questionnaire with 55 component and materials for OEM evaluation, of which 28 were identified. We will use the OEM recommendations to contact companies with manufacturing capabilities that meet the top three OEM recommendations.

## RESULTS

The four regional Technical Exchange Centers continue to be the catalyst for this project. One of the main components of this project is to increase communication between fuel cell OEMs and fuel cell component/subsystem suppliers. We held a number of events, from Connecticut to Colorado, reaching a broad and varied audience of more than 250 participants from across the country.

All four regional Technical Exchange Centers worked together to execute a National Supply Chain Exchange at the Fuel Cell Seminar and Energy Exposition. We had 22 suppliers and six integrators that included industry leaders Ballard, FuelCell Energy, and Doosan as integrators as well as Johnson Matthey and Saint Gobain, among others, as suppliers. Our post-event survey indicated 75% made new contacts they otherwise would not have and 64% are continuing dialogue for potential relationships.

Concerning our working group/standardization efforts:

- A number of OEMs were contacted, including several major automakers, to identify balance-of-plant components for standardization. Those contacted have responded and completed the component questionnaire with their recommendations for which components to standardize.
- Components have been ranked based on information obtained from the integrators. We hope to have one-on-one interactions to discuss what components and to what level of standardization we should work toward. After discussion held with several OEMs, about six of the 19 components originally on the list to be considered for standardization have been eliminated.

- The two highest-ranked components to standardize are humidifiers and AC/DC converters, a unanimous choice by the participants. We want to be sure of the components so we do not dilute our efforts over multiple choices.

Relative to the database, the Northeast Technical Exchange Center continues to build theirs with the addition of specialization in hydrogen refueling, a demo, and searchable map database. They are wrapping up work with the Hydrogen Safety Panel, have written white papers for fuel cell electric vehicles and light-duty vehicles and buses, and are working on a third white paper for refueling.

The work detailed above is a necessary stepping stone to help the United States and our fuel cell industry to be a competitive and global leader in the fuel cell market. The formation of resources, such as the regional and national databases, and communication between fuel cell component and subsystem suppliers, both individually and within working groups, is a must to achieve the goal to develop a robust supply chain, standardize and improve functionality and performance, and maintain competitive pricing.

## CONCLUSIONS AND UPCOMING ACTIVITIES

It is more than clear that our networking and contacts are a driving force for progress in the fuel cell industry. We have seen a number of partnerships develop, such as the Honda and General Motors announcement to jointly produce fuel cells for both their companies, that benefit not only the automakers but the industry as a whole. While there are still a number of gaps between OEM needs and supplier capabilities, this project has helped make the introductions and, in some cases, build the relationships that will eventually help to bridge these gaps.

The next budget year will also determine if we are able to continue to support our Technical Exchange Centers through other avenues once this project is completed. For example, the Colorado Hydrogen Coalition is developing a plan to continue the project and house the Rocky Mountain Region Technical Exchange Center going forward using industry funding and stakeholder sponsorships, and the Colorado Advanced Manufacturing Alliance has submitted a proposal to provide support through business-to-business networking sessions in conjunction with established manufacturing events in the region.

While we planned most of the 2018 Ohio Fuel Cell Symposium during FY 2018, it will actually be held in FY 2019, and we are very excited to hear the messages that will be presented by our speakers—industry leaders Plug Power, FuelCell Energy, the National Fuel Cell Research Center, and LG Fuel Cell Systems. We will also be hosting a Supply Chain Exchange Event where these organizations will also participate.

While the working group and standardization components of this project have moved slower than anticipated, we are now in a position to move forward toward our final goals of standardizing component specifications to improve cost efficiency and improve durability and performance of the fuel cell components and subsystems.

## FY 2018 PUBLICATIONS/PRESENTATIONS

1. Participated in the Annual Merit Review, June 13–15, 2018, in Washington DC. The OFCC had a poster presentation and we took part in a panel discussion.
2. U.S. Department of Energy, Ohio Fuel Cell Coalition, *Hydrogen and Fuel Cells Regional Technical Exchange Centers Brochure* (2017), <https://www.fuelcellcorridor.com/doe-ofcc-tec-brochure>.