



# Fuel Cell & Hydrogen Energy Association Codes and Standards Support

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(FCHEA)

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Project ID #SCS022

This presentation does not contain any proprietary, confidential, or otherwise restricted information

# Overview

## Timeline

- Project start date: 11/2011
- Project end date: 06/2017\*

\* Project continuation determined annually by DOE

## Budget

- FY16 DOE Funding: \$200K
- Planned FY17 DOE Funding: \$136K through June 2017
- Total DOE Project Value\*: \$1.2M

\* Previous subcontract thru NREL

\*\*Any proposed future work is subject to change based on funding levels.”

## Barriers

- F. Enabling National and International Markets Requires Consistent RCS
- H. Insufficient Synchronization of National Codes and Standards
- J Limited Participation of Business in the Code Development Process

## Partners

- Interactions/ collaborations: FCHEA Members; CDOs & SDOs through NHFCCSCC and direct participation
- Project Lead -ORNL- Prime Contract

# Relevance

- FCHEA represents the leading companies and organizations that are advancing innovative, clean, safe, and reliable energy technologies.
- As the U.S. national trade association for the fuel cell and hydrogen energy industry, FCHEA utilizes a **Working Group structure** to facilitate focused effort in each of the three following applications: **Portable Power**, **Stationary Power**, and **Transportation**, which includes vehicles and the infrastructure to support them.
- FCHEA project contributes directly to achievement of **four of the seven objectives** outlined in the Fuel Cell Technologies Office Multi-Year Research, Development and Demonstration Plan, Chapter 3.7, Hydrogen Safety, Codes, and Standards.

# Relevance - Objectives

- Support and facilitate development and promulgation of essential codes and standards to enable widespread deployment and market entry of hydrogen and fuel cell technologies and completion of all essential domestic and international RCS by 2020.
- FCHEA participates directly in key domestic and international RCS technical committees; and encourages members to participate directly in appropriate technical committees, working groups or discussions. Member companies can therefore participate directly or indirectly as appropriate.
  - ISO/TC 197 (Hydrogen Technologies)
  - IEC/TC 105 (Fuel Cell Technologies)
  - CSA Fuel Cell Standards Committee (HGV, HPIT)
  - SAE Fuel Cell Vehicle Safety Committee (automotive)
  - NFPA 2: Hydrogen Technologies Code
  - Others as needs arise

# Relevance to DOE Objectives

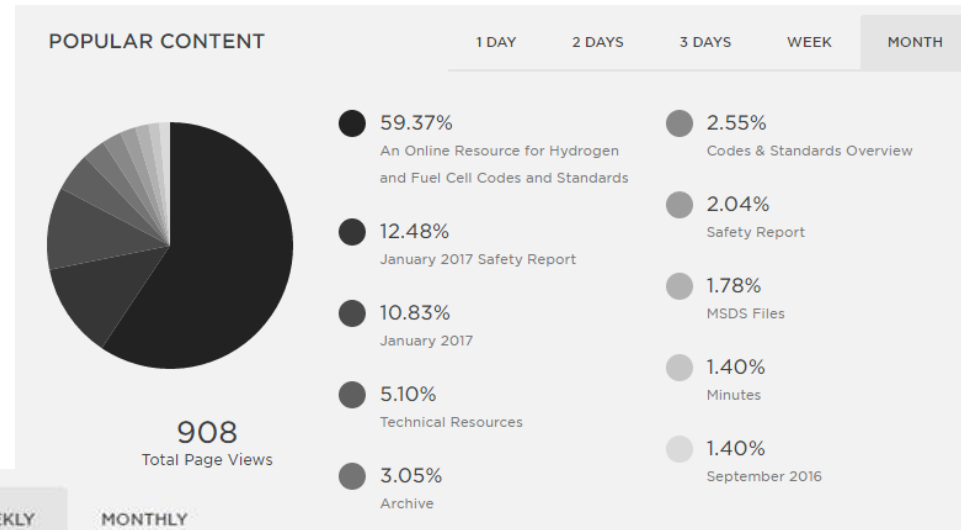
- Ensure that best safety practices underlie research, technology development, and market deployment activities supported through DOE-funded projects.
  - FCHEA supports **information-sharing** of pre-competitive safety information
    - Open discussions during FCHEA Working Group and Task Force meetings between codes and standards development organizations, researchers, government and industry. **Aids harmonization** of requirements and enhances collaboration. Provides **mechanisms for industry to contribute** to the development of requirements. Members are encouraged to participate directly – but when this is not practical, they may contribute through FCHEA comments and voting.
    - Identify and schedule Topical Discussions during monthly meetings of the National Hydrogen and Fuel Cell Codes & Standards Coordinating Committee (NHFCCSCC) which FCHEA administers. Enables **industry priorities** to be discussed and synergistic activities to be coordinated. Topics are then discussed within the appropriate FCHEA WGs to **broaden awareness and participation** in development of activities to address identified topics.
    - Posting and/or linking data, workshop proceedings, and other informational resources online at [www.hydrogenandfuelcellsafety.info](http://www.hydrogenandfuelcellsafety.info). This facilitates **access to available resources** as well as a providing a mechanism for reaching out to others working on similar activities.

