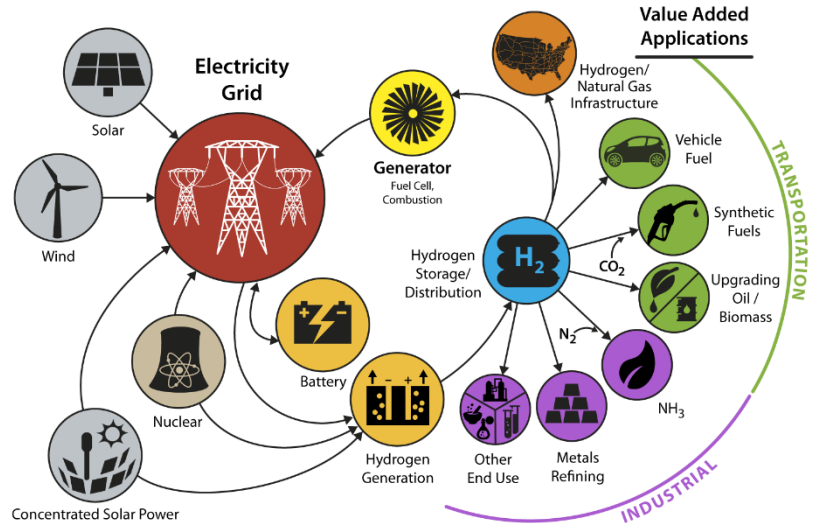


H2@Scale Workshop

November 16-17 2016, National Renewable Energy Lab – Golden, CO

Background

H2@Scale is a concept that describes the potential of wide-scale renewable hydrogen production to dramatically reduce U.S. greenhouse gas emissions. Hydrogen is currently a feedstock for numerous industrial applications: petroleum refining, fertilizer production, biofuels production, and others (e.g. plastics, cosmetics, and food industries). Ten million metric tons of hydrogen are currently produced in the US every year (95% of which is via centralized reforming of natural gas¹, usually without carbon capture and sequestration). Widespread use of technologies that are clean and/or renewable to produce hydrogen would be a paradigm shift that deeply decarbonizes current industries, along with emerging value-add applications, such as synthetic natural gas production or use of hydrogen in metals refining. Moreover, renewable hydrogen production has been identified as a viable approach for energy storage that can enable grid stability in regions of the country with high penetrations of renewables.² If you are not familiar with the H2@Scale concept, this previously held webinar³ provides an overview of the national lab 'big idea' and how it can enable deep decarbonization across sectors.



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Objectives

The purpose of this workshop is to identify the current barriers and research needs for wide-scale deployment of renewable hydrogen production. Along with a Request for Information that is currently open⁴, the workshop will guide the development of a DOE roadmap on research, development, and demonstration activities that can enable hydrogen as an energy carrier at a national scale. Specifically, DOE will obtain feedback from industry, regulatory bodies, utilities, and other stakeholders to identify the opportunities, challenges, and barriers for H2@Scale.

- The first day will provide an overview on the H2@Scale concept. Participants will discuss challenges and needs for value-add applications (i.e. metals refining, ammonia production, production of liquid fuels), as well as enabling renewables integration with the grid. A high-level breakout session will collect input on primary barriers to success.
- On the second day, participants will engage in deep-dive breakout sessions to provide more targeted feedback on R&D challenges that DOE can help address. Breakout sessions will focus on various industrial uses for hydrogen and on the electric grid perspective.

¹ <http://energy.gov/eere/fuelcells/hydrogen-production-natural-gas-reforming>

² <http://www.nrel.gov/docs/fy15osti/62518.pdf>

³ <http://energy.gov/eere/fuelcells/downloads/h2-scale-potential-opportunity-webinar>

