THE FUEL CELL CORRIDOR™

Global Center of the Fuel Cell Industry

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

US DOE Office of EERE

Fuel Cell Technologies Office

AMR, Washington, D.C., June 8, 2016

Project ID: MN012

Principal Investigator: Pat Valente, OFCC

pat.valente@fuelcellcorridor.com

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OVERVIEW

TIMELINE

- Start Date: Sept. 2015
- End Date: Aug. 2018

BUDGET

- Start Date: Sept. 2015
- End Date: Aug. 2018
- Total Federal Budget $583,243
- FY16 Planned DOE funding: $203,533
- Funds spent $28,089 as of 3/31/16

BARRIERS

- Lack of standardization of components to lower costs
- Lack of national accessible database
- Lack of communication nationally between OEMs and suppliers

PARTNERS/COLLABORATORS

- Pat Valente, Ohio Fuel Cell Coalition (OFCC)
- Douglas Wheeler, DJW Technology (DJWT)
- Michael Ulsh, National Renewable Energy Lab (NREL)
- Jack Brouwer, National Fuel Cell Research Center (NFCRC) at UC Irvine
- Joel Reinbold, Connecticut Center for Advanced Technology (CCAT)

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Relevance

Objective 1. Establish regional Technical Exchange Centers to increase communication between 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 a supplier contact list.

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.

Relevance - Department of Energy Impact

Project inception Sept. 2015 through April 2016

- **National Technical Exchange Network for Supply Chain**
  - Work has commenced to create four Regional Technical Exchange Centers nationally, and a network to provide a database of supplier capabilities that can accelerate mass production, reduce cost, and improve performance and durability of fuel cell systems.
  - National web-centered database of fuel cell component suppliers and subsystem component suppliers available to OEMs.

