Fuel Cell & Hydrogen Energy Association Codes and Standards Support

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Fuel Cell and Hydrogen Energy Association (FCHEA)

April 29, 2019

Project ID #SCS022

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

Overview

Timeline

- Project start date: 07/01/17
- Project end date: 07/15/19*

* Project continuation determined annually by DOE

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

Budget

- FY18 DOE Funding: $131,387
- Planned FY19 DOE Funding: $130,000
- Total DOE Project Value: $430,346.62*

Partners

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

Relevance

- As the premiere trade association for the fuel cell and hydrogen energy industry, FCHEA utilized 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:
    - 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.
    - Ensure that best safety practices underlie research, technology development, and market deployment activities supported through DOE-funded projects.
    - Conduct R&D to provide critical data and information needed to define requirements in developing codes and standards.
    - 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 - 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 technical committees, working groups or discussions. Member companies can also participate indirectly through FCHEA WGs to staff who participate on US Technical Advisory Groups.
        - ISO/TC 197 – developing standards to support gaseous hydrogen refueling; as well as revisions to published standards. ISO work items are reviewed and tracked by the appropriate FCHEA WGs..
        - IEC/TC 105 – fuel cell requirements with efforts to harmonize with national standards and international regulations. Our stationary power and portable power working groups review and track IEC/TC 105 documents and work to promote harmonization with national codes, standards and regulations.
        - CSA Fuel Cell Standards Committee – Staff participates on this committee and takes items to the appropriate FCHEA WGs for discussion and action. CSA develops national standards and serves as secretariat for the US TAG on IEC/TC 105.
        - NFPA 2: Hydrogen Technologies- staff serves on the NFPA Hydrogen Technologies Committee and acts as proponent for FCHEA member public input developed through our Transportation Working Group Hydrogen Codes Task Force.
        - SAE Fuel Cell Vehicle Safety Task Force – Staff participates in the quarterly meetings of the SAE FCV Safety Task Force and has recently applied for Liaison membership on the SAE Fuel Cell Standard Committee (TEVFC). .
        - Others as needs arise

Relevance to DOE Objectives

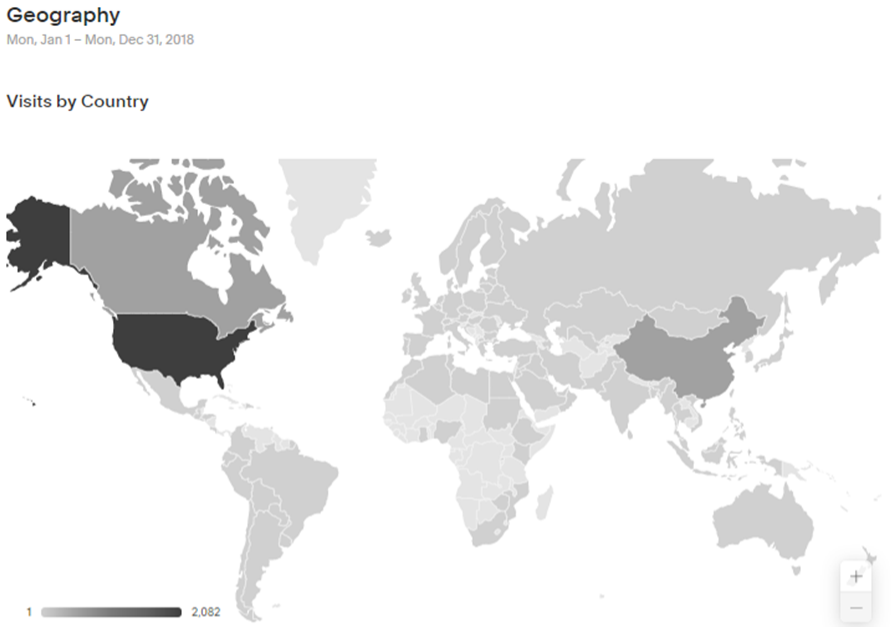
- Ensure that best safety practices underlie research, technology development, and market deployment activities supported through DOE-funded projects.
  - FCHEA supports information-sharing of pre-competitive safety information
    - Open discussions during FCHEA Working Group and Task Force meetings 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 to development of FCHEA comments and voting through solicited and unsolicited comments on draft documents.
    - Identify and schedule Topical Discussions during monthly meetings of the National Hydrogen and Fuel Cell Codes & Standards Coordinating Committee (NHFCCSCC) which FCHEA administers. Along with FCHEA Board determined priorities, 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. This facilitates access to available resources as well as a providing a mechanism for reaching out to others working on similar activities.

