U.S. DEPARTMENT OF ENERGY

Office of ENERGY EFFICIENCY & RENEWABLE ENERGY

H2@Scale: Enabling affordable, reliable, clean, and secure energy across sectors.

H2@Scale U.S. Department of Energy

What is H2@Scale?

H2@Scale is a U.S. Department of Energy (DOE) initiative that brings together stakeholders to advance affordable hydrogen production, transport, storage, and utilization to increase revenue opportunities in multiple energy sectors. It includes DOE funded projects and national laboratory-industry co-funded activities to accelerate the early-stage research, development, and demonstration of applicable hydrogen technologies.

The U.S. currently produces more than **10 million tonnes** of hydrogen, roughly one seventh of the global supply, primarily for oil refining and fertilizer. Large-scale infrastructure includes over 1,600 miles of hydrogen pipelines, a growing network of stations, and thousands of tons of storage in underground caverns.

Why H2@Scale?

Hydrogen can enable U.S. energy security, resiliency, and economic prosperity, and is part of our "all of the above" energy strategy for these reasons:

1) Hydrogen can be produced from diverse domestic resources for use in multiple sectors, or for export.
2) Hydrogen has the highest energy content by weight of all known fuels—3X higher than gasoline—and is a critical feedstock for the entire chemicals industry, including liquid fuels.
3) Hydrogen and fuel cells can enable zero or near zero emissions in transportation, stationary or remote power, and portable power applications.
4) Hydrogen can be used as a "responsive load" on the grid to enable grid stability and gigawatt-hour energy storage, and increase utilization of power generators, ***including nuclear, coal, natural gas, and renewables.***
5) Hydrogen can enable innovations in domestic industries, such as transportation (e.g., in vehicles, aviation, and marine applications) and iron making.

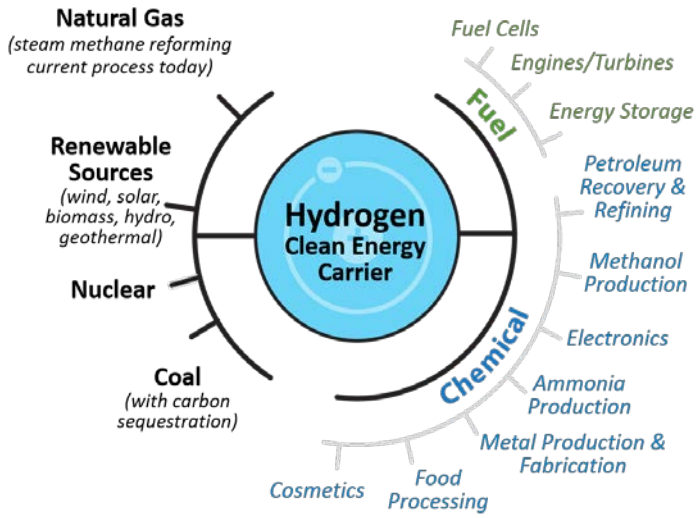


Figure 1 depicts the H2@Scale vision with hydrogen as an energy carrier, like electricity—that also serves as a critical feedstock in multiple industries.

More than 20 industry projects are part of the H2@Scale initiative.

Emerging Hydrogen Markets

Hydrogen is an essential feedstock and fuel in many current and emerging industries, such as the petrochemical sector and fuel cell transportation. Thousands of fuel cells are already in use in commercial vehicles, forklifts, and backup power units throughout the U.S. The next steps to expand the value proposition of hydrogen technologies are to grow hydrogen infrastructure and determine additional applications where hydrogen has a strong business case. Examples include steel manufacturing, the production of ammonia and liquid fuels (using CO_2 plus hydrogen), and the use of hydrogen for marine, rail, datacenter, and heavy-duty vehicle applications.

Hydrogen is the energy carrier that unites all our nation's energy resources: natural gas, coal, nuclear, and renewables.

Regional development of hydrogen infrastructure and end-use technologies could enable economies of scale, making hydrogen more affordable.

H2@Scale R&D Challenges

The DOE's H2@Scale Consortium facilitates R&D projects that leverage the world-class capabilites of the national laboratories in partnership with industry and academia. Partnerships with key stakeholders (e.g., power generators and technology developers) on early stage R&D projects can be facilitated through cooperative agreements with matching DOE funds. R&D challenges to enable the goals of H2@Scale span hydrogen production, delivery, storage, infrastructure, and use in diverse applications. While DOE's role focuses on early-stage R&D, such as new concepts for dispatchable hydrogen production, delivery, and storage, reliance on the private sector for demonstration is critical. First-of-its-kind demonstrations can allow cutting edge technologies to be integrated into existing systems and validated to show a business case for future deployments and guide future R&D plans.

