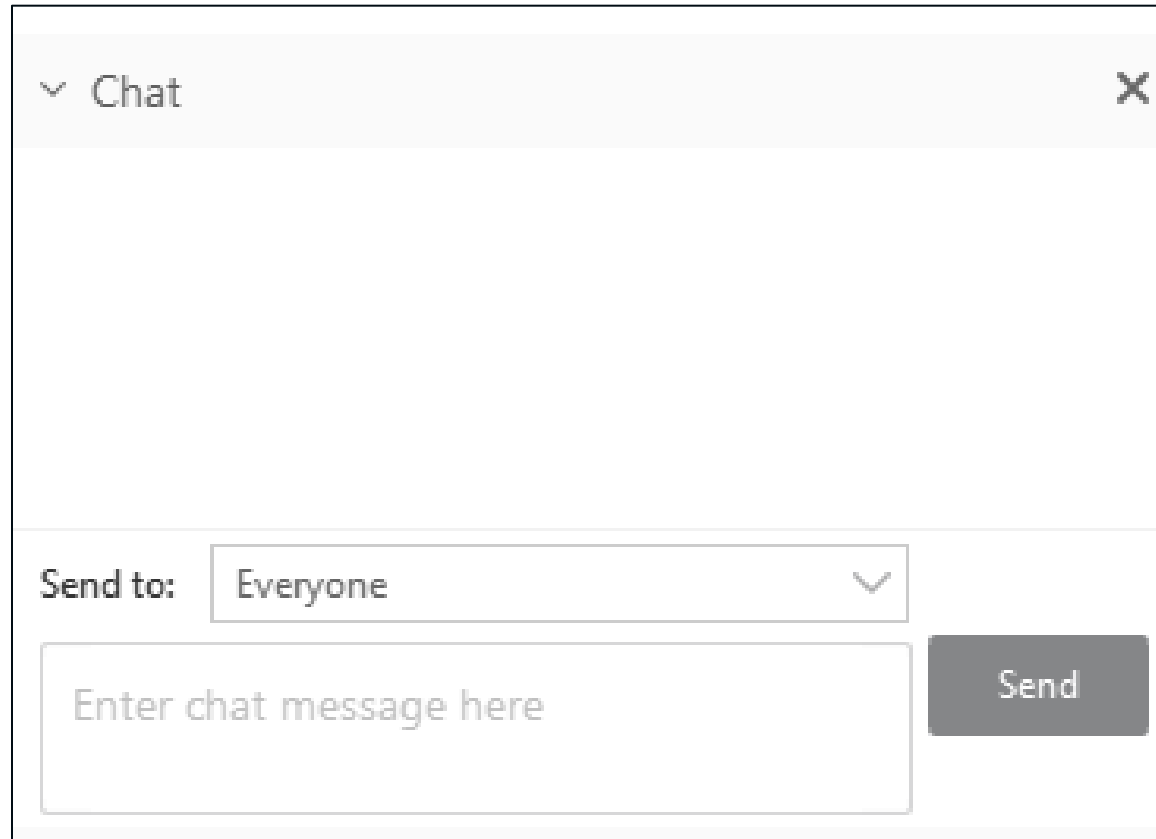


Permitting Hydrogen Fueling Stations

August 22nd, 2017

Presenter(s)
Carl Rivkin, CSP, P.E.

- Please type your questions to the chat box. **Send to: (HOST)**



The image shows a chat window titled "Chat" with a close button (X) in the top right corner. Below the title bar is a large empty text area for messages. At the bottom of the window, there is a "Send to:" dropdown menu currently set to "Everyone". Below the dropdown is a text input field with the placeholder text "Enter chat message here". To the right of the input field is a dark grey "Send" button.

FCTO Codes & Standards Program

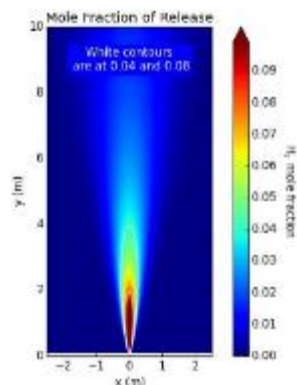
Performing R&D needed to develop science-based codes and standards, thereby enabling the safe deployment of H₂ and fuel cell technologies

Codes & Standards

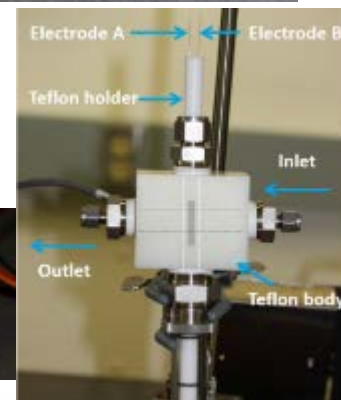
- Conduct **R&D to provide critical data** and information needed to define requirements in developing codes and standards.
- Support and facilitate development of **essential codes and standards to enable widespread deployment** of hydrogen and fuel cell technologies and completion of essential regulations, codes and standards (RCS).

Safety

- Ensure that **best safety practices** underlie activities supported through DOE-funded projects.
- Enable **widespread sharing of safety-related information resources** and lessons learned with key stakeholders.



614g 100 cycles



H2Tools.org



Permitting Hydrogen Fueling Stations

Carl Rivkin, CSP, P.E.

NREL

22 August 2017

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

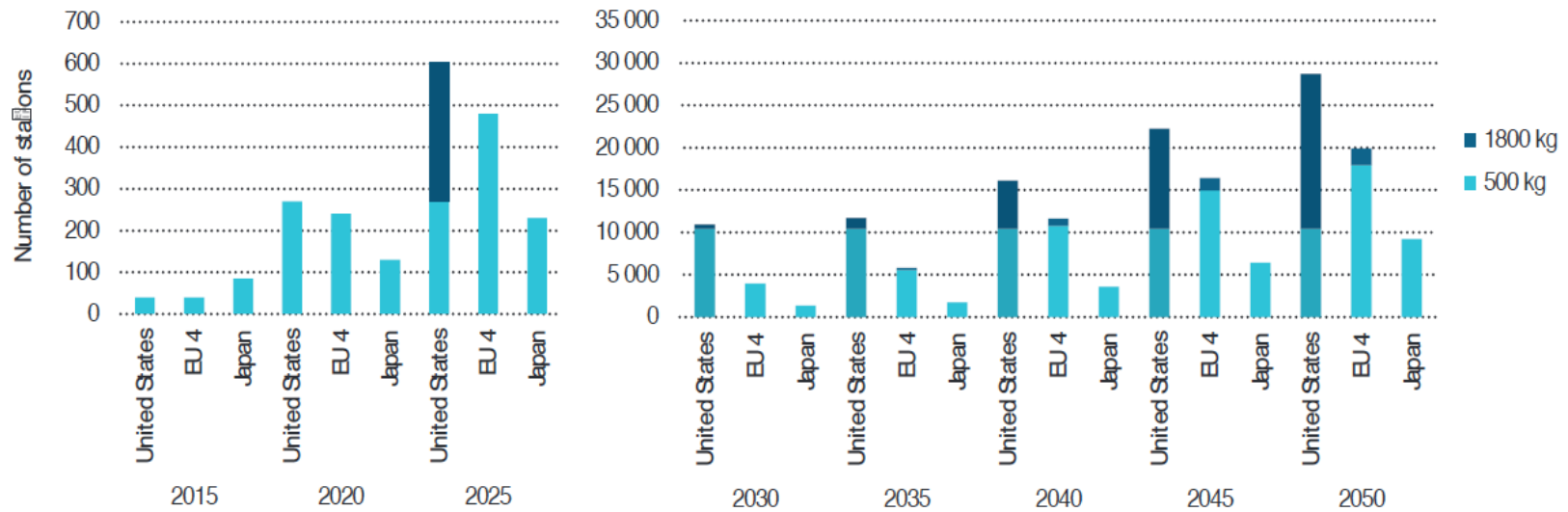
NREL hydrogen safety work covered in this presentation is funded by the US DOE Energy Efficiency and Renewable Energy Office Fuel Cell Technology Office

Webinar Outline

- Introduction
- Topic 1. The permitting process
- Topic 2. The safety permit
- Topic 3. DOE permitting tools
- Topic 4. Facilitating the permitting process
- Topic 5. Wrap up and questions