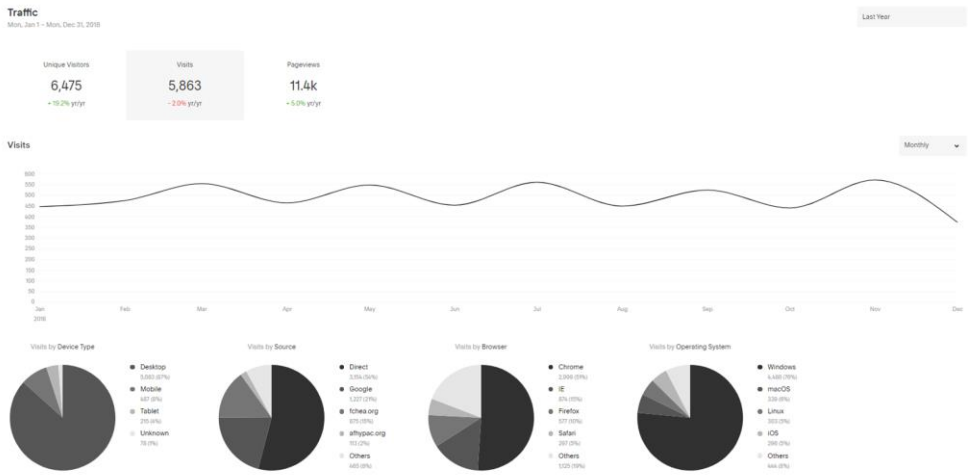
Relevance to DOE Objectives – Cont'd

- 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 Board of Directors sets broad overall priorities. Working Groups set specific RCS industry priorities and engage in related activities with outside organizations. (Examples: NFPA 2, CSA HGV standards, SAE)
        - Direct participation in National CDO/SDO Technical Committees
            - Examples include SAE, CSA standards development, model code development, engagement with hydrogen component manufacturers
        - 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.
- *The Hydrogen and Fuel Cell Safety Report* is read by thousands of interested parties all over the world. 2,200 people, including AHJs and first responders, have signed up to receive E-mail notification when new issues are posted. Many others find it through Internet searches and bookmarks.
- Nearly 20% increase in unique visitors to the site in 2018, along with a 5% increase in page views.
- Analytics: Top geographies of our visitors. Behind the US, China is our next largest source of traffic.





Location	Visits
US United States	2,082 (35.4%)
CN China	643 (10.9%)
CA Canada	434 (7.39%)
GB United Kingdom	267 (4.55%)
FR France	251 (4.27%)
DE Germany	242 (4.12%)

Relevance - Impact

- Enabling National and International Markets Requires Consistent RCS (Barrier F)
  - Lack of consistency limits international trade and markets.
    - FCHEA Board Priorities for our RCS efforts include the following:
      - Advocate for Removal of Regulatory and Policy Barriers
      - Harmonize Codes, Standards, and Regulations
- 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.
    - FCHEA facilitates the monthly meetings of the NHFCCSCC, where CDOs/SDOs can share information about timing and issues; and where industry and researchers can engage in the discussion and provide essential linkages. Organizations that report out during the calls include: DOE, DOT, IEC, NFPA, ICC, CSA, SAE, ASTM, ASME, H2USA, H2FIRST, The State of California, and NIST.
    - FCHEA staff participates directly in the key national and international codes and standards technical committees to provide consistency – ensuring the industry is engaged..
- Limited Participation of Business in the 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.
    - Participation in FCHEA RCS Working Groups allows these businesses opportunities to be briefed on the RCS efforts of interest; to weigh in on issues that arise; and to review documents in order to develop a FCHEA comment or position.
    - The Hydrogen and Fuel Cell Safety Report and the FCHEA Regulatory Matrix provide quick overview information, making it easier for organizations to track and engage in key efforts.