Call to Action for Stakeholders

- Respond to Requests for Information (RFIs) to identify potential early, economically viable applications for scaling hydrogen regionally.
- Take part in merit reviews of proposed approaches using rigorous criteria for technical and economic viability, scalability, and value.
- Leverage early-stage R&D resources and funding through partnerships with national labs in the H2@Scale Consortium.
- Provide data from industry-led demonstrations to help guide early-stage R&D and disseminate progress through H2@Scale Consortium and working groups.

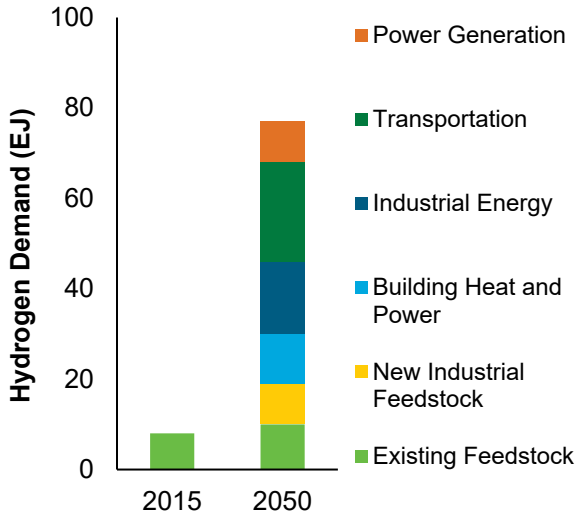
Focus Areas

Regional focus areas include, but are not limited to:

- West Coast
- Southeast
- Northeast
- Central
- Midwest

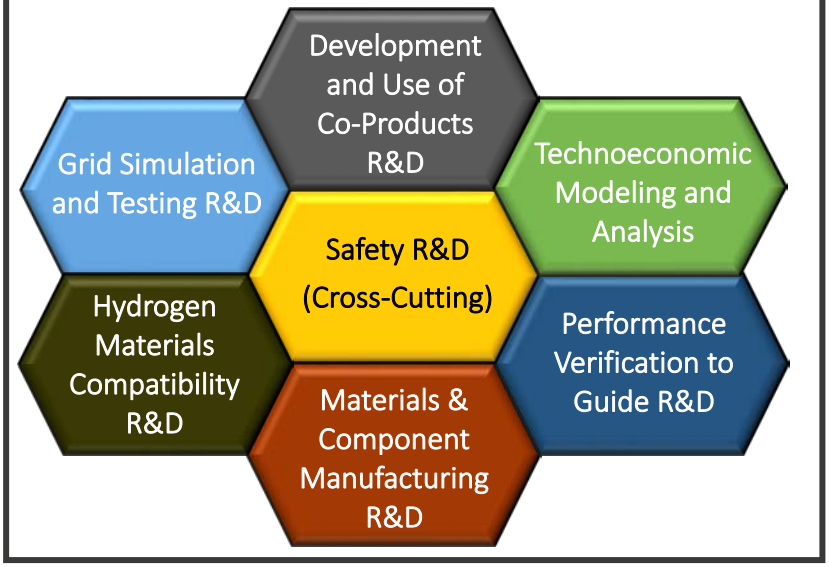
Companies, universities, and local organizations could all be involved in regional clusters and applications for scaling hydrogen, supported by technical expertise and early-stage R&D from National Laboratories through Cooperative Research and Development Agreement (CRADA) projects.

VALUE PROPOSITION[2]



2. Source: "Hydrogen Scaling Up." Hydrogen Council. November 2017. http://hydrogencouncil.com/wp-content/uploads/2017/11/Hydrogen-scaling-up-Hydrogen-Council.pdf

H2@Scale Consortium R&D Pillars



Emerging applications for hydrogen can enable 10-fold growth in global demand.[2]

How Does it Work?

To join the H2@Scale Consortium through cost-shared CRADA projects, interested stakeholders can view national lab capabilities at https://www.energy.gov/eere/fuelcells/h2-scale and determine which lab capabilities and/or working groups may be of value. Contact: H2Scale@ee.doe.gov.