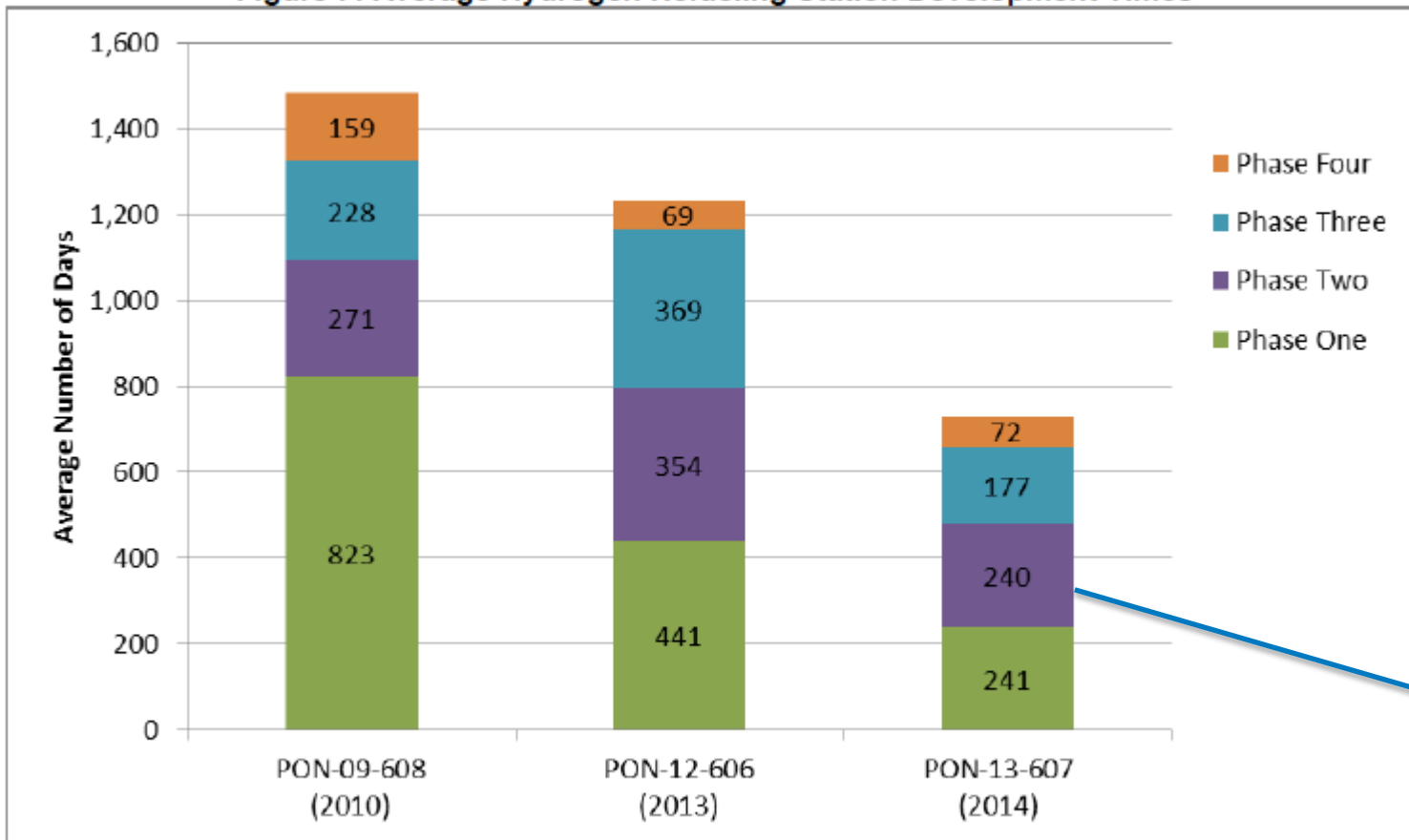
Why is DOE presenting this Webinar?

- Large –scale development and deployment of hydrogen technologies infrastructure is required to move new energy technologies forward, particularly hydrogen vehicle fueling
- IEA projects for the US- 600 hydrogen stations by 2025, over 10,000 stations by 2030, over 15,000 stations by 2035, and close to 30,000 stations in 2050
- There are opportunities to improve the the efficiency of the permitting process



California Information on Permitting stations

Figure 7: Average Hydrogen Refueling Station Development Times



Source: California Energy Commission staff

- California directly adopted NFPA 2 to facilitate station permitting along with extensive AHJ outreach
- California has developed the Hydrogen Station Permitting Guide-
<http://businessportal.ca.gov/Portals/0/Files/Hydrogen%20Permitting%20Guidebook%20FINAL%20-%20202.0.pdf?ver=2016-11-14-170829-243>

<http://www.energy.ca.gov/2017publications/CEC-600-2017-002/CEC-600-2017-002.pdf>

Initial Lack of Hydrogen and Fuel Cell Standards Serious Impediment to Permitting

National Codes and Standards Template-2003 Funded by DOE EERE Fuel Cell Technology Office

National Template: Vehicle Systems & Refueling Facilities

STANDARDS DEVELOPMENT ORGANIZATIONS

LEAD STANDARDS DEVELOPMENT ORGANIZATIONS (SDOs)

Vehicles	Fuel Delivery, Storage	Fueling, Service, Parking Facility
CONTROLLING AUTHORITIES: DOT/NHTS (crashworthiness) EPA (emissions)	CONTROLLING AUTHORITIES: DOT/PHMSA (over-road transport, pipeline safety)	CONTROLLING AUTHORITIES: State and Local Government (zoning, building permits)
General FC Vehicle Safety: SAE	Composite Containers: ASME, SF, G, MPA	Storage Tanks: ASME, SF, G, MPA, API
Fuel Cell Vehicle Systems: SAE	Pipelines: ASME, API, G, AGA	Piping: ASME, SF, G, MPA
Fuel System Components: SF	Equipment: ASME, API, G, AGA	Dispensers: SF, UL, MPA
Containers: SAE	Fuel Transfer: MPA, API	On-site H₂ Production: SF, UL, G, API
Reformers: SAE		Codes for the Environment: G, MPA
Emissions: SAE		
Recycling: SAE		
Service/Repair: SAE		

Interface

Fuel Specs:
SAE, SF, API

Wts/Measures:
NIST, API, ASME

Fueling:
SAE

Sensors:
UL

Connect:
SAE

Comm:
SAE

National Template: Stationary & Portable Systems

STANDARDS DEVELOPMENT ORGANIZATIONS

LEAD STANDARDS DEVELOPMENT ORGANIZATIONS (SDOs)

Hydrogen Generator	Portable Fuel Cells	Stationary Fuel Cells
CONTROLLING AUTHORITIES: EPA (emissions) DOT/PHMSA (pipeline) OSHA, State and Local Gov't (zoning, building permits)	CONTROLLING AUTHORITIES: CPSC, DOT/PHMSA, OSHA, EPA (methanol) State and Local Government (zoning, building permits)	CONTROLLING AUTHORITIES: OSHA, State and Local Government (zoning, building permits)
Electrolyzers: UL, SF	Handheld Systems: UL, SF	H₂ ICes: UL, SF
Reformers: UL, SF, API	Portable Systems: SF, UL, G	H₂ Fueled Turbines: API, SF, UL, ASME
Perform. Test Procedures: ASME, SF	Handheld Fuel Containers: UL, SF, G	FC Systems: SF, ASME, UL
Chemical Hydrides: UL, SF, MPA	Portable Fuel Containers: G, SF, ASME	FC Installation: MPA
	H₂ Fuel Specifications: G, SAE	FC Performance Test Procedures: ASME, SF, gti
	Perform. Test Procedures: gti, SF, ASME, SF	