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	
ISO 19880-1 Gaseous Hydrogen Filling Stations. The document is now at FDIS stage – with circulation anticipated in early 2019. Future plans are to remove annexes and turn them into stand-alone docs through NWIPs. However this would not necessarily be through the existing WG 24. ~~DIS was unanimously approved. WG 24 resolving comments from DIS. FDIS anticipated in December 2018.~~	**ISO 19880-2: Gaseous hydrogen filling station dispensers** Now that ISO 19880-1 has reached the FDIS stage, WG19 will continue to work to address the comments on their DIS, and prepare a document for a CIB within ISO TC 197. ~~WG requested TC 197 suspend this activity until ISO 19880-1 moves to FDIS in order to ensure critical harmonization.~~ **HGV 4.3 Fueling Parameters** Work on the next edition has begun to align with SAE J2601. Industry review has closed for the draft document, and the TSC will meet to discuss comments. **ISO 17268 Gaseous Hydrogen Land Vehicle Refuelling Connection Devices** has been published, however, ISO/TC 197 agrees to extend the work of WG 5 to work toward the next revision and agrees to limit the focus of the revision to H70 high flow. A formal call for additional members will take place in order to have this task started in 2019.~~is developing a revised standard. Preparation of FDIS underway~~.	~~**ISO/CD 19880-3 Gaseous hydrogen – Fueling stations – Valves Covers the safety performance of valves over 1MPa for gaseous hydrogen fueling stations. Passed FDIS and was published June 15, 2018. This item will be removed in the next revision of this matrix.**~~ **CSA HPRD1:** Work on the next revision of Pressure Relief Devices is pending. **NFPA 55: Compressed Gases and Cryogenic Fluids Code:** Second Draft meeting took place July 24-25, 2018.Second Draft Report Posting Date: January 23, 2019. **CSA HGV 4.1 Hydrogen dispensing systems**- began a new project to develop the next edition. The TSC met during CSA's Committee Week in mid-October. Additional meetings will be scheduled soon. **CSA HGV 4.9 Hydrogen Fueling Stations** - began a new project to develop the next edition. The TSC met during CSA's Committee Week in mid-October. Additional meetings will be scheduled soon.	INFRASTRUCTURE
		IEC 62282-6-400 - Micro Fuel Cells – Power & Data Interchangeability: WG ~~to~~ meet in Italy in early November to address comments on CDV. **IEC 62282-6-300 Ed.2 - Fuel Cartridges** – extended publication target date to 2021. **IEC 62282-6-200 Ed.3 - Micro Fuel Cells – Performance** – target date for publication is 2021.	MICRO