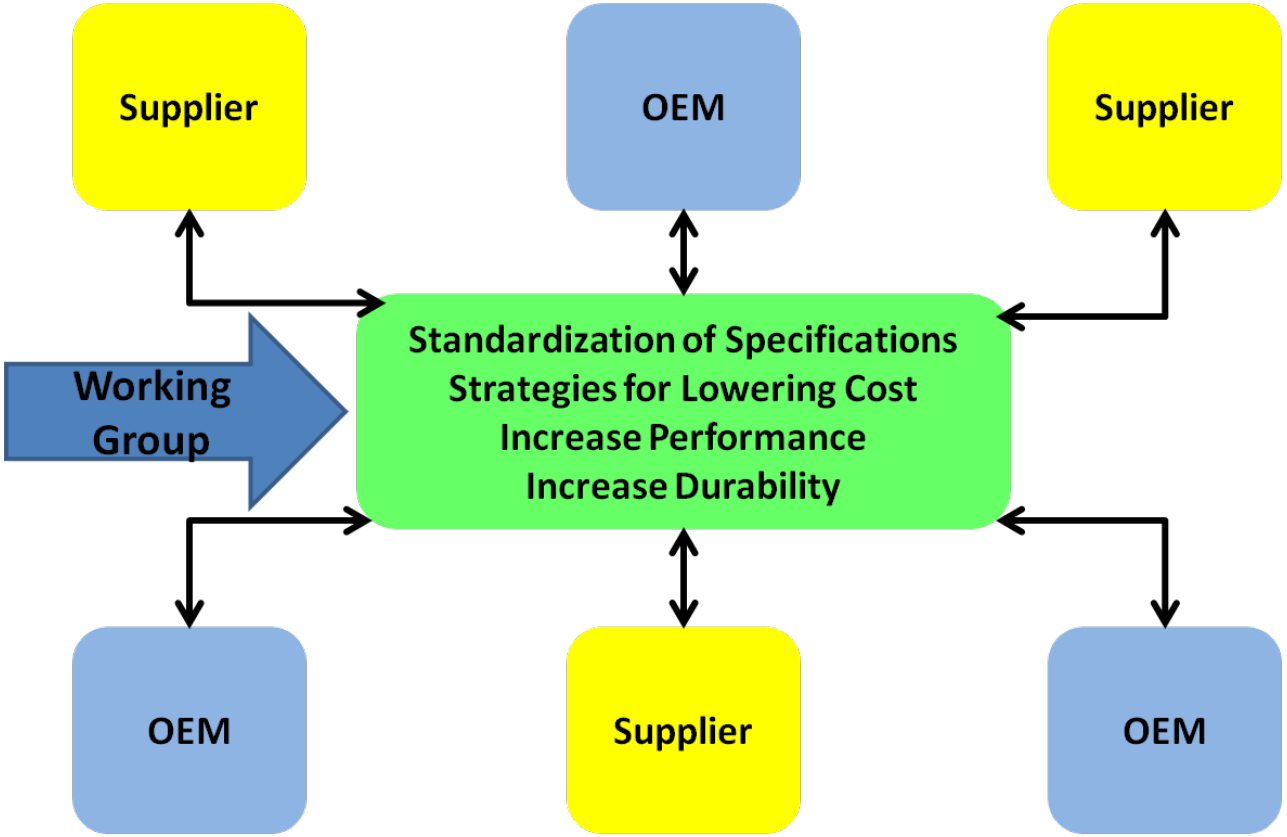
Relevance - Department of Energy Impact

- **Working Groups to Standardize Components**
  - Establishment of working groups comprised of hydrogen and fuel cell manufacturers (OEMs) and stack component manufacturers, and Balance-of-Plant (BoP) suppliers to assist suppliers and OEMs in the application of Design for Manufacturing and Assembly (DFMA®) for the development of standardization, and with the objective of driving down component cost.

- **Barriers Relevance**
  - The Regional Technical Exchange Centers and working groups address the barriers of lack of an accessible, national database, communication between OEMs and BOPs, and the lack of component standardization.

Working Groups – National Level

- Analyze needs of OEMs
  - Multiple suppliers
- Standardization of component specifications
- Mitigate the gap
  - OEM needs and supplier components



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Approach - Milestones

M1 – 1st qtr/Yr 1: Start-up of Technical Exchange Centers; database compatibility assessment *

M2 – 2nd qtr/Yr 1: OFCC produces brochure to attract new suppliers *

M3 – 4th qtr/Yr 1: Working group identifies pathways to standardization of components and subsystems *

M4 – 2nd qtr/Yr 2: Working relationship progress report – Suppliers and OEMS; data transfer to JMU

M5 – 4th qtr/Yr 2: Hold National Supply Chain Exchange

M6 – 4th qtr/Yr 2: Report on supply chain gaps and reduction in costs

M7 – 4th qtr/Yr 3: Summary report on Supply Chain Exchange data

M8 – 4th qtr/Yr 3: Report standardization and production process changes for initial standardized product.

*In Progress

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Approach - Deliverables

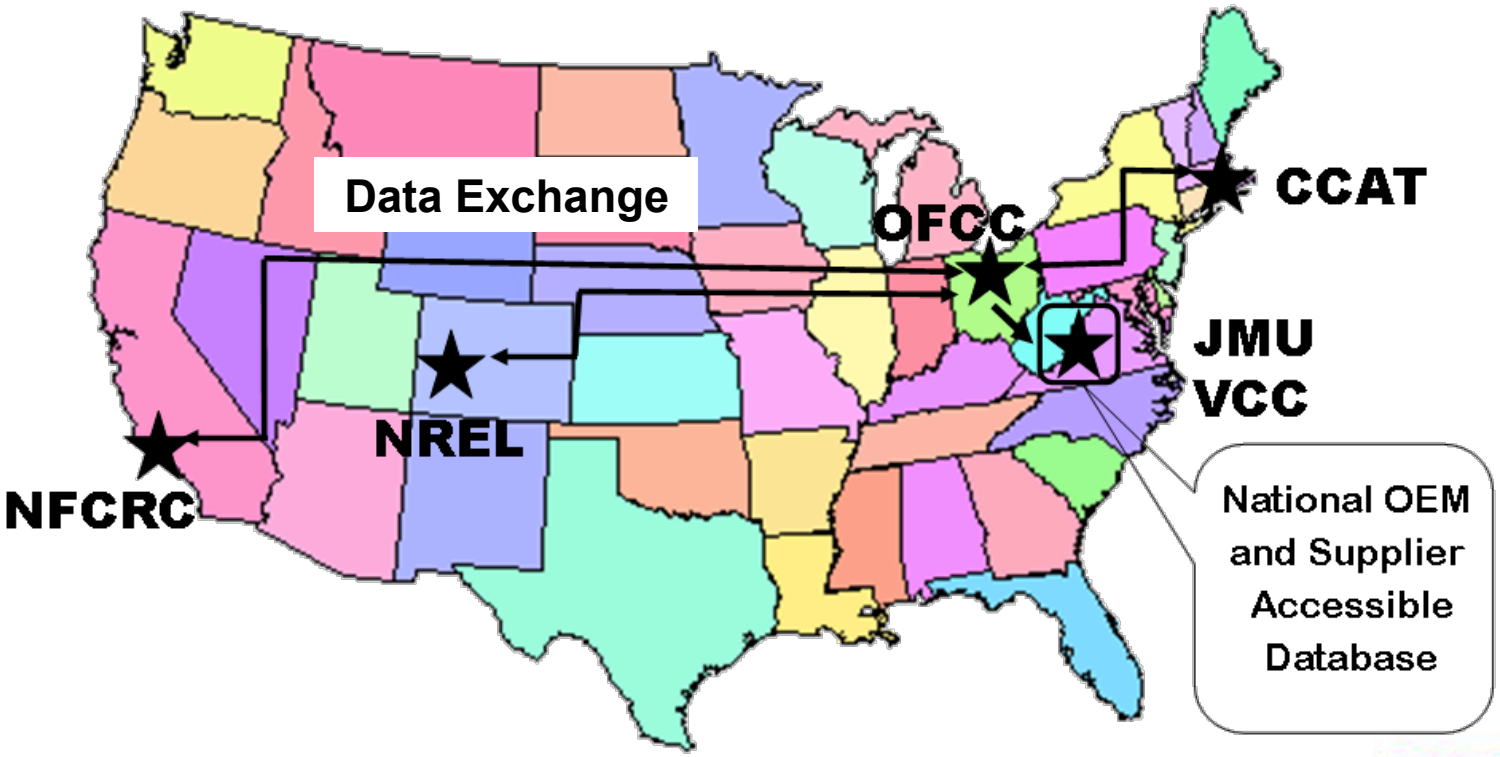
- **D 1 (Task 1.2)**
  Create OEM Needs brochure for DOE review (in progress)
- **D 2 (Task 4.2)**
  A report will be issued identifying supply chain gaps and strategies to overcome these gaps and reduce supply chain cost.
- **D3 (Task 6.1)**
  A report reviewing standardization and production process changes for initial standardized product.
- **D 4 (Task 7)**
  Final Report summarizing details of three-year project.