Interface

Installation Piping:
ASME, SF, G, MPA, API

Storage:
ASME, SF, G, MPA, API

Compressors Safety Cert.:
SF, UL

Comp. Design, Perf. & Safety:
API

Sensors/Detectors:
UL, SF, MPA

Fuel specifications:
G, SAE, API, SF

Weights/Measures:
NIST, API, ASME

Dispensers:
MPA, SAE, SF, UL, API

Non-vehicle Dispensing:
G

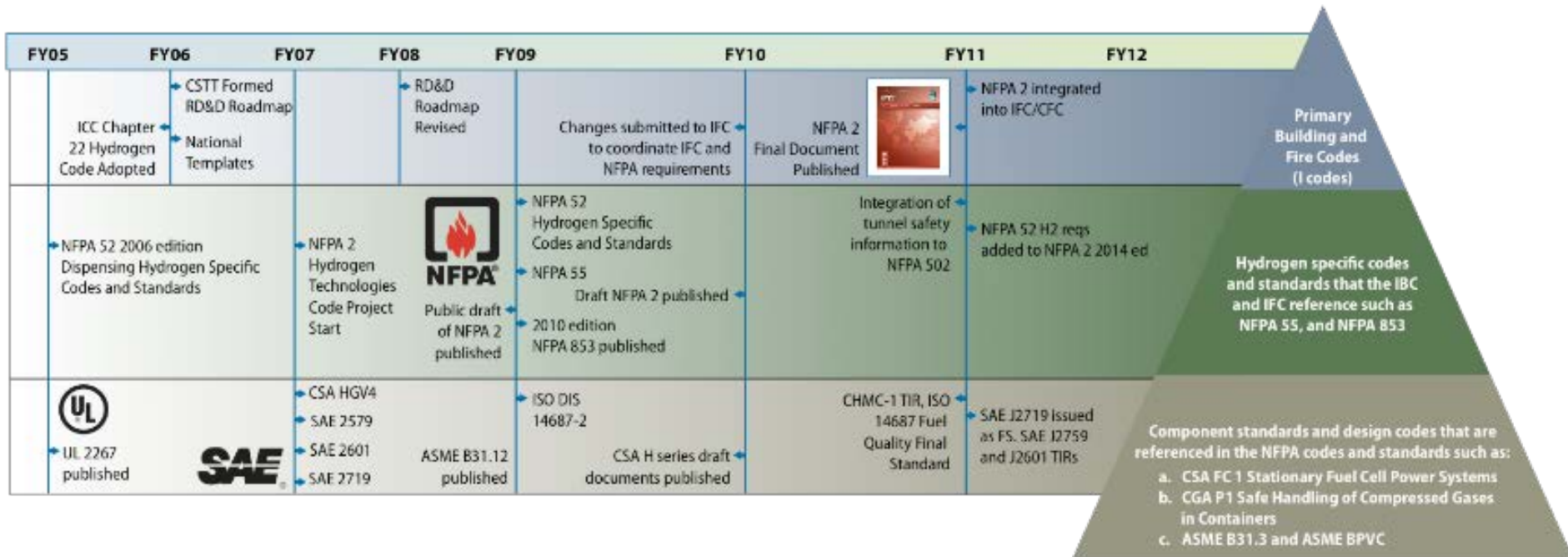
Codes for Built Environ.:
G, MPA, G, SF

Interconnection:
UL, MPA

<http://energy.gov/eere/fuelcells/downloads/national-template-hydrogen-vehicle-and-infrastructure-codes-and-standards>

DOE Code Development Support Coordinated with Template

Moved from hydrogen codes that only addressed industrial applications to comprehensive codes for hydrogen technologies in the retail environment



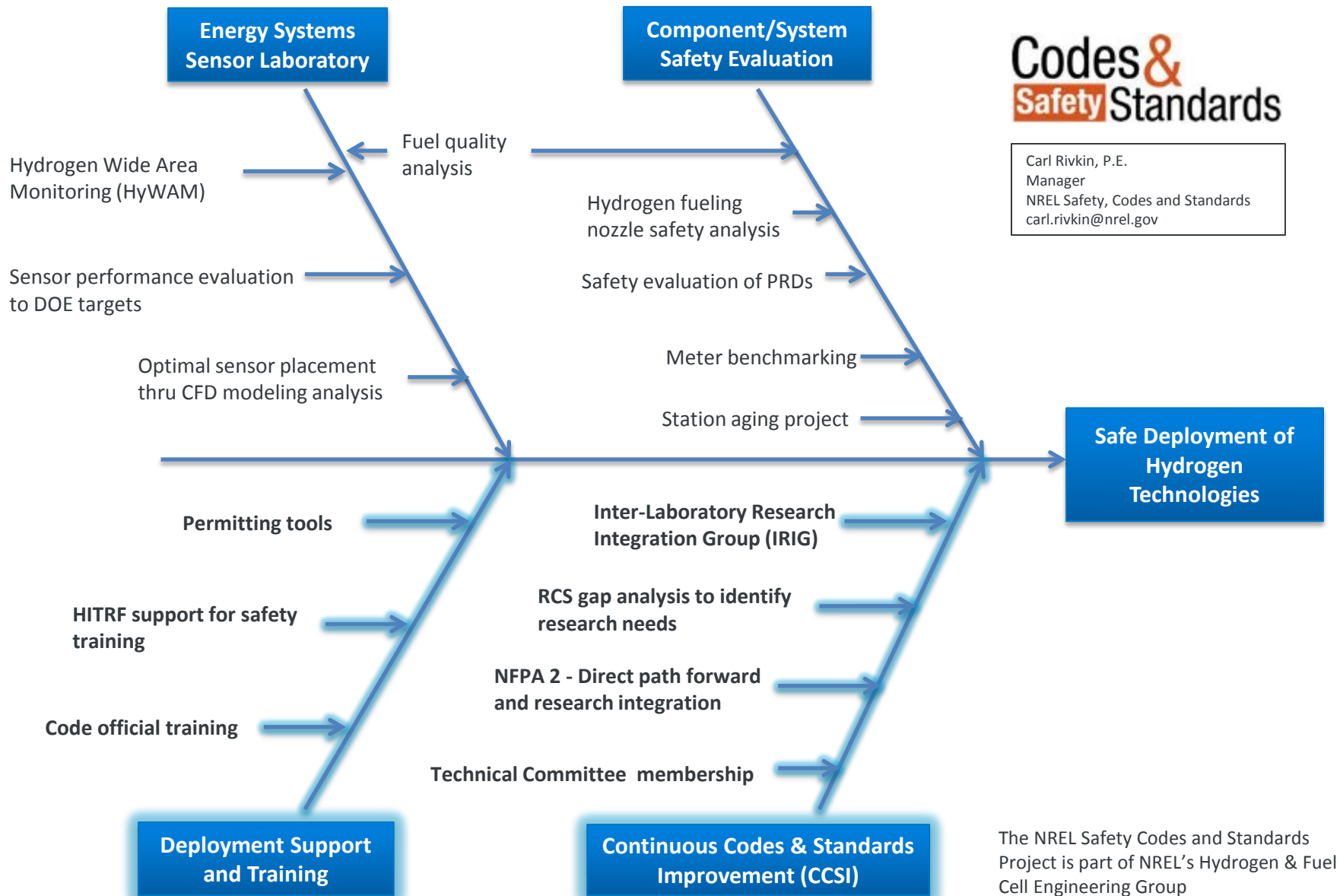
Key DOE Accomplishments on the Code Development Path

Code Change	Impact
2003 International Fire Code adds chapter on hydrogen fueling stations	This was the first hydrogen fueling information available in the fire codes
2005 NFPA forms Hydrogen Technologies Technical Committee	With the support of DOE NFPA forms the first Fire Code Committee specifically devoted to hydrogen technologies safety
2006 NFPA 52 Vehicular Alternative Fuels codes adds multiple chapters on hydrogen vehicle fueling	First detailed set of requirements for both hydrogen vehicle fueling and hydrogen storage at stations
2009 SAE J2719 Fuel Quality published	First US standard for hydrogen fuel quality for passenger vehicles

Key DOE Accomplishments on the Code Development Path (Ctd.)

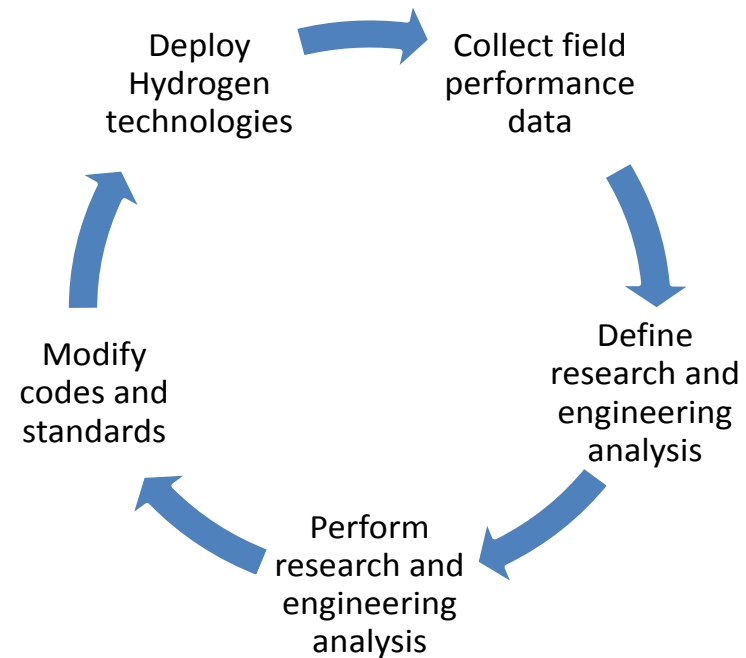
Code Change	Impact
2010 SAE 2601 Fueling Protocol published	First US standard for fueling passenger vehicles at retail stations
2011 NFPA 2 Hydrogen Technologies Code first edition published	First National Fire specifically for hydrogen including risk-informed setback distances for bulk gaseous storage systems
2012 CSA Hydrogen Component Standards published	Comprehensive set of listing standards for hydrogen components
2015 International Fire Code references NFPA 2	Reference to NFPA 2 hydrogen technologies Code effectively makes NFPA2 the national code for hydrogen
2016 NFPA 2 Hydrogen Technologies Codes incorporates fueling material from NFPA 52	Further consolidation of NFPA hydrogen requirements into what is now the national code for hydrogen technologies