Level of Effort

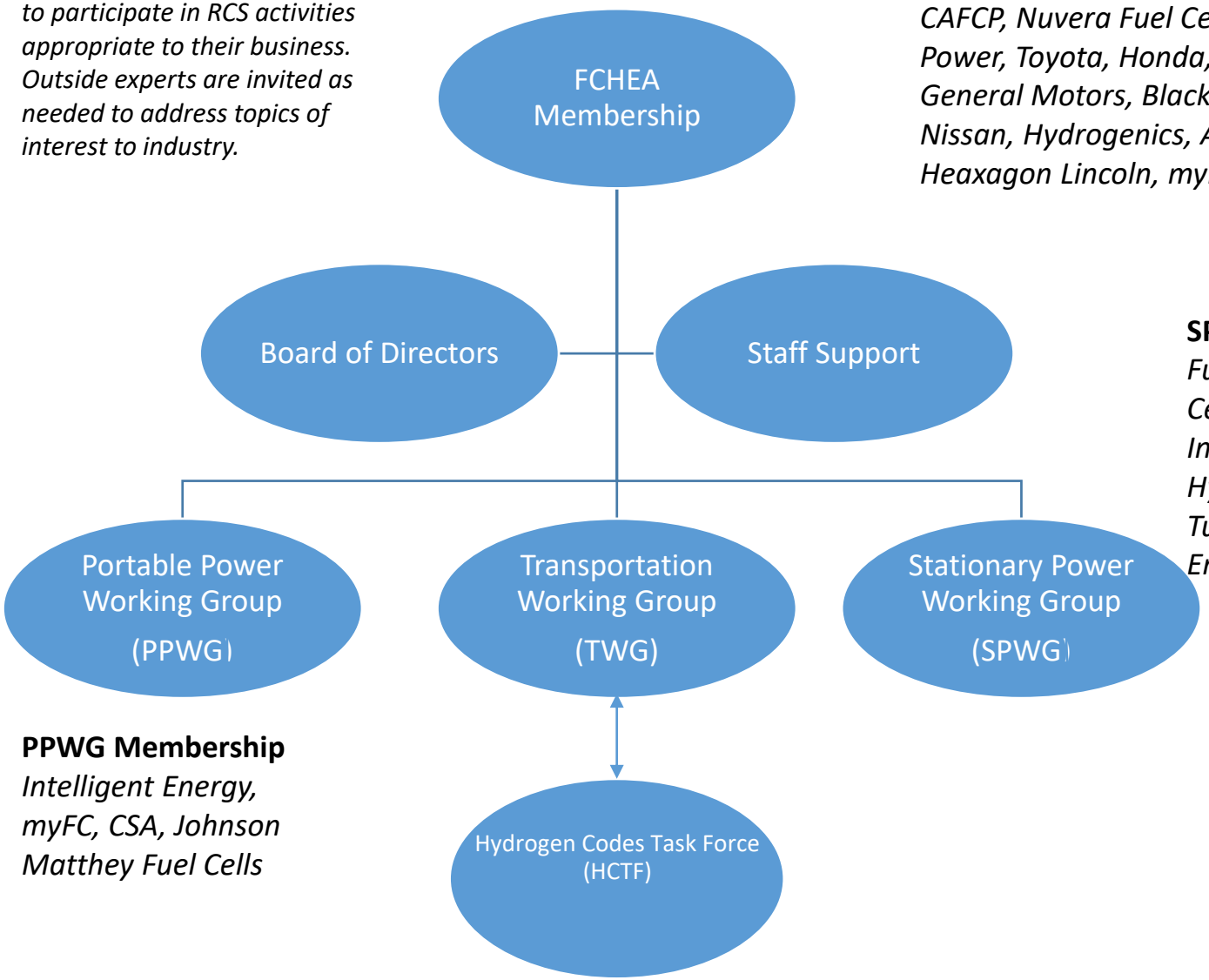
Through the use of "Track Changes" software, users can quickly identify what has changed during the past quarter. The "track changes" version is reviewed by our WGs and the NHFCCSCC, and provided to ORNL each quarter. Clean copies are available upon request and archived, and form the basis of the next quarters mark-up.

Approach: FCHEA WGs

- FCHEA Working Groups provide regular opportunities to engage industry in developing RCS:
  - **Transportation WG**
    - Transportation Infrastructure standards, R&D, deployment.
    - Hydrogen Codes Task Force
      - In process of working through proposals received on next editions of NFPA 2/NFPA 55
      - Coordinating with H2USA and others to address known restrictions for FCEVs and hydrogen infrastructure in state and regional regulations.
  - **Stationary Power WG**
    - Supports RCS relating to Stationary Power.
      - Recent topics include new work item proposals and opportunity to comment on draft revisions to International Standards on stationary fuel cells from IEC/TC 105
  - **Portable Power WG**
    - Complete regulatory framework to ship and to allow consumer transport of FCs and FC cartridges to be regulated in parity with similar technologies.
    - RCS from UL, CSA, DOT, the UN, ICAO, IEC and others.
      - Encourage international harmonization of requirements; adoption of international standards into regulations, and equal opportunity for all micro fuel cell technologies.