# Relevance to DOE Objectives – Cont'd

- Conduct R&D to provide critical data and information needed to define requirements in developing codes and standards.
  - FCHEA conducts forums to identify R&D needs, and engages in dialog with DOE; providing a mechanism for input and feedback into DOE R&D plans and activities.
    - FCHEA Working Groups set industry priorities and engage in related activities with outside organizations. (Examples: TIA, component manufacturers, USACA)
    - Direct participation in National CDO/SDO Technical Committees
      - Examples include SAE, CSA standards development, model code development, engagement with hydrogen equipment suppliers
    - Direct participation in US TAG for ISO/TC 197 and IEC/TC 105 with opportunities for FCHEA members to review and comment on developing draft documents.
    - Facilitation and documentation of monthly NHFCCSCC meetings
    - Monthly summary reports
    - Strategic meetings of FCHEA Board of Directors and Executive Committee
      - DOE is invited to engage with industry in discussions of accomplishments and challenges.

# Relevance to DOE Objectives – Cont'd

- Develop and enable widespread sharing of safety-related information resources and lessons learned with first responders, authorities having jurisdiction (AHJs), and other key stakeholders.



# Relevance - Impact

Barrier	Issue	Impact
Enabling National and International Markets Requires Consistent RCS (Barrier F)	Lack of consistency limits international trade and markets.	This is a key issue identified by industry, and is the reason that we work to ensure developing standards are technically consistent with published standards.
Insufficient Synchronization of National Codes and Standards (Barrier H)	The codes and standards development and revision cycles established by SDOs vary and are difficult to coordinate or synchronize even under a consensus national agenda.	Development and revision cycles vary and are difficult to coordinate. <ul style="list-style-type: none"> <li>FCHEA matrix provides a single resource on activities.</li> <li>FCHEA facilitates the monthly meetings of the NHFCCSCC.</li> <li>FCHEA staff participates directly in key technical committees to provide consistency.</li> </ul>
Limited Participation of Business in Code Development Process (Barrier J)	Businesses, particularly small businesses, do not always have the resources to participate fully in the codes and standards development process.	<ul style="list-style-type: none"> <li>Participation in FCHEA RCS Working Groups allows access.</li> <li>The Hydrogen and Fuel Cell Safety Report and the Matrix provide quick overview information.</li> </ul>



# Sample Page from Matrix

Significance to Commercialization  
More Critical  
*Highest Effort*

← Significance

A. Essential To or Enables Commercialization	B. Important to Commercialization	C. Supports Commercialization	
<p><b>IEC 62282-4-102: Fuel cell systems for forklift applications— Performance requirements and test procedures: Approved for FDIS circulation.</b></p>			VEHICLES
<p><b>ISO 19880-1 Gaseous Hydrogen Filling Stations.</b> TS published in June. Development of IS continues. Glenn Scheffler has been appointed as co-convenor.</p> <p><b>CSA Group HPIT 2: Compressed Hydrogen Station and Components for Fueling Industrial Trucks:</b> <del>In publication.</del> Published – to be removed in next update of matrix.</p> <p><b>Hydrogen Dispenser Metrology:</b> <a href="#">The July 2016 National Conference on Weights and Measures (NCWM) Meeting agreed to (1) recognize that a Category 3 device may make the required information from the event logger available electronically and (2) expanding the current hydrogen code acceptance tolerance of 1.5 % to 5.0 % and the current maintenance tolerance of 2.0 % to 7.0 %.</a> The code will have only one accuracy class designated as <a href="#">Accuracy Class 7.0 in NIST Handbook 44 Section 3.39 Hydrogen Gas-Measuring Devices-Tentative Code.</a> <del>The National Conference on Weights and Measures (NCWM) approved hydrogen gas measuring devices and 5% increase in specification clause, with no sunset clause. Enables dispenser designers to apply for certificates.</del></p>	<p><b>ISO 19880-2: Gaseous hydrogen filling station dispensers</b> DIS is scheduled for early 2017.</p> <p><b>HGV 4.3 Fueling Parameters</b> Work on the next edition will commence in the first quarter of 2017 to align with SAE J2601.</p> <p><b>ISO 17268 Gaseous Hydrogen Land Vehicle Refuelling Connection Devices</b> is developing a revised standard. The DIS is anticipated <del>in a few weeks</del> <b>shortly</b>, pending resolution of pressure definitions and relevant requirements.</p>	<p><b>ISO/CD 19880-3 Gaseous hydrogen -- Fueling stations -- Valves</b> Covers the safety performance of valves over 1MPa for gaseous hydrogen fueling stations. Revised CD passed; however DIS 2 will be circulated in March 2017.</p> <p><b>CSA HPRD1</b> Work on the next revision of Pressure Relief Devices is pending.</p> <p><b>NFPA 55: Compressed Gases and Cryogenic Fluids Code:</b> Reopened First Draft. Agreed to act on Public Inputs submitted to NFPA 2 on extract text from NFPA 55. Revision cycle has officially been changed from Annual 2018 to Annual 2019, and will remain in-cycle with NFPA 2.</p>	INFRASTRUCTURE