Integrated Approach: NREL Safety Codes and Standards Project Structure



Continuous Codes and Standards Improvement (CCSI)

- With baseline set of codes and standards in place the next step is to improve those documents through lessons learned
- This is the CCSI process
- Field data indicates:
 - Component reliability
 - Equipment Enclosures
 - Alternative fueling
 - Transit infrastructure



Inter-Laboratory Research Integration Group (IRIG)

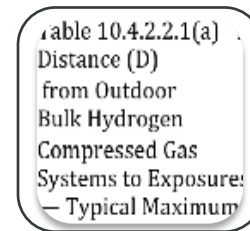
U.S. DEPARTMENT OF
ENERGY

Energy Efficiency &
Renewable Energy

DOE-funded hydrogen
technology and alternative
fuel research projects
conducted at DOE and
other laboratories



Existing work product:
Improved technology
performance and reduced
technology costs



+ New IRIG work product:
Increased public safety and
reduced permitting and
deployment costs



IRIG/CCSI process:
Research and testing needs
defined from the code
development
committees/project
deployment

Leveraging DOE research, particularly stranded R&D assets, can support major code proposals and enable advances in public safety.

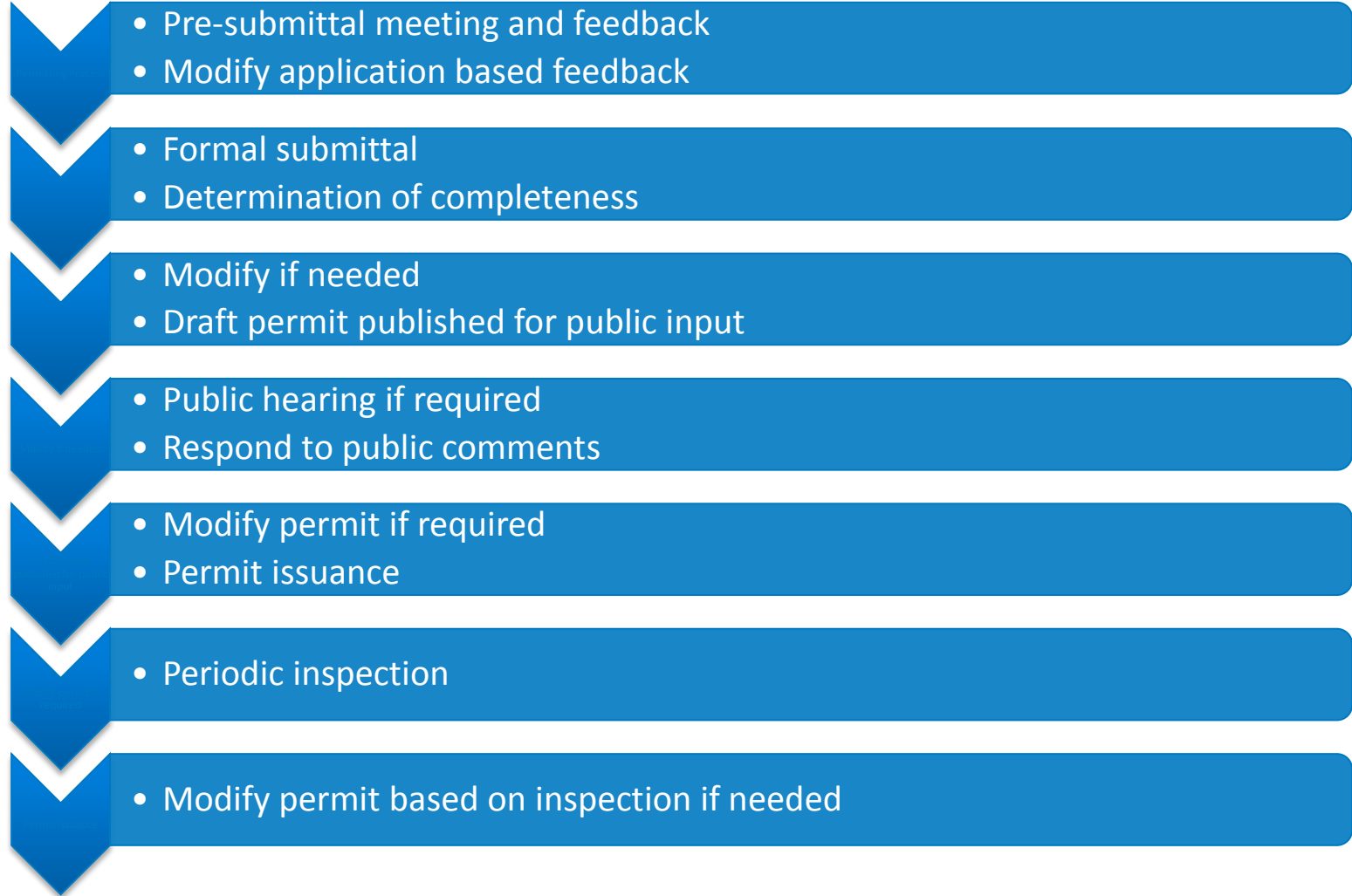
Topic 1. The Permitting Process: Basic Objectives

- Protect public safety, health, the environment, and ensure planned development
- Apply requirements consistently
- Perform the process in a legal framework that protects the rights of all interested parties
- Conduct permitting in a timely manner
- Allow for public input and transparency through Freedom of Information Act (FOI) process
- Modify permits as needed based on facility inspections

The Permitting Process: Types of Permits/Approvals

Permit/Approval Type	Authority Having Jurisdiction (AHJ)	Description
Zoning	Planning Board	Ensure compliance with jurisdiction development plan
Environmental	Federal, State, and Local Environmental Agency	Protect the environment and public health
Public health	State or Local Health Department	Protect public health for sale of consumer products such as food
Worker safety	Federal or State Occupational Safety and Health Agency (OSHA)	Compliance with Occupational Safety and Health Regulations
Fire safety/Building	Local Fire or Building Department	Provide safety to workers and the general public

The Permitting Process: Approval Sequence



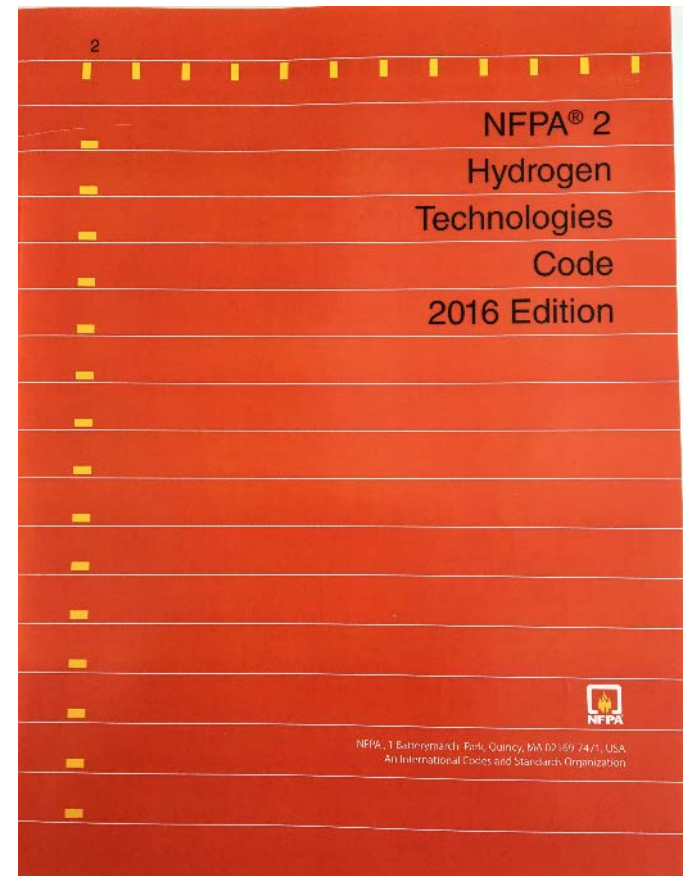
Consumer Warning- These are commonly occurring steps in permitting- refer to specific jurisdiction's administrative rules for for actual steps in that jurisdiction