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
CAFCP, Nuvera Fuel Cells, CSA, United Hydrogen, Plug Power, Toyota, Honda, Air Products, NEL Hydrogen, General Motors, Black & Veatch, BMW, Air Liquide, Nissan, Hydrogenics, Anglo American, Hyundai, Heaxagon Lincoln, myFC, Audi, Linde

SPWG Membership
FuelCell Energy, Doosan Fuel Cells America, Bloom Energy, Intelligent Energy, Plug Power, Hydrogenics, Fuji Electric, Global Tungsten, Solid Power, Aris Energy, Hexagon Lincoln

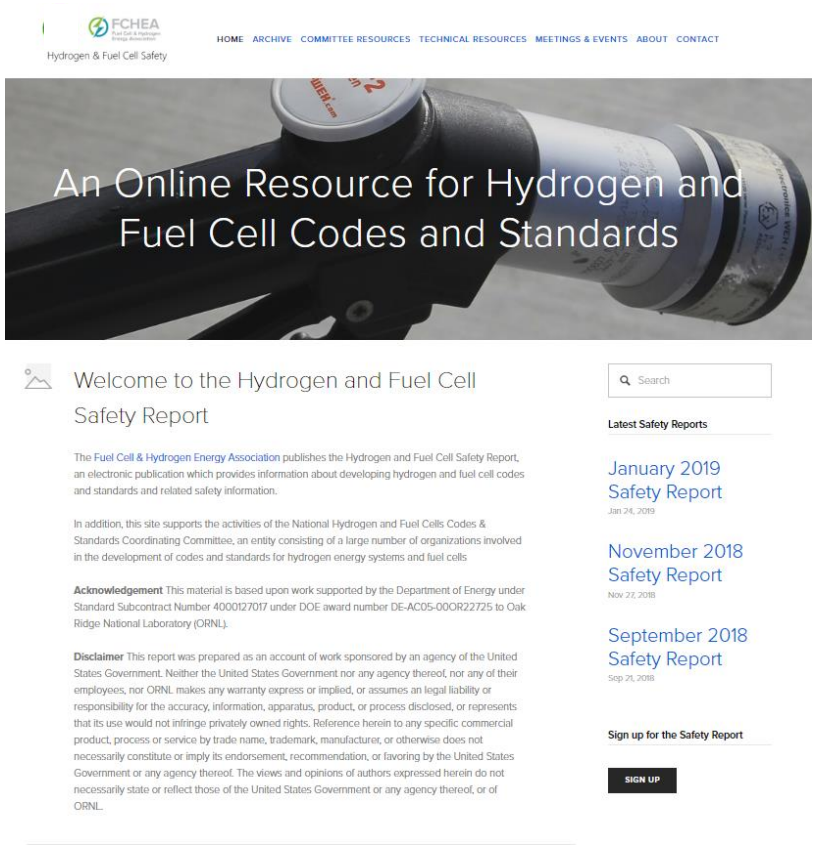
HCTF Membership
CAFCP, Honda, Toyota, Air Liquide, Plug Power, CSA, Altergy, General Motors