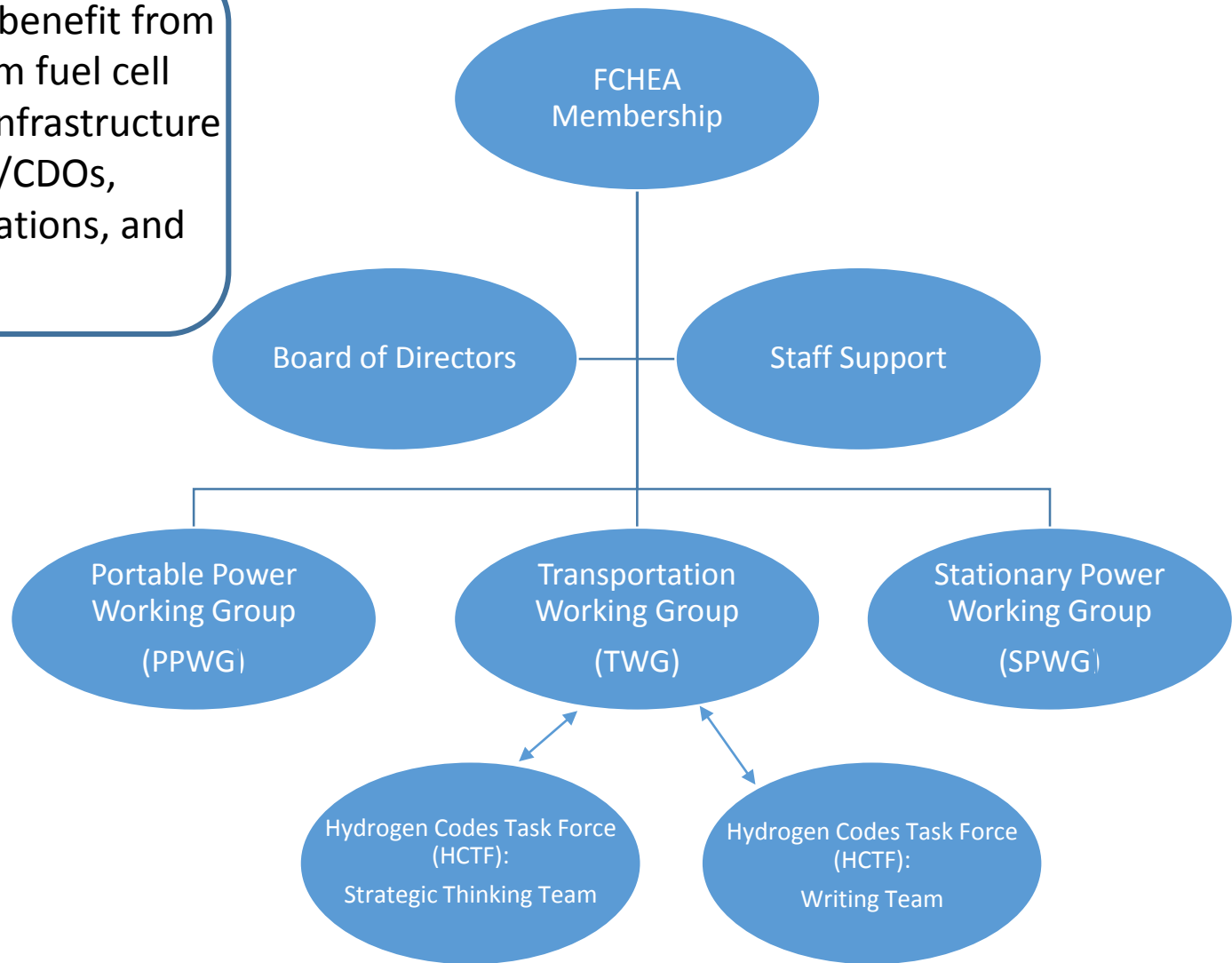
↑ Level of Effort

# Approach: FCHEA WGs

- FCHEA Working Groups provide regular opportunities to engage industry in developing RCS:
  - **Transportation WG**
    - Transportation Infrastructure standards, R&D, deployment.
      - Coordinating with H2USA to address known restrictions for FCEVs and hydrogen infrastructure in state and regional regulations.
    - Hydrogen Codes Task Force
      - Serving on NFPA 2 Technical Committee and task groups in support of 2020 edition of NFPA 2. Working to harmonize with NFPA 55.
  - **Stationary Power WG**
    - Supporting New Jersey Micro-grid activities to encourage fuel cell projects.
    - Tracking RCS relating to Stationary Power.
      - Recent topics include the TIA focus group, new work item proposals and comments on draft revisions to International Standards on stationary fuel cells from IEC/TC 105
  - **Portable Power WG**
    - Update regulatory framework to ship and to allow consumer transport of FCs and FC cartridges to be regulated in parity with similar technologies.
      - Convenor for IEC/TC 105 WG 8

# FCHEA RCS Activities Flow

FCHEA activities benefit from participation from fuel cell manufacturers, infrastructure developers, SDO/CDOs, research organizations, and many others.



# Approach: Coordination and Outreach

## NHFCCSCC (monthly)

- Forum for effective communication and collaboration
- Facilitates the development of the consensus-based C&S
- Identifies critical gaps and makes recommendations to address them.

## Safety Report (bi-monthly)

- Central source of information on RCS
- activities and issues
- Improves coordination of RCS activities and information transfer
- Meetings of the NHFCCSCC
- Summarizes key domestic and international RCS issues
- List key upcoming events and issues



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# Approach to Resolve Technical Challenges

- Challenge: Development and Harmonization of Regulations, Codes and Standards
  - APPROACH: Technology and application-specific forums to identify issues and discuss progress and needs in developing RCS; open dialog between CDOs/SDOs, government and research organizations, industry and users; Direct Participation in RCS-development activities; and information dissemination and outreach to develop consensus requirements to ensure consistency.
- Challenge: Dissemination of Data, Safety Knowledge, and Information