Topic 2. The Safety Permit: Building and Fire Codes

Key Elements of the Permit

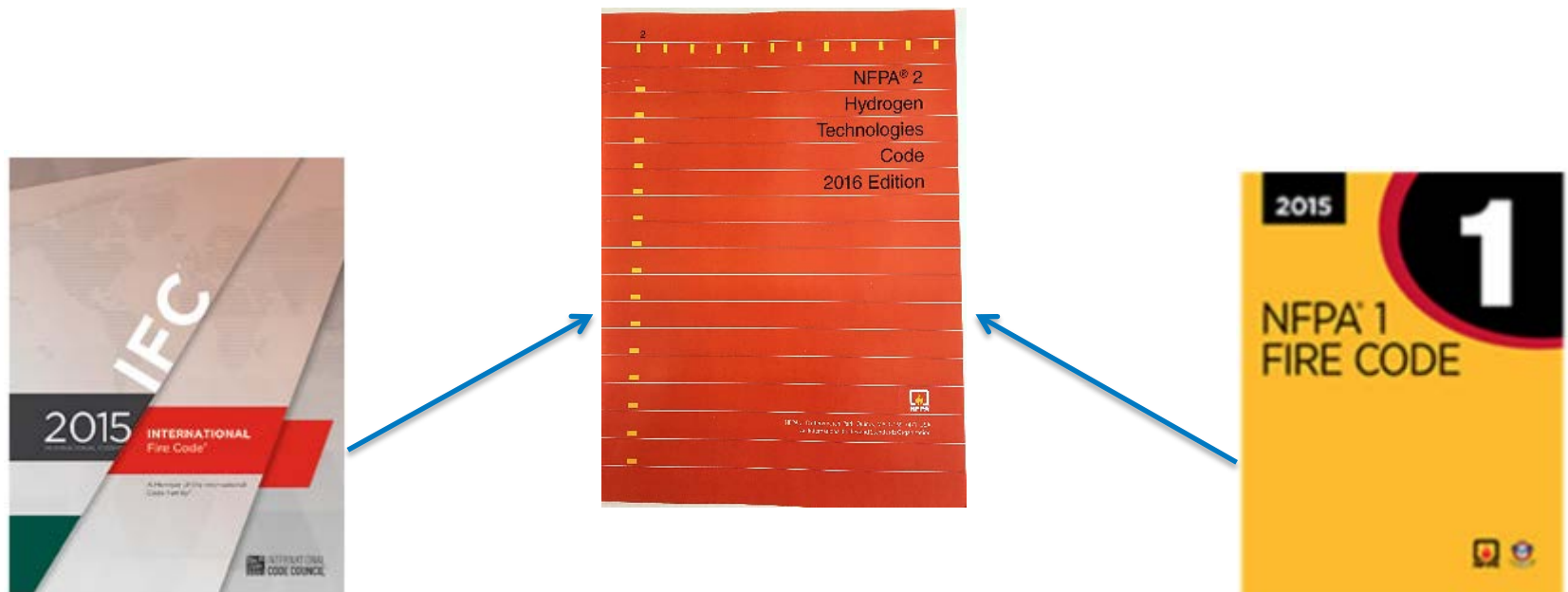
- Typically issued by the Fire Department coordinated with the Building Department
- Ensure compliance with Building and Fire Codes
- Key code- NFPA 2 Hydrogen Technologies Code addresses all aspects of hydrogen fueling stations
- True national code for hydrogen that will help standardize and accelerate permitting

NFPA 2 The National Hydrogen Safety Code –



Fire Code Coverage

- The *International Fire Code* (IFC) is in use or adopted in 42 states, the District of Columbia, NYC, Guam and Puerto Rico.
- NFPA 1 Uniform Fire Code adopted in 19 states (some states use both the International Fire Code and NFPA 1) which references NFPA 2
- 2015 International Fire Code references NFPA 2

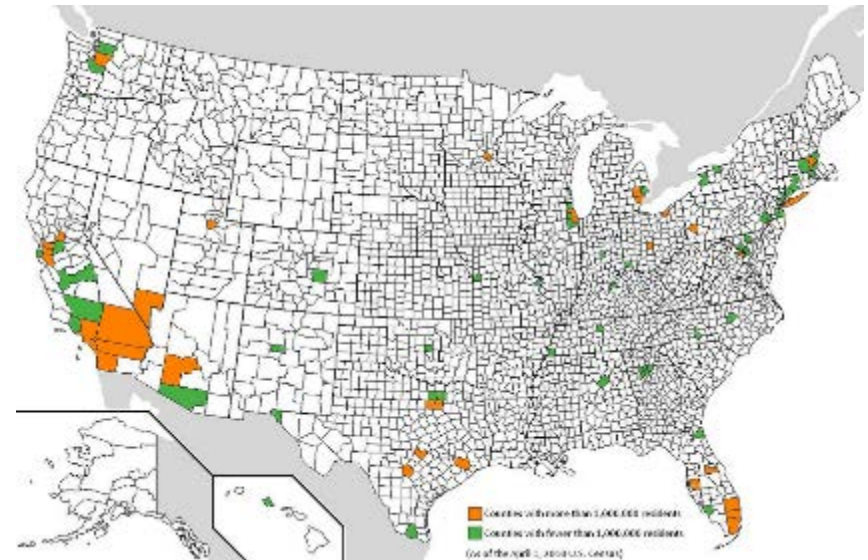


Topic 2. The Safety Permit: Building and Fire Codes

The Impact of a National Code

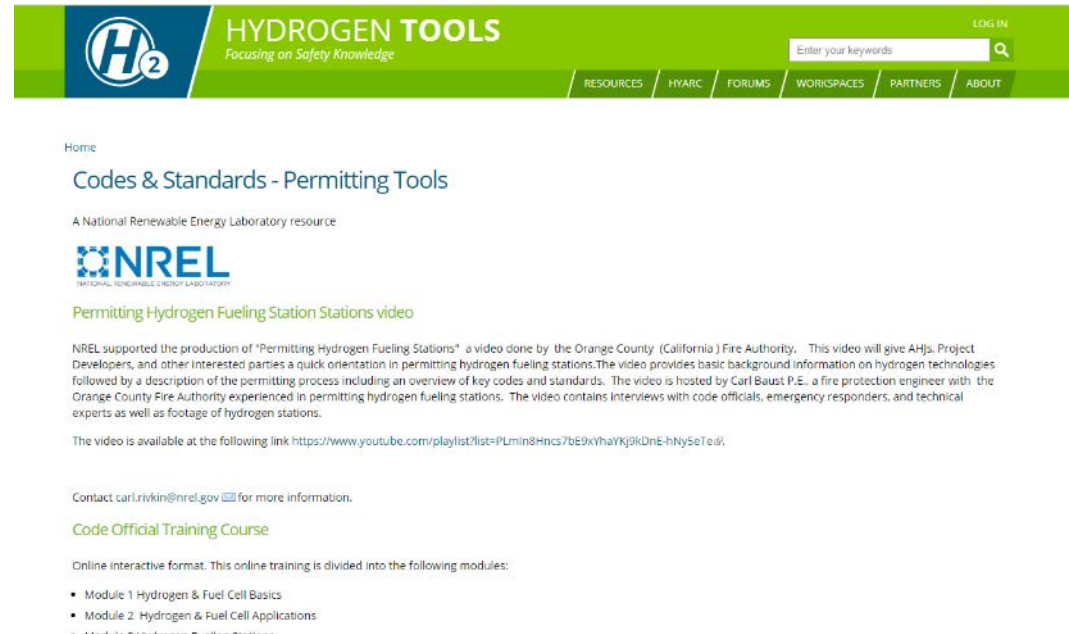
- Reduces variations in requirements among jurisdictions
- AHJ more likely to be familiar with requirements
- Industry can work with one document and one technical committee to make code changes
- Less confusion in identifying applicable requirements
- More likely to be current, complete, and consistent than a patchwork of codes

NFPA 2 The National Hydrogen Safety Code and the land of a thousand plus jurisdictions



Permitting Tools Streamline Process

- Permitting video – easiest access
- Code Official Training – online
- NREL technical reports providing detailed codes and standards citations
- National Permit Guide for Hydrogen Fueling Stations
- Permitting web site- detailed code citations
- Hydrogen technologies safety guide- detailed safety information
- **A TOOL FOR EVERY USER**