⁴ <https://eere-exchange.energy.gov/#Foald962c3a0a-3bd1-4331-af59-678214bb27d5>

Workshop Agenda

Day 1 – November 16

8:00 – 8:30 AM **Registration**

8:30 – 10:00 AM **Plenary Session**

- Workshop Overview, *Reuben Sarkar (Deputy Assistant Secretary for Transportation, U.S. Department of Energy) and Dr. Sunita Satyapal (Director of U.S. Department of Energy Fuel Cell Technologies Office)*
- H2@Scale Overview, *Dr. Bryan Pivovar (Manager of Electrochemical Engineering and Materials Chemistry Group at the National Renewable Energy Laboratory)*
- Electrolysis Integration with Energy Infrastructure, *Dr. Jeffrey Reed (Director of Business Strategy and Advanced Technology, SoCal Gas)*
- Decarbonizing Industrial Processes using Renewable Hydrogen, *Dr. Richard Boardman (Energy Systems Integration Initiatives at Idaho National Laboratory)*

10:00 – 10:15 PM **Break**

10:15 – 11:45 AM **DOE Collaboration Panel**

Discover the cross-cutting value of hydrogen production to a variety of DOE offices. Offices represented will include the Office of Strategic Programs (*Sarah Garman, Policy Analyst*), Energy Efficiency and Renewable Energy (*Levi Irwin, Solar Energy Technologies Office*), Nuclear Energy (*Dr. Carl Sink, Director*), Fossil Energy (*David Lyons, Technology Manager*), Manufacturing (*Dr. Sridhar Seetharam, Senior Technical Advisor*), and Bioenergy Technologies Office (*Kevin Craig, Program Manager of Conversion Technologies*).

11:45 – 1:00 PM **Networking Lunch**

1:00 – 2:15 PM **Hydrogen Production, Storage, and Distribution: Overview and Challenges**

Presentations will describe the current status and R&D challenges associated with large-scale electrolysis and hydrogen delivery technologies, such as pipelines, caverns, liquefaction, and fueling stations. Presenters will include *Dr. Kathy Ayers (Vice President of Research and Development, Proton Onsite)*, along with representatives from hydrogen infrastructure development and industrial gas companies (*Tim Brown, First Element, & Al Burgunder, Praxair*), and a discussion of the world's largest wind-to-hydrogen demonstration by *Dr. Birgit Scheppat (H2BZ- Initiative Hessen)*.

2:15 – 2:30 PM **Break**

2:30 – 3:45 PM Grid and Utilities Panel

Discussion of the compatibility of hydrogen production with current and future electricity generation technologies. Representatives from electric utilities including *Dr. Noah Meeks (Southern Company)* and *Marino Monardi (PG&E Corporation)* will share their perspectives, along with *Evolved Energy Research* providing a high-level analysis aligned with meeting global climate goals.

3:45 – 5:15 PM Day 1 Breakout Sessions: H2@Scale Path Forward

Discuss the role of government, industry, and academia in addressing R&D, economic, and policy barriers to wide-scale deployment of renewable and low-carbon hydrogen. Identify priority needs in R&D that will enable implementation of the H2@Scale vision. Breakout sessions will be divided by topic, including:

1. Incorporating hydrogen production with current and future power generation
2. Integrating value-add applications of hydrogen in current and future markets
3. Infrastructure needs for wide-scale deployment of hydrogen

5:15 – 5:30 PM Report Out

5:30 – 7:30 PM Networking dinner/reception

Day 2 – November 17

8:00 – 9:30 AM Industrial End-Uses Panel

This panel will be kicked off with a presentation from *Dr. Mark Johnson (Director of the U.S. Department of Energy's Advanced Manufacturing Office)*. Discussion of current and value-add industrial end-uses of hydrogen. End-uses covered will include ammonia production by *Dr. Grigori Soloveichik (DOE ARPA-E)*, metals refining by *Dr. Hong Yong Sohn (University of Utah)*, and fuels production *Jon La Follet (Shell)*.

9:30 – 9:45 AM Break

9:45 – 11:15 AM Day 2 Breakout Sessions: Industrial End-Uses

Discussion of opportunities and barriers in using renewable and low-carbon hydrogen in end-use applications. Attendees will have a chance to continue discussions from Day 1. Day 2 breakout session topics will focus on:

1. Chemical applications of hydrogen, such as ammonia production
2. Use of hydrogen in fuels (e.g. synthetic gas, upgrading of petroleum, conversion of bio-oils)
3. Integration of hydrogen with metals refining (e.g. use of hydrogen as a reductant)

11:15 – 12:00 PM Report Out and Closing Remarks

1:00 - 2:30 PM Optional Site Tour