PPWG Membership
Intelligent Energy, myFC, CSA, Johnson Matthey Fuel Cells

Approach: Coordination and Outreach

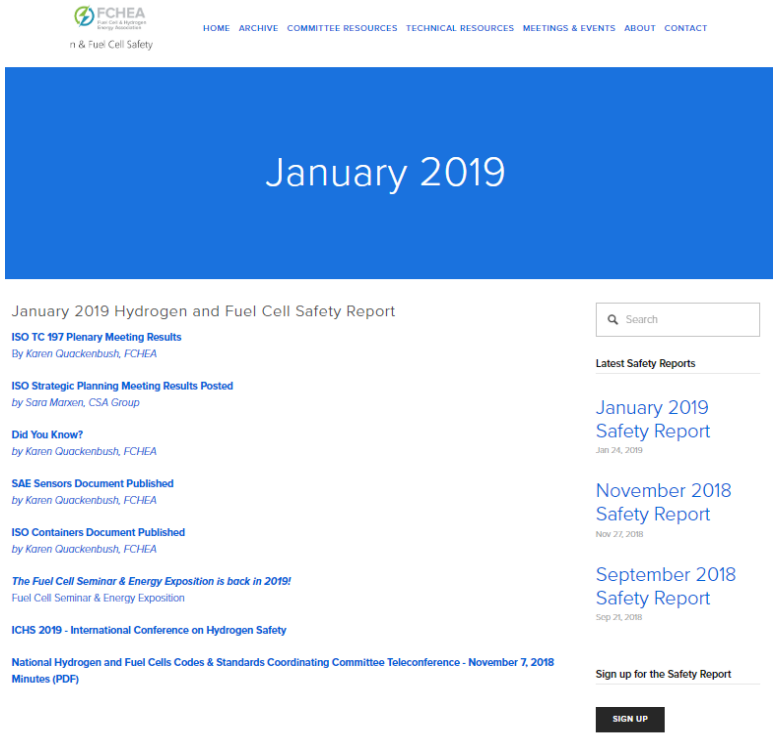
NHFCCSCC (monthly)

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



Approach to Resolve Technical Challenges

- **Challenge: Development and Harmonization of Regulations, Codes and Standards**
  - Facilitate the development of clear and comprehensive codes and standards to ensure consistency and facilitate deployment of hydrogen and fuel cell technologies
  - 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**
  - General lack of understanding of hydrogen and fuel cell safety needs among local government officials, fire marshals, and the public. Failure to comprehensively consider the properties and behavior of hydrogen may lead to overly restrictive policies that preclude or delay deployment of hydrogen and fuel cell technologies.
  - APPROACH: FCHEA publishes, maintains, and disseminates key safety information through the *Hydrogen and Fuel Cell Safety Report* website at www.hydrogenandfuelcellsafety.info; and works with stakeholders to disseminate FCV and infrastructure-deployment activities. Recent activity – Increasing the Value Proposition: Hydrogen Safety. On December 13, 2018, the Northeast Electrochemical Energy Storage Cluster and the FCHEA hosted a webinar to provide an overview of design considerations that could be employed to ensure safety for a range of hydrogen applications; recent codes and standards changes for hydrogen and fuel cell technologies; and resources available through the Hydrogen Safety Panel. We published the proceedings in our “Technical Resources” area of the Safety Report.
- **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: Working Groups

- **Transportation WG**: Infrastructure RCS review. Administers Hydrogen Codes Task Force to review and develop public input for NFPA 2. Continued participation in NFPA to track code change proposals and decisions taken in current revision cycle for next editions of NFPA 2 and NFPA 55 model codes.
  - Hydrogen Codes Task Force develops harmonized public inputs for the next development cycles of key model codes. The public inputs are solicited from business and experts with operational experience, and focus on harmonizing requirements with other industry-accepted standards and codes.
  - 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

- **Stationary Power WG**: Forum for engaging in the development of RCS for stationary applications. WG reviews and provides feedback on draft documents, including New Work Item Proposals. Activities include domestic and international standards development, as well as NFPA 853: Standard for the Installation of Stationary Fuel Cell Power Systems.
  - 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.

- **Portable Power WG:** 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. Serving as IEC/TC 105 WG 8 Convenor to advance these documents. Once published to Draft International Standard level, will work with US DOT PHMSA and ICAO to ensure harmonized requirements.
  - 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

- Coordination
  - NHFCCSCC – Monthly facilitated discussion of key topics of broad interest, such as “Facilitating Deployment”, and “Legal Metrology Standards Hydrogen Fuel”. 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 planning and scheduling.

- 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

- This project was not reviewed last year.

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 in RCS development; 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 works with the full range of stakeholders, including industry, state and local officials, and others to address RCS and outreach needs and facilitate deployment.
- 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. Industry RCS priorities and needs were discussed with DOE at a FCHEA / Department of Energy H2 Fuels Workshop* held to identify and prioritize hydrogen fuel production, storage, and infrastructure R&D needs on November 15, 2018. FCHEA provided a full report on this workshop to our members, as well as to DOE.
    - Conducting this workshop was a separate activity from the project being reviewed; however, the engagement regarding our RCS priorities and needs was a part of the project being reviewed.