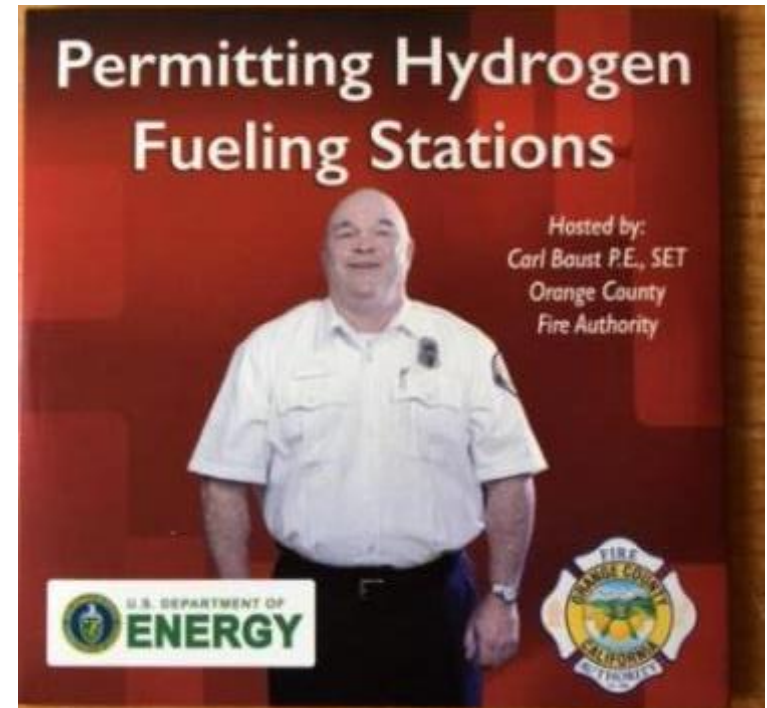
The screenshot shows the 'HYDROGEN TOOLS' website header with the tagline 'Focusing on Safety Knowledge'. The navigation menu includes 'RESOURCES', 'HYARC', 'FORUMS', 'WORKSPACES', 'PARTNERS', and 'ABOUT'. A search bar is present with the placeholder text 'Enter your keywords'. The main content area is titled 'Codes & Standards - Permitting Tools' and identifies it as a 'National Renewable Energy Laboratory resource'. It features the NREL logo and a section for 'Permitting Hydrogen Fueling Station Stations video'. The text describes a video produced by the Orange County (California) Fire Authority, hosted by Carl Baust, P.E., which provides basic background information on hydrogen technologies and a detailed description of the permitting process. A contact email 'carl.rivkin@nrel.gov' is provided for more information. Below this, there is a section for 'Code Official Training Course' which is an online interactive format divided into three modules: 'Module 1 Hydrogen & Fuel Cell Basics', 'Module 2 Hydrogen & Fuel Cell Applications', and 'Module 3 Hydrogen Fueling Stations'.

NREL permitting products provide guidance for both the infrequent user needing to get quickly oriented and the experienced user needing detailed information

Key Topics Addressed in Video

- Objective- get AHJ quickly oriented on hydrogen fueling station
 - Why there is an interest in fuel cell electric vehicles (FCEVs)
 - Basics of hydrogen technologies
 - Planning and building considerations
 - Fire department regulations
 - Annual station inspections

NREL Collaboration with OCFA



Video will get AHJs and project developers quickly oriented on hydrogen technologies and code requirements effectively streamlining the permitting process.

Code Official Training Course

Format: Interactive with multiple embedded files, links, audio, photos and schematics, and learning evaluation tool that provides awareness level training

Introduction to Hydrogen for Code Officials

U.S. Department of Energy
Hydrogen Program
hydrogen.energy.gov


COURSE MATERIALS LIBRARY EXIT

Hydrogen & Fuel Cell Basics Hydrogen & Fuel Cell Applications Hydrogen Fueling Stations Fuel Cell Facilities

Hydrogen Storage

Hydrogen has a very high energy content by weight (about three times more than gasoline), but a very low energy content by volume (about four times less than gasoline). As a result, storing hydrogen—particularly within the size and weight constraints of a vehicle—is challenging. All systems for storing and handling hydrogen are designed with safety in mind.

Today, hydrogen is commonly stored and transported in two ways. The two most common forms of hydrogen fuel are compressed hydrogen gas and cryogenic liquid hydrogen.



AC Transit maintains this hydrogen fueling facility in Oakland, California, to power fuel-cell buses.

Photo courtesy of Filmsight Productions

To learn more, visit the following links on the Fuel Cell Technologies Office website:

- [Hydrogen Storage](#) fact sheet
- [Hydrogen Storage](#) page

◀ Back 13 of 23 Next ▶

🔊 ||

Easy access, online training allows code officials and other parties quick
Orientation-https://www.hydrogen.energy.gov/training/code_official_training/

Stationary Fuel Cell Guide

- Telecommunications Industry Association Fuel Cell Focus Group – guide published April 2017

Background for market newcomer

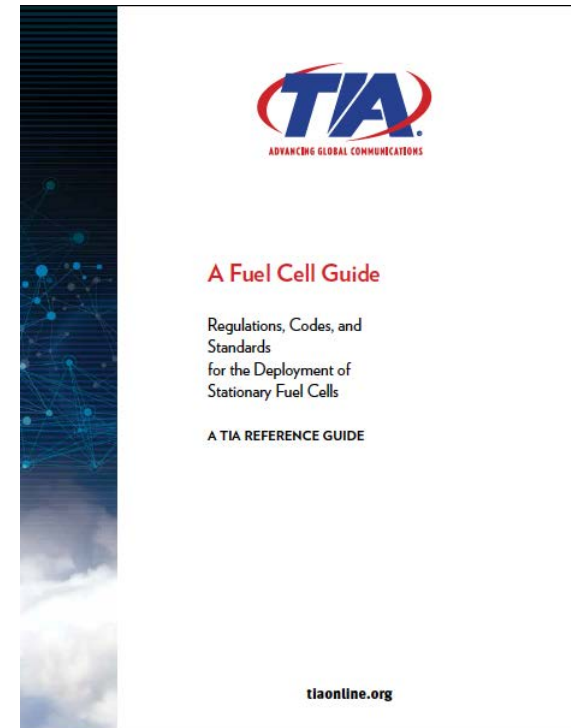
Generally Applicable Codes and Standard

Needed to expand fuel cell market

Fuel Supply Considerations

Clarify and speed up process

The Permitting process

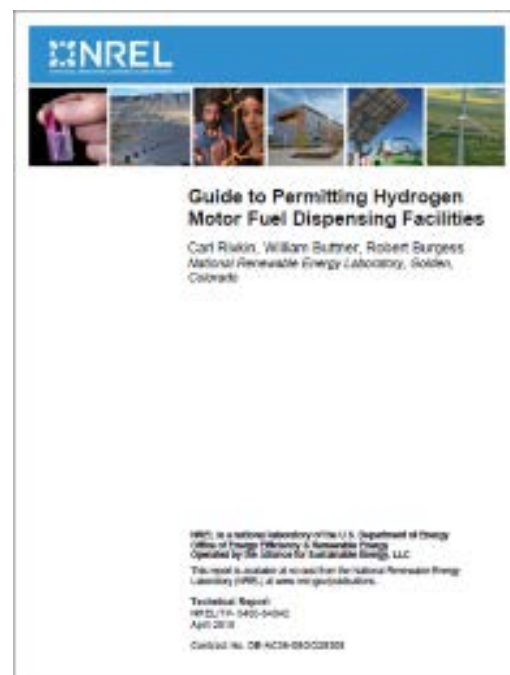


Guide will get more fuel cells installed faster and safer and expand more reliable infrastructure

Project Impact

- **Objective:** Reduce difficulty of permit development and review for hydrogen fueling stations
- Permit guidance document will provide information that will reduce work required to develop and review permits
- Guide covers different station configurations and codes and standards in detail
- Permitting will be faster and more efficient due to focused and detailed information on hydrogen fueling stations

Works with Permitting Video to Give more Detailed Information



Hydrogen Technologies Safety Guide

Key Features

- Meant to complement other hydrogen technologies permitting tools by giving more information in the following areas:
 - Properties of hydrogen
 - History of hydrogen use in industry
 - Comprehensive set of code references
 - Component and material selection for hydrogen storage and dispensing systems



Hydrogen Technologies Safety Guide

C. Rivkin, R. Burgess, and W. Buttner
National Renewable Energy Laboratory

NREL is a national laboratory of the U.S. Department of Energy
Office of Energy Efficiency & Renewable Energy
Operated by the Alliance for Sustainable Energy, LLC