  - APPROACH: FCHEA publishes, maintains, and disseminates key safety information through the *Hydrogen and Fuel Cell Safety Report* website at [www.hydrogenandfuelcellsafety.info](http://www.hydrogenandfuelcellsafety.info); and works with stakeholders to disseminate FCV and infrastructure-deployment activities, internally as well as externally. Recent activity – direct engagement with component manufacturers to contribute to harmonized requirements and identify concerns and challenges.
- Milestones: Monthly summaries, bi-monthly Safety Report
  - Aligned with the Go/No-Go Decisions in DOE's current plans. Provides regular mechanism to identify and address industry priorities.

# Accomplishments and Progress: Portable Power

- Standards and Regulations for micro fuel cells
  - Working to ensure International Standards are inclusive of all fuel types. IEC 62282-6-101 Edition 2, and associated “fuel specific” Part 2 documents. Took on convenorship of international working group.
  - Ensuring that appropriate international standards for shipping of fuel cells and fuel cell cartridges are included in the ICAO Technical for the Safe Transport of Dangerous Goods by Air.
- Significance: Supports Objective from MYRDD - Enabling National and International Markets Requires Consistent RCS by ensuring national and international standards for micro fuel cell applications are harmonized, then adopted by International Regulations.

Take Home Message: Regular dialog in FCHEA WGs and consistent messaging and participation in relevant RCS forums can result in consistent RCS.

# Accomplishments and Progress: Transportation and Stationary

- **Transportation WG:** Infrastructure RCS review. Forum to develop and prioritize industry needs for harmonized requirements for I-Codes as well as 2019/2020 editions of NFPA 2 and NFPA 55 model codes. Examples include repair garages, ventilation, and outdoor defueling.
  - Developed public input. Serve on NFPA 2 Technical Committee. Awaiting report to coordinate industry review and feedback.
  - Significance: Supports Objective from MYRDD – Provides consistent RCS and synchronization of national codes and standards.

Take Home Message: FCHEA WGs and TFs work collaboratively with others to effectively make changes to developing RCS

# Accomplishments and Progress: Transportation and Stationary

- **Stationary Power WG:** Forum for engaging in the development of RCS for stationary applications, as well as contributing to appropriate guidelines for deployment of fuel cells in specific markets (example: TIA).
  - Significance: Supports Objective from MYRDD – Develop and enable widespread sharing of safety-related information resources and lessons learned with first responders, authorities having jurisdiction (AHJs), and other key stakeholders. Provides consistency in requirements and reduces duplication of effort.