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 guidelines for AHJs to facilitate adoption of NFPA 2 and withdrawal of regional restrictions (such as FCEVs in tunnels, over bridges, in parking garages, etc.)
  - Industry is working at regional level to provide baseline education on current FCEV technologies
- 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.
  - Published standards being updated to reflect advances and learnings. Ex: Residential and industrial Electrolysers documents, dispensing hoses for gaseous hydrogen fueling stations, valves for gaseous hydrogen fueling stations.
- Significant work remaining:
  - Harmonization of national and international component standards. US experts analyzing similarities and differences between US best practice and developing international requirements.
  - Significant revisions in next editions of NFPA 2 and NFPA 55 to be analyzed and harmonized with I-Codes as applicable.

Proposed Future Work

- **Portable Power WG**: To ensure harmonization with international standards for fuel cells as carry on and checked baggage. FCHEA is Convening IEC/TC 105 WG 8 to ensure resulting revisions are coordinated with ICAO and US DOT PHMSA.
- **Transportation WG**: Complete NFPA 2 revision cycle and conduct thorough review of 2020 edition. Ensure any remaining concerns are addressed through code change proposals for the following revision cycle. Ensure requirements are consistent throughout NFPA and ICC codes. Identify any remaining gaps and recommend how to address them.
- **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**
  - **NHFCCSCC** – continue to administer, identify key issues, and document discussions and outcomes. Provide industry feedback and other input to the Department of Energy (DOE) on RCS development needs and priorities; outreach needs and priorities; R&D needs and priorities to support RSC development activities.
  - **Safety Report** – continue to report on the developing RCS to improve coordination of activities and improve information transfer to facilitate industry engagement in RCS.
- Technology Transfer Activities: We develop consensus and information rather than technologies. These are shared openly at www.hydrogenandfuelcellsafety.info. We also hold regular working group meetings, monthly coordination webinars, and web-based workshops/webinars to reach beyond our membership.

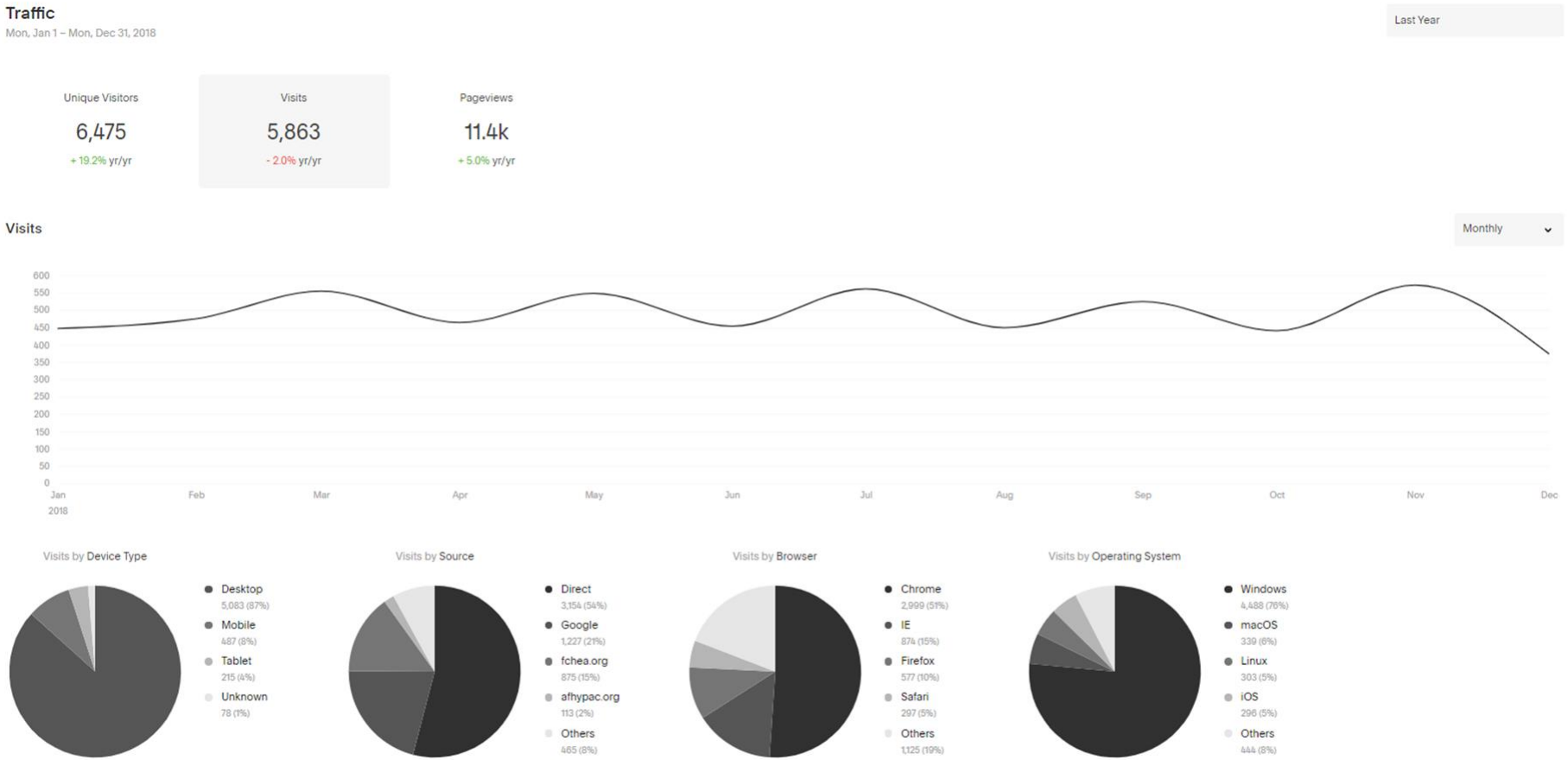
Any proposed future work is subject to change based on funding levels.