Approach – Technical Scope
In-Progress

- Collaboration of Supply Chain Exchange experience and best practices
- Identification of supply chain manufacturers and OEMs
- Established Technical Exchange Center regions
- Accessed database compatibility with James Madison University/Virginia Clean Cities
- Interviews of OEMS to identify immediate needs from supply chain for inclusion in needs-based brochure to distribute to suppliers
- Determination of participants and initiation of Working Groups

Accomplishments and Progress

Creation of 4 Regional Technical Exchange Centers to transition to National Website Database



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Accomplishments and Progress

- **October 22, 2015 – Springfield, Massachusetts**
  Supply Chain Exchange and Partnership Development Forum
  - Collaborator – Connecticut Center for Advanced Technology (CCAT) in conjunction with Business of Energy Storage Conference
  - Attendance: 127 including 20 OEMs, 48 Suppliers, 7 Utilities/Integrators
  - Connections: 170 meetings between OEMs, suppliers, and business partners
  - Reach: Most from CT, MA, NY (200 miles/3 hours); Representatives from CO, OH, CA, WI, and NJ.
  - This event is relevant to current DOE Manufacturing R & D activities for supply chain development. The increased communication between OEM's and integrators will yield information in needs assessment, specification analysis, and standardization (DOE Task 4), as well as information related to the nationwide Fuel Cell and Hydrogen Opportunity Center database.

Accomplishments and Progress

Events in-progress align with project objectives for Task 1, Milestone 1, Creation of Regional Technical Exchange Centers.

- **May 5, 2016 – Long Beach, California**
  Supply Chain Exchange and Partnership Development Workshop
  - Collaborator – National Fuel Cell Research Center (NFCRC) in conjunction with the Advanced Clean Energy Expo
- **September/October 2016 – North Canton, Ohio**
  Supply Chain Exchange and Partnership Development Regional Forum
  - Collaborator – Ohio Fuel Cell Coalition (OFCC) in conjunction with Stark Area Regional Transit Authority, Stark State College, and LG Fuel Cell Systems

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Component Grids

Hydrogen FC Components / Company				
Products	Check (x) Appropriate Boxes			
Systems				
Complete Systems				
Stacks				
Humidifier(s)				
Selective (Polymer) Membrane Separation (gas cleanup)				
Gas Diffusion Layers				
Micro Porous Layer				
Bipolar Plates				
Carbon/graphite				
Metalic				
Manifolds				
End Plates				
Compressive load (Belleville washers)				
IGBT (inverter components)				
DC-AC Inverter				
DC-DC converter				
DC bus controller				
Electronics				
Controllers				
Automation of system integration				
Switches				
Analytical instruments				
Electric switchgear for interconnection with grid				
Breakers				
Surge and short circuit protection				
Synchronize with grid waveform				
"Lock-out" switches				