Take Home Message: FCHEA works with other stakeholders, even where FCHEA is not leading the activity, to ensure valuable resources are shared.



# Accomplishments and Progress

- Coordination
  - NHFCCSCC – Monthly facilitated discussion of key topics of broad interest, such as “Facilitating Deployment”, and “H2FIRST”. Progress in the development of RCS is reported and captured for the FCHEA Regulatory Matrix, providing an **up-to-date overview of current industry priorities and recent progress in RCS**.
  - Hydrogen & Fuel Cell Safety Report – Published every two months, **keeping readers informed of the progress and issues encountered in the development of RCS**. Has introduced industry to the many new WGs in ISO/TC 197 and the call for participation in US standards committees. Calendar of events aids in scheduling meetings.
- Significance: Contributes to DOE goal to develop and enable widespread sharing of safety-related information resources and lessons learned with first responders, authorities having jurisdiction (AHJs), and other key stakeholders. Increases participation of stakeholders in development of harmonized RCS.

**Take-Home Message: FCHEA is building relationships and working directly with stakeholders to identify and address issues in order to ensure consistency in RCS and facilitate deployment of hydrogen and fuel cell technologies.**

# Responses to Previous Year Reviewers' Comments

- The tracking matrix could be a good approach, but the method of gathering industry input is uncertain, and value to the industry is not clear.
  - Slide 11 describes the primary way we engage our members directly in our RCS activities. In WG meetings, the most recent version of the matrix is reviewed to ensure priorities are aligned to industry timeframes. Publishing the matrix using Redline/Strike-out allows an easy determination of progress and changes since the last quarter.
- The accomplishments of this project are uncertain since it is mainly tracking the efforts of other organizations. The WG effort of this project is highly confounded with the C&S activities occurring in the actual organizations.
  - FCHEA is not a standards development organization. CDOs/SDOs rely on technical input from industry to develop their codes, standards, and guidelines. FCHEA represents the leading companies and organizations that are advancing innovative, clean, safe, and reliable energy technologies. FCHEA drives support and provides a consistent industry voice to regulators and policymakers. In addition, some of our smaller organization members lack the resources to commit to timeframes necessary to participate in the CDO/SDO activities directly. Engagement in FCHEA's WGs provides the ability to stay informed of the development of codes and standards that impact fuel cells and hydrogen infrastructure deployment, with the option to provide input on these activities at critical stages of development.
- One reviewer lamented the absence of the NHA conferences, exhorting that they should be brought back.
  - FCHEA is pleased to report that our involvement with the 2107 Fuel Cell Seminar & Energy Exhibition has extended to development of technical content. As a result, the 2017 Call for Abstracts has been expanded from past years to include topics such as hydrogen production, material handling and specialty vehicle applications, RCS, permitting, case studies, and many, many more.

<https://www.fuelcellseminar.com/>

# Collaborations

- FCHEA performs this work with ORNL.
- FCHEA members represent the full global supply chain, including universities, government laboratories and agencies, trade associations, fuel cell materials, components and systems manufacturers, hydrogen producers and fuel distributors, utilities and other end users. Members direct our activities, provide input to RCS through FCHEA involvement; review and prioritize our efforts.
- CDOs/SDOs through direct participation on RCS activities, participation in the NHFCCSCC, and participation in appropriate FCHEA WGs. This facilitates information-sharing and synchronization.
- FCHEA's PPWG is collaborating with appropriate research activities to address future research needs to inform harmonized safety standards and regulations.
- FCHEA works with the full range of stakeholders, including industry, state and local officials, and others to address RCS and outreach needs and facilitate deployment.
  - State and regional RCS issues identified by H2USA are coordinated with FCHEA's national and international efforts. FCHEA also provides information upon request to address specific regional needs.
- FCHEA works closely with DOE to facilitate productive dialog on industry priorities, R&D needs, and deployment barriers; as well as to promulgate R&D results and information and data resources available through DOE-funded projects.