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 to address industry needs; information dissemination & outreach tools.
- Technical Accomplishments:
  - Significant progress in conducting information exchange and data transfer to improve harmonization in domestic and international RCS; maintained central point of information for RCS activities; identified and communicated needs in RCS, R&D, and outreach.
  - Success in engaging industry to participate in codes and standards development process. Some participate directly, while others take the opportunity to review draft codes and standards when out for review. FCHEA staff then represents these comments and concerns on the Technical Committees of CSA, SAE, ISO/TC 197, IEC/TC 105, ICC, NFPA, and others as appropriate.
- 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 industry to facilitate deployment of hydrogen vehicles infrastructure; complete code inputs for 2020 code revision cycle. Determine RCS priorities and needs for the next round of code revisions.

Technical Backup Slides

Safety Report Viewing Statistics



Safety Report Page Visits

Geography

Mon, Jan 1 – Mon, Dec 31, 2018

Visits by Country

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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 2/28/2019 are:

- 3M
- Air Liquide
- Air Products and Chemicals
- Alakai Technologies
- Altergy
- American Honda Motor Company
- Anglo American Marketing Limited
- Audi
- ARC: Hydrogen
- ARIS Energy Solutions
- Black & Veatch
- Bloom Energy
- BMW of North America, Inc.
- California Fuel Cell Partnership
- Center for Hydrogen and Next Generation Energy
- Connecticut Hydrogen-Fuel Cell Coalition
- CSA Group
- Doosan Fuel Cell America
- Edgewise Energy
- Fuel Cell Seminar & Energy Exposition
- FuelCell Energy
- Fuji Electric
- General Motors
- Gore Fuel Cell Technologies
- Hexagon
- Hydrogenics
- Hyundai Motor Company
- Intelligent Energy
- Johnson Matthey Fuel Cells
- MyFC
- Nebraska Public Power District
- NEL Hydrogen
- Nissan Group of North America
- Nuvera Fuel Cells
- Ohio Fuel Cell Coalition
- PDC Machines
- Plug Power
- South Coast Air Quality Management District
- The Linde Group
- Toyota Motor North America
- United Hydrogen