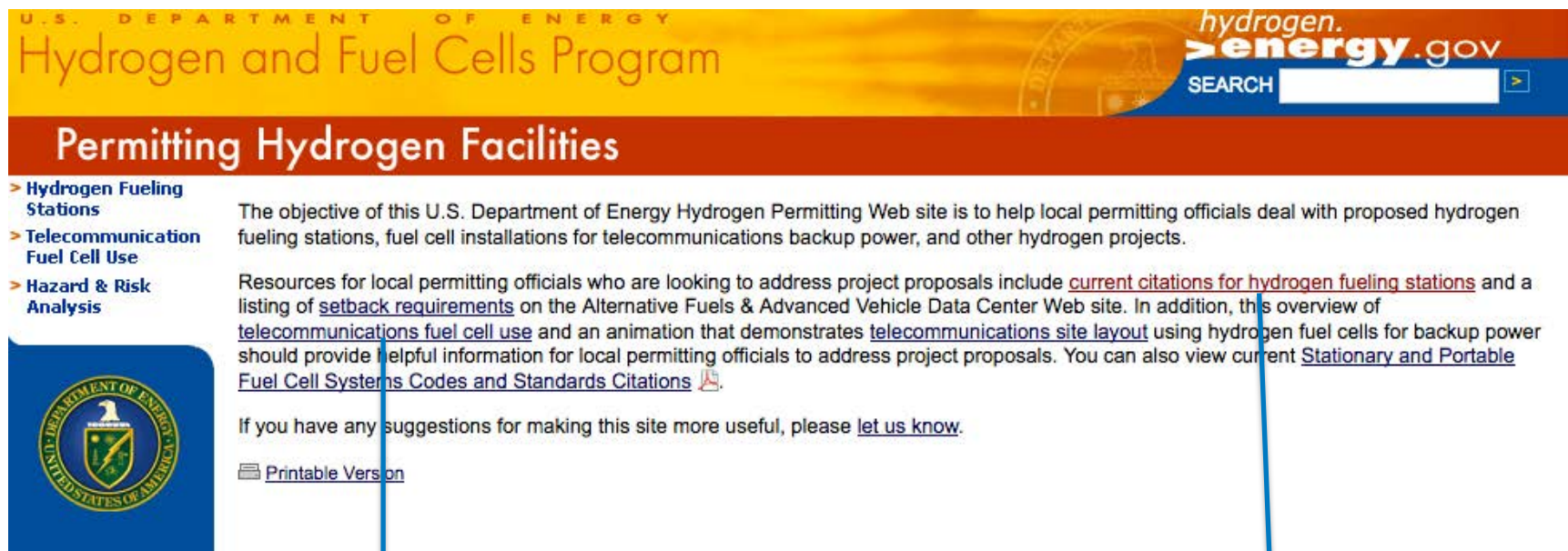
This report is available at no cost from the National Renewable Energy
Laboratory (NREL) at www.nrel.gov/publications.


Technical Report
NREL/TP-5400-60948
January 2015

Contract No. DE-AC36-08G021000


Published January 2015

DOE Permitting Tools Provide Independent Source of Permitting and Safety Information



The screenshot shows the top of a web page with a yellow and orange header. The text 'U.S. DEPARTMENT OF ENERGY' is at the top left, followed by 'Hydrogen and Fuel Cells Program'. On the right, there is a search bar with 'hydrogen.energy.gov' and a 'SEARCH' button. Below the header is a red banner with the text 'Permitting Hydrogen Facilities'. To the left of the main content is a blue sidebar with three menu items: '> Hydrogen Fueling Stations', '> Telecommunication Fuel Cell Use', and '> Hazard & Risk Analysis'. The main content area has a blue background and contains the following text: 'The objective of this U.S. Department of Energy Hydrogen Permitting Web site is to help local permitting officials deal with proposed hydrogen fueling stations, fuel cell installations for telecommunications backup power, and other hydrogen projects.' Below this is a paragraph of resources: 'Resources for local permitting officials who are looking to address project proposals include [current citations for hydrogen fueling stations](#) and a listing of [setback requirements](#) on the Alternative Fuels & Advanced Vehicle Data Center Web site. In addition, this overview of [telecommunications fuel cell use](#) and an animation that demonstrates [telecommunications site layout](#) using hydrogen fuel cells for backup power should provide helpful information for local permitting officials to address project proposals. You can also view current [Stationary and Portable Fuel Cell Systems Codes and Standards Citations](#) .

If you have any suggestions for making this site more useful, please [let us know](#).

 [Printable Version](#)

Two blue arrows point from the underlined links in the text to a box at the bottom of the page.

Detailed information for permitting hydrogen fueling stations and telecommunications fuel cells

DOE Permitting Web Site

Permitting Tools Provide Independent Source of Permitting and Safety Information

The screenshot shows the top portion of the DOE Alternative Fuels Data Center website. It includes the U.S. Department of Energy logo, the text 'Energy Efficiency & Renewable Energy', and the 'Alternative Fuels Data Center' title. A navigation menu contains links for 'FUELS & VEHICLES', 'CONSERVE FUEL', 'LOCATE STATIONS', 'LAWS & INCENTIVES', 'Maps & Data', and 'Case Studies'. A search bar is also visible.

This is a screenshot of a PDF document. The title is 'Hydrogen Vehicle and Infrastructure Codes and Standards Citations'. The text explains that the document lists codes and standards typically used for U.S. hydrogen vehicle and infrastructure projects, and provides instructions on how to use the document to identify applicable codes and standards for a specific project. It also includes a URL: www.afdc.energy.gov/afdc/codes_standards_basics.html.

Codes and Standards Resources

The codes and standards resources linked below help project developers and code officials prepare and review code-compliant projects.

Standards Development Organizations

Standards development organizations (SDOs) are responsible for leading the support and development of key codes and standards for alternative fuel vehicles, dispensing, storage, and infrastructure. The following charts show the SDOs responsible for these alternative fuel codes and standards.

- [Biodiesel Vehicle and Infrastructure Codes and Standards Chart](#)
- [Electric Vehicle and Infrastructure Codes and Standards Chart](#)
- [Ethanol Vehicle and Infrastructure Codes and Standards Chart](#)
- [National Template: Hydrogen Vehicle and Infrastructure Codes and Standards](#)
- [Natural Gas Vehicle and Infrastructure Codes and Standards Chart](#)
- [Propane Vehicle and Infrastructure Codes and Standards Chart](#)

Codes and Standards

The following documents are lists of nationally recognized codes and standards related to vehicles and infrastructure used for fuel projects. Additional codes and standards might exist for some jurisdictions.

- [Biodiesel Vehicle and Infrastructure Codes and Standards Citations](#)
- [Electric Vehicle and Infrastructure Codes and Standards Citations](#)
- [Ethanol Vehicle and Infrastructure Codes and Standards Citations](#)
- [Hydrogen Vehicle and Infrastructure Codes and Standards Citations](#)
- [Natural Gas Vehicle and Infrastructure Codes and Standards Citations](#)
- [Propane Vehicle and Infrastructure Codes and Standards Citations](#)

Detailed Code Citations in PDF

Topic 4. Facilitating the Permitting Process

Recollections of a young AHJ



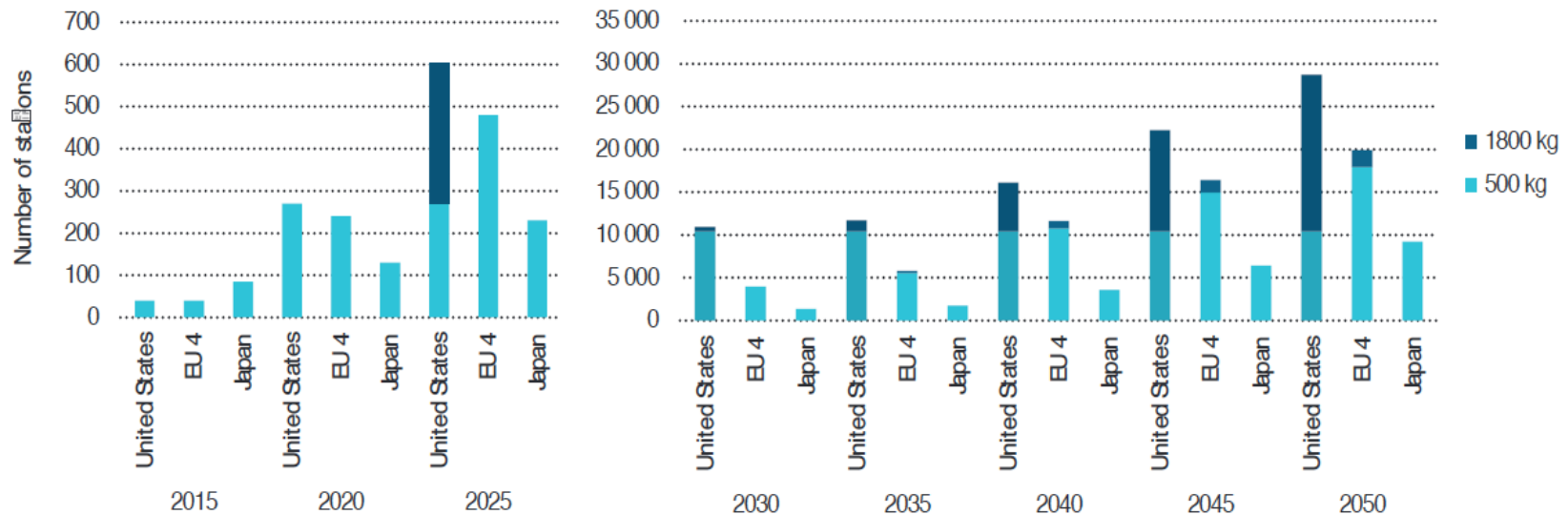
- AHJ in large jurisdictions operate on a tight timeline
- Typically have a back-log of applications
- The more the applicant can help the AHJ, the smoother the process
- Pre-permit submittal meeting to orient AHJ in application review can be helpful
- Summarize requirements and how the permit complies in a cover letter
- Avoid putting AHJ in position where will they have to defend a decision where they do not have expertise