# Collaborations - FCHEA Members

FCHEA represents members throughout the global supply chain of the fuel cell and hydrogen energy industry, including fuel cell manufacturers and component suppliers, industrial gas suppliers, automakers, energy companies, non-profits, national laboratories, associations, and others. Our members as of 4/3/2017 are:

3M	Hyundai
Air Liquide	Idaho National Laboratory
Air Products and Chemicals	Intelligent Energy
Allergy Systems	ITM Power
American Honda Motor Company	Johnson Matthey Fuel Cells
Anglo American Marketing Limited	LG Fuel Cell Systems Inc.
ARC: Hydrogen	McPhy Energy
AREVA	Methanol Institute
Black & Veatch	myFC
Bloom Energy	National Renewable Energy Laboratory
BMW of North America, Inc.	Nebraska Public Power District
California Air Resources Board	NEL Hydrogen
California Fuel Cell Partnership	Nissan Technical Center North America
CERES Power	Nuvera Fuel Cells
CHANGE	Ohio Fuel Cell Coalition
Connecticut Hydrogen-Fuel Cell Coalition	Pajarito Powder
CSA Group	PDC Machines
Daimler	Plug Power
Doosan Fuel Cell America	Sandia National Laboratories
Edgewise Energy	Savannah River National Laboratories
Fuel Cell Seminar & Energy Exposition	Shell Oil Company
FuelCell Energy	South Coast Air Quality Management District
Fuji Electric	The Linde Group
GE Fuel Cells	Toyota Motor North America
General Motors	Treadstone Technologies
Gore Fuel Cell Technologies	United Hydrogen
Hydrogenics	Volkswagen Group of America

# Remaining Challenges and Barriers

- The four objectives supported by this project are ongoing and on target to be reached between now and 2020.
- Further advances on US Model Codes. This includes reference to available harmonized standards.
- Easy access to technical papers to facilitate adoption of NFPA 2 and withdrawal of regional restrictions (such as FCEVs in tunnels, over bridges, in parking garages, etc.)
- US harmonization with IEC 62282-6-100 for inclusion of division 2.1 and 4.3 fuel cartridges for checked baggage.
- International standards need to develop in a coordinated fashion to ensure they reflect the needs of industry and consistency with accepted practices.
  - Significant progress: ISO/TC 197 WGs on hydrogen fueling stations and components.
  - Progress: Published standards being updated to reflect advances and learnings.
    - CSA seed document on hydrogen fueling components to be brought back to CSA following ISO publication.
  - Significant work remaining: Update the National and International RCS Templates to determine gaps and areas where harmonization efforts are needed. CSA has begun this effort for the National template. FCHEA to ensure industry priorities are reflected in updated templates, and provide technical experts to any resulting new efforts. Work closely with H2USA to provide expertise or data required to remove any regional restrictions for deployment of FCEVs and hydrogen infrastructure.

# Proposed Future Work

- **Portable Power WG:** Through IEC/TC 105, revise micro fuel cell and cartridges documents to ensure harmonization with international standards for fuel cells as carry on and checked baggage. DOT continues to not be harmonized with inclusion of division 2.1 and 4.3 fuel cartridges for checked baggage (micro fuel cell applications).
- **Transportation WG:** Contribute to updating National and International RCS Templates to ensure US industry interests and priorities are reflected. Continue dialog with component manufacturers to resolve issues in advance of infrastructure roll-out.
- **Stationary Power WG:** Continue to review international standards and US as well as state regulations to ensure consistency with accepted US requirements and best practices.
- Coordination
  - Continue to administer the **NHFCCSCC** and publish the **Safety Report**.
  - Technology Transfer Activities: We develop consensus and information rather than technologies. These are shared openly at [www.hydrogenandfuelcellsafety.info](http://www.hydrogenandfuelcellsafety.info). We also hold regular working group meetings, monthly coordination webinars, and web-based workshops/webinars to reach beyond our membership.

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

# Project Summary

- **Relevance:**

- FCHEA project contributes directly to achievement of **four of the seven objectives** outlined in the Fuel Cell Technologies Office Multi-Year Research, Development and Demonstration Plan. **Project facilitates industry participation in essential codes and standards to meet DOE goals.**

- **Approach:**

- **Multi-tiered approach:** forums to identify issues and discuss progress and needs in developing RCS; facilitating open dialog; participating directly in national and international RCS-development activities; information dissemination & outreach tools.

- **Technical Accomplishments:**

- Significant **progress in harmonizing national and international requirements** for transportation of portable fuel cells in passenger aircraft; proposals to improve harmonization in domestic RCS; maintained central point of information for RCS activities; identified and communicated needs in RCS, R&D, and outreach.

- **Proposed Future Work:**

- Continued focus on harmonization of requirements to facilitate deployment; ensure international standards are consistent with US practices; continue building relationships with key stakeholders, including outside associations; continue dialog with component manufacturers to facilitate deployment of hydrogen infrastructure; ensure industry has opportunity to evaluate code inputs for 2019/2020 code revision cycles; feed back any concerns to appropriate ICC or NFPA Technical Committee through formal code development process; ensure industry priorities are reflected in updates to National and International RCS Templates.

