SHASTA

Subsurface Hydrogen Assessment, Storage, and Technology Acceleration

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https://edx.netl.doe.gov/shasta/

Enabling an Accelerated and Affordable Clean Hydrogen Future - Fossil Energy Sector's Role