Facilities a single AHJ might permit

- Steel manufacturing
- Small boat manufacturing
- Chemical dye plant
- Fertilizer Manufacturing plant
- Tannery
- Pulp and paper manufacturing
- Marine Coal terminal
- Automobile assembly plant
- Bowling ball manufacturing facility
- Municipal waste incinerator
- Copper refinery
- Crematory
- Poultry processing plant
- Automobile paint spray booth
- Cement kiln
- Asphalt plants
- Surfactant manufacturing
- Ethylene oxide treatment facilities
- Gasoline terminals
- Battery manufacturer

Topic 4. Facilitating the Permitting Process

- Progress in hydrogen infrastructure deployment (from IEA Technology Roadmap 2015) shows the number of hydrogen fueling stations will increase to the thousands in the US
- Now is the time for standard permits to address increased deployment of standardized fueling facilities



Topic 4. Facilitating the Permitting Process: Standard Permits

- What is a standard permit?
 - Permit is written for a facility or process with common attributes
 - Permit defines boundary conditions for a process or facility
 - Define code requirements for a process or facility and list key requirements in permit
- Why do standard permits?
 - Streamline process without compromising safety
 - Help both the permit applicant and the AHJ
 - Necessary in jurisdictions where large number of permits must be processed on a timeline defined by administrative regulations

Why Use a Standard Permit?

Boundary Conditions for Hydrogen Fueling Station

- Storage capacity limit
- Pressure limit
- Number of dispensers set
- Compliant piping, venting, and storage systems
- Required sensors, alarms, and emergency shut-offs
- Meet system start-up testing requirements
- Maintenance plan

Standard Permit

- If your facility falls within the following boundary conditions: X, Y, Z ...
- And if you meet the following conditions: X,Y,Z...
- Then, sign in the box agreeing compliance with the stated conditions
- And, you will be issued a permit

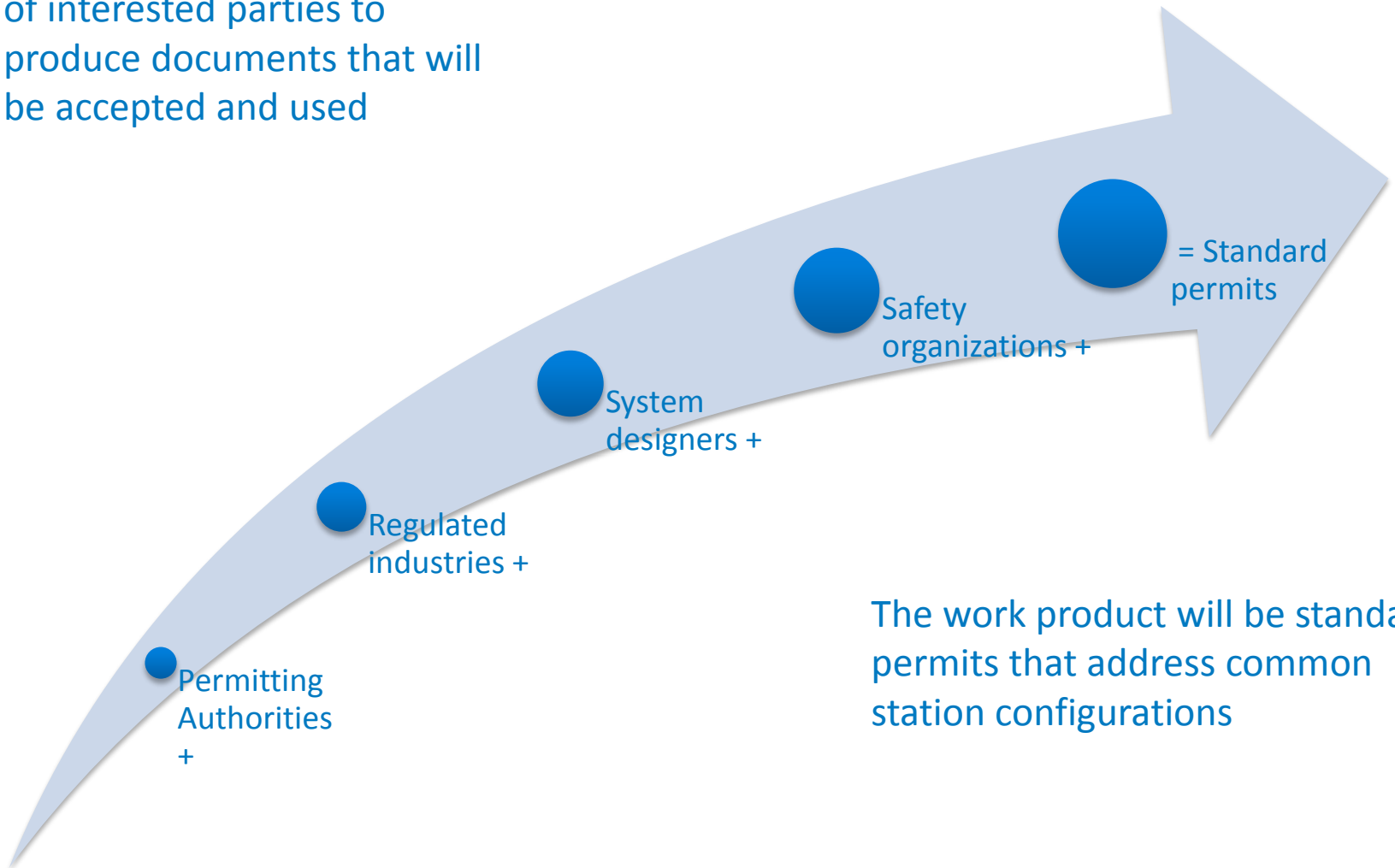


Example of Standard Permit Concept

Station Boundary Conditions	Standard Permit Conditions
Maximum fueling pressure	Station piping complies with ASME B31
Maximum storage capacity	Station storage vessels comply with ASME BPV
Number of dispensers	Station pressure relief complies with CGA
Capacity of existing fueling operations	Station meets all setback and electronic area classification requirements in NFPA 2
Operating hours before maintenance required	Station has all alarms and emergency shutoffs required by NFPA 2
Maximum number vehicles than be fueled in hour, day, year	Station complies with all maintenance, recordkeeping, and training requirements of NFPA 2
Types of fuels at station	Any modification of the system defined in the permit application requires review and approval of the AHJ
Hazardous materials storage at station- <ul style="list-style-type: none">• Type• Amount	The station has an emergency response plan and that plan has been coordinated with the local Emergency Responders
Operating restrictions based on zoning ordinances	The station is in compliance with all ordinances

Developing Standard Permits

Process requires collaboration of interested parties to produce documents that will be accepted and used



The work product will be standard permits that address common station configurations

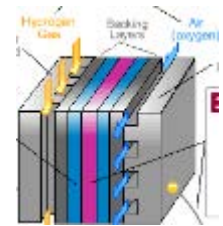
Summary

- DOE has supported the development of a comprehensive set of codes and standards to permit hydrogen technologies
- DOE and NREL have developed a comprehensive set of permitting tools to complement the codes and standards
 - These codes include a national hydrogen code NFPA 2
 - These codes and standards are now being field tested and improvements made through the CCSI process
 - Thousands of fueling stations must be built to support commercial deployment of FCEVs
 - Hydrogen fueling stations are coalescing around standard designs
- The combination of standard station designs and a national hydrogen code present the opportunity for standard station permits
- Standard permits can accelerate the station permitting process without compromising public safety

Thank You and Questions

- **Carl Rivkin, CSP, P.E.** - *Manager, Safety Codes & Standards*
carl.rivkin@nrel.gov

This work is supported by the DOE EERE Fuel Cell Technology Office!



U.S. DEPARTMENT OF
ENERGY

Office of
**ENERGY EFFICIENCY &
RENEWABLE ENERGY**

 **NREL**
NATIONAL RENEWABLE ENERGY LABORATORY

Thank you

DOEFuelCellWebinars@ee.doe.gov

hydrogenandfuelcells.energy.gov