# Backup Slides



# FCHEA RCS Activities Flow

*\* All members are encouraged to participate in RCS activities appropriate to their business. Outside experts are invited as needed to address topics of interest to industry.*

## TWG Membership

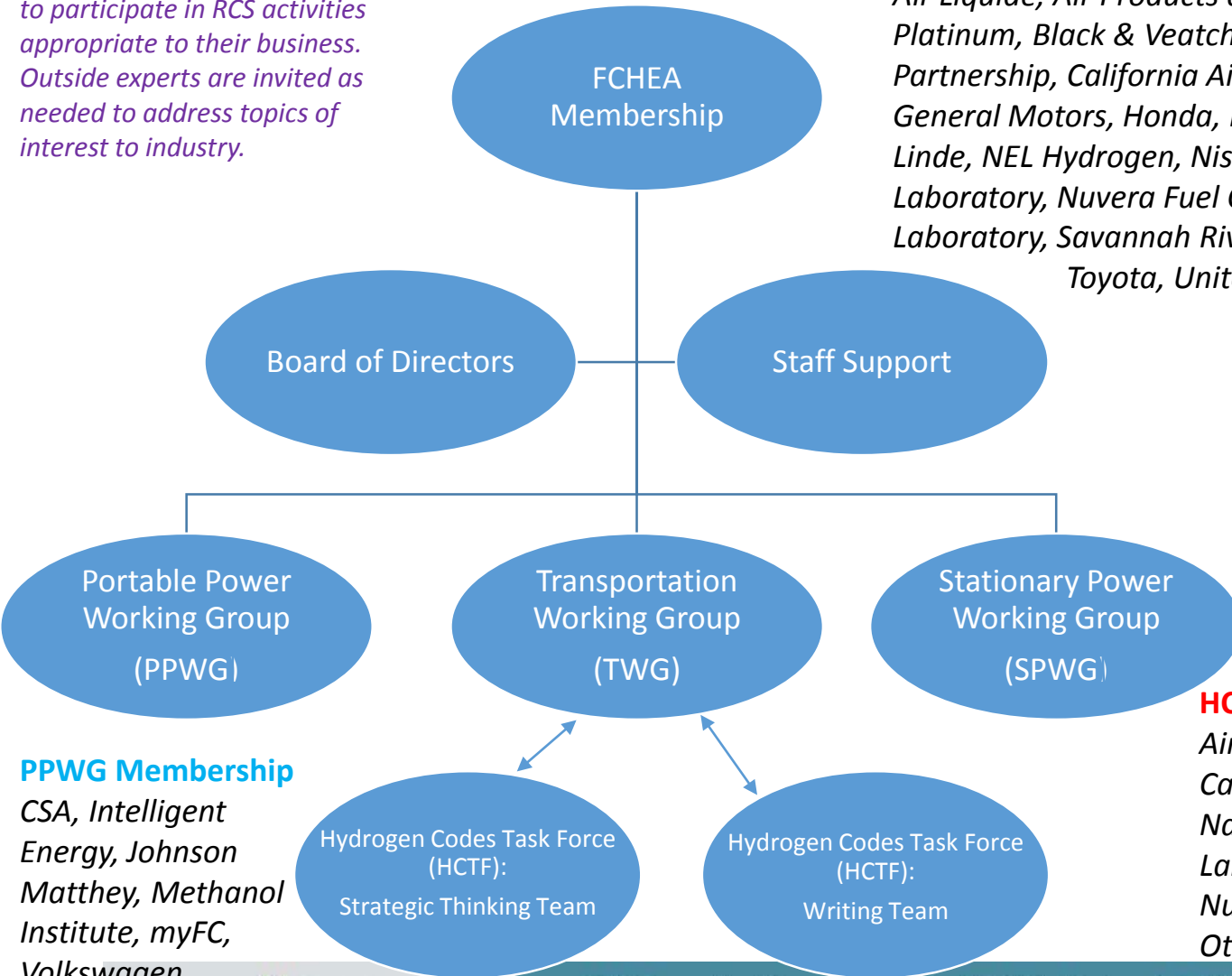
*Air Liquide, Air Products and Chemicals, Anglo American Platinum, Black & Veatch, BMW, California Fuel Cell Partnership, California Air Resources Board, CSA, Daimler, General Motors, Honda, Hydrogenics, Hyundai, ITM Power, Linde, NEL Hydrogen, Nissan, National Renewable Energy Laboratory, Nuvera Fuel Cells, Plug Power, Sandia National Laboratory, Savannah River National Laboratory, Shell, Toyota, United Hydrogen, Volkswagen*

## SPWG Membership

*Altery Systems, Bloom Energy, Ceres Power, Doosan Fuel Cells America, Edgewise Energy, FuelCell Energy, Fuji Electric, GE Fuel Cells, Hydrogenics, Intelligent Energy, LG FCS, Plug Power*

## HCTF Membership

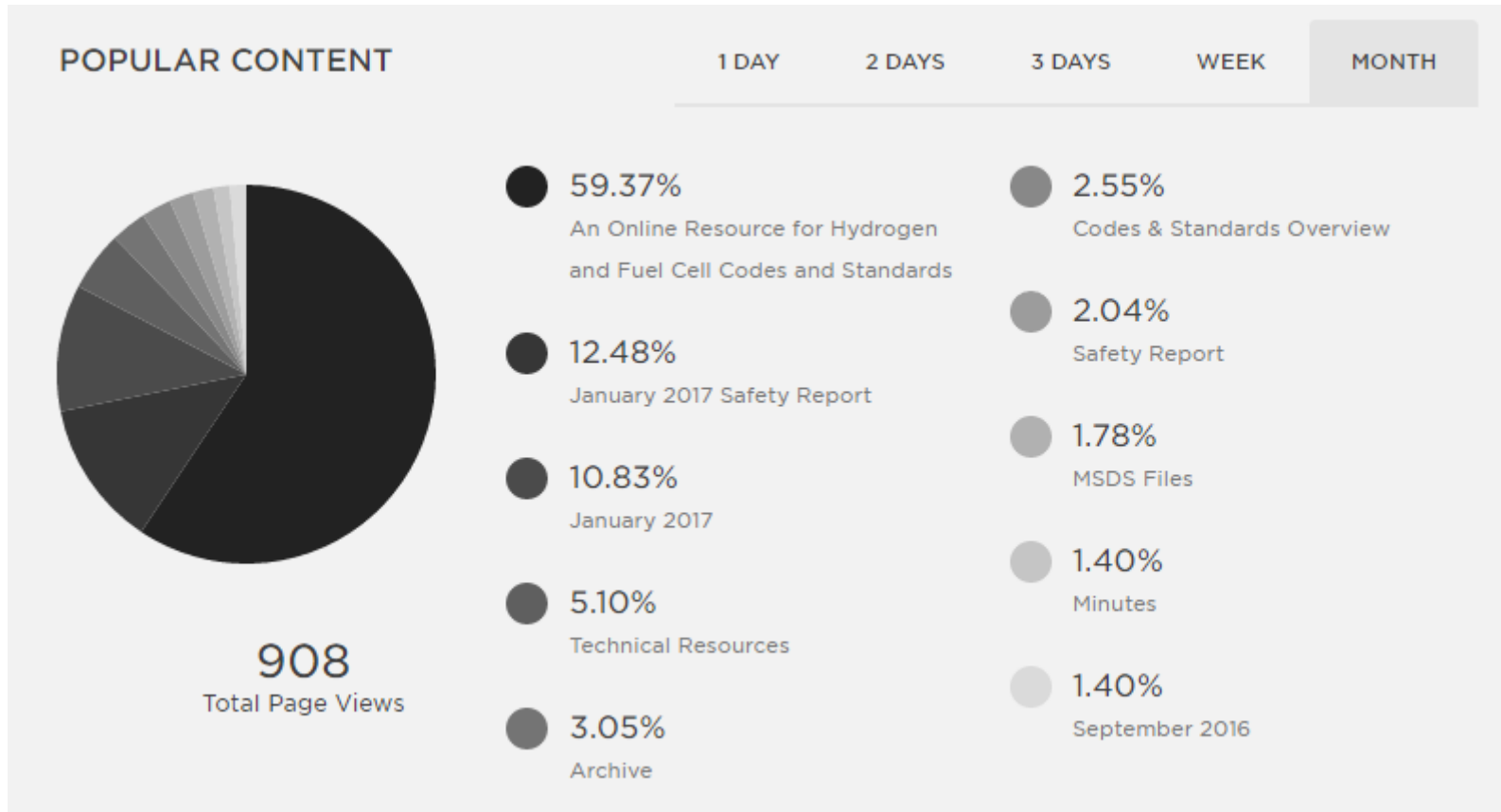
*Air Liquide, Air Products & Chemicals, California Fuel Cell Partnership, National Renewable Energy Laboratory, Nissan, Nuvera Fuel Cells, Toyota, Other invited experts*



## PPWG Membership

*CSA, Intelligent Energy, Johnson Matthey, Methanol Institute, myFC, Volkswagen*

# Safety Report Viewing Statistics



# Safety Report Page Visits