Solid Oxide FC Components			
Products	Check (x) Appropr		
Systems			
Complete Systems			
Stacks			
IGBT (inverter components)			
DC-AC Inverter			
DC-DC converter			
DC bus controller			
Electronics			
Controllers			
Automation of system integration			
Switches			
Analytical instruments			
Electric switchgear for interconnection with grid			
Breakers			
Surge and short circuit protection			
Synchronize with grid waveform			
"Lock-out" switches			
HT Pressurization Machinery			
Natural gas			
Air			
HT/HP Containment Vessels			
Low Chrome			
Si Treating			
Insulators - High temp insulators			

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Responses to Previous Year Reviewers' Comments

Project Presented but not Reviewed in 2015

Collaborators

Collaborators	Relevance of Collaborators
Patrick Valente, Ohio Fuel Cell Coalition Prime	Responsible for all programmatic and technical decisions for the project.
Joel Reinbold, Connecticut Center for Advanced Technology (CCAT); subcontractor	Establish and coordinate the East Coast Technical Exchange Center; assist with supply chain mapping and standardization.
Douglas Wheeler, DJW Technology (DJWT); subcontractor	Establish and coordinate the West Coast Technical Exchange Center at NFCRC; set –up working group; consulting.
Jack Brouwer, National Fuel Cell Research Center (NFCRC) at UC Irvine; subcontractor	Establish and coordinate the West Coast Technical Exchange Center.
Michael Ulsh, National Renewable Energy Lab (NREL – Federal Lab); subcontractor	Technical support and establish and coordinate Central Plain States Technical Exchange Center; establish working groups.

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Barriers and Issues

- Lack of national accessible database
- Lack of communication nationally between OEMs and suppliers
- Formation of a robust supply chain serving OEMs in the hydrogen and fuel cell systems industry
- Standardizing the parts and components with the establishment of multiple suppliers
- Lower cost of materials and components through standardization of components
- Increasing the reliability of the materials and components for these systems.

Current and Proposed Future Work

Task 1: Creation of Technical Exchange Centers (Month 1 – Month 12)

Task 2: Formation of Supplier Working Groups to Standardize Components (Month 3 – Month 12)

Task 3: Operation of Regional Technical Exchange Centers (Month 13 – Month 24)

Task 4: Supplier Working Group Standardization (Month 13 to Month 24)

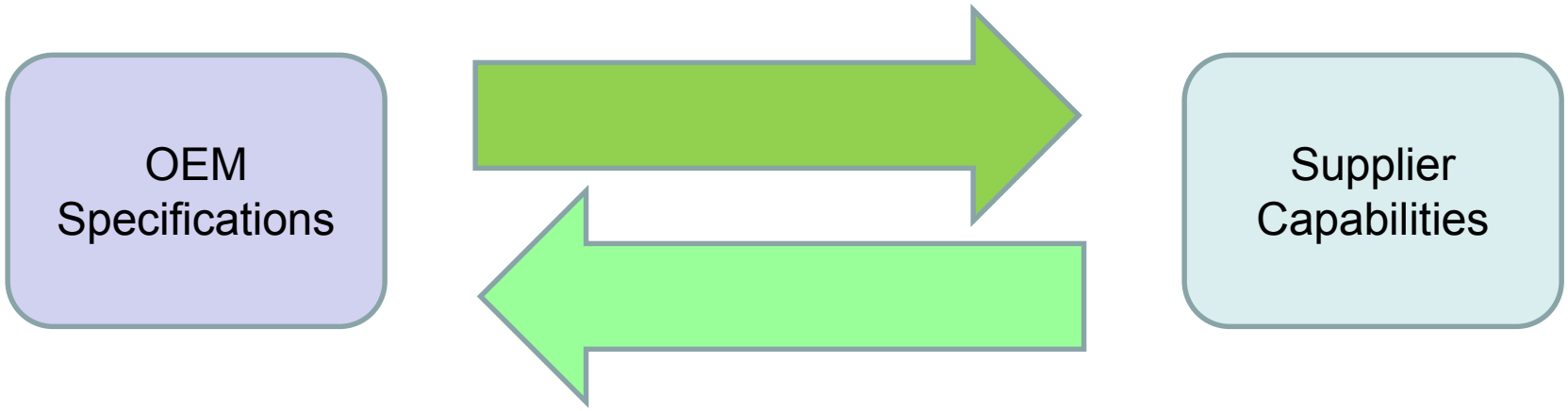
Task 5: Completion of Operation of Technical Exchange Centers (Month 25 to Month 36)

Task 6: Completion of Working Group Standardization (Month 25 – Month 36)

Task 7: Management and Reporting (Month 1 to Month 36)

Technology Transfer Activities

- Project focus is two way technology transfer between OEMs and Suppliers



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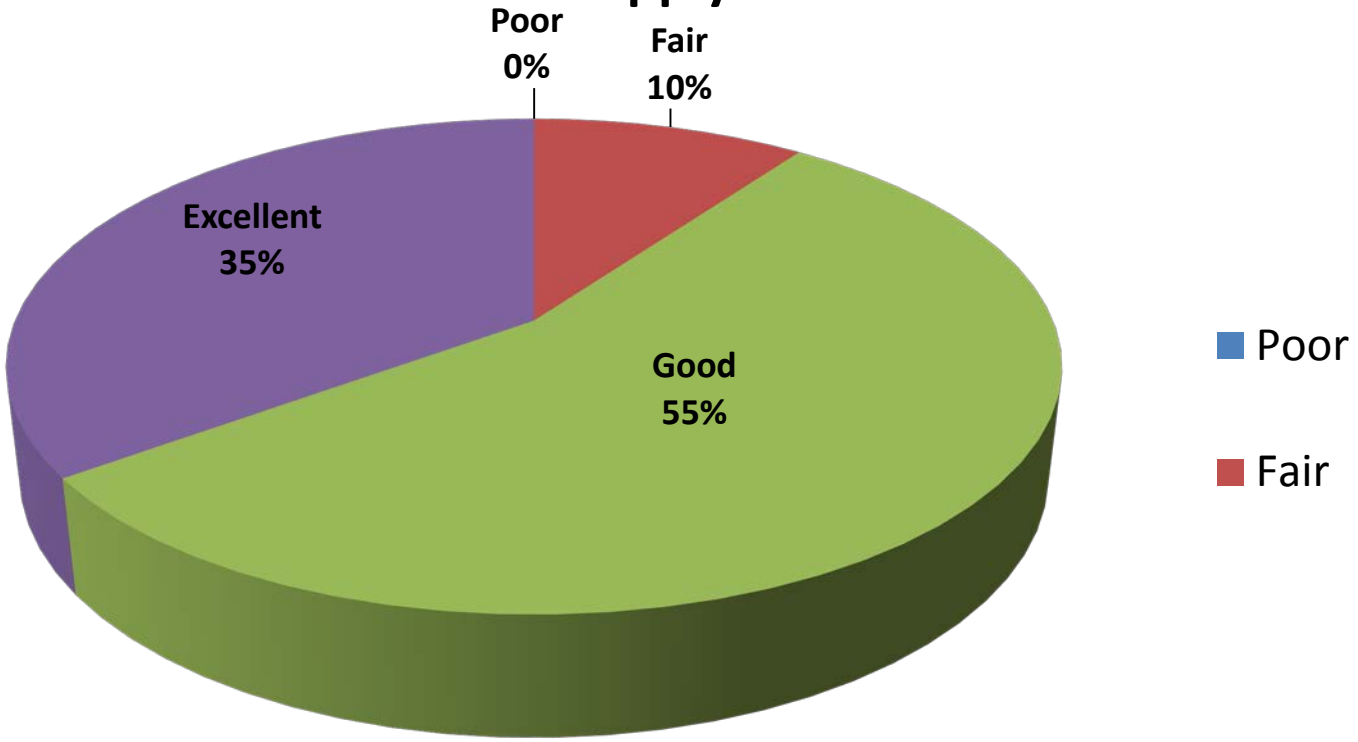
Summary Slide

The Integrated Regional Technical Exchange Centers project is to facilitate the development of a robust supply chain for fuel cell and hydrogen systems that will accelerate mass production, reduce costs, and improve performance and durability of these systems by:

- Establishing regional Technical Exchange Centers and conducting nationwide supply chain exchanges to increase communications between OEMs and suppliers.
- Establishing a web-accessible database, first regionally, then nationally, containing inputs from suppliers and OEMs with a supplier contact list.
- Standardizing component and subsystem specifications.
- Identifying critical opportunities in the hydrogen and fuel cell supply chain where the U.S. can achieve or maintain a competitive advantage.

Usefulness of the information presented at the October 2012 supply chain event:



Data collected from 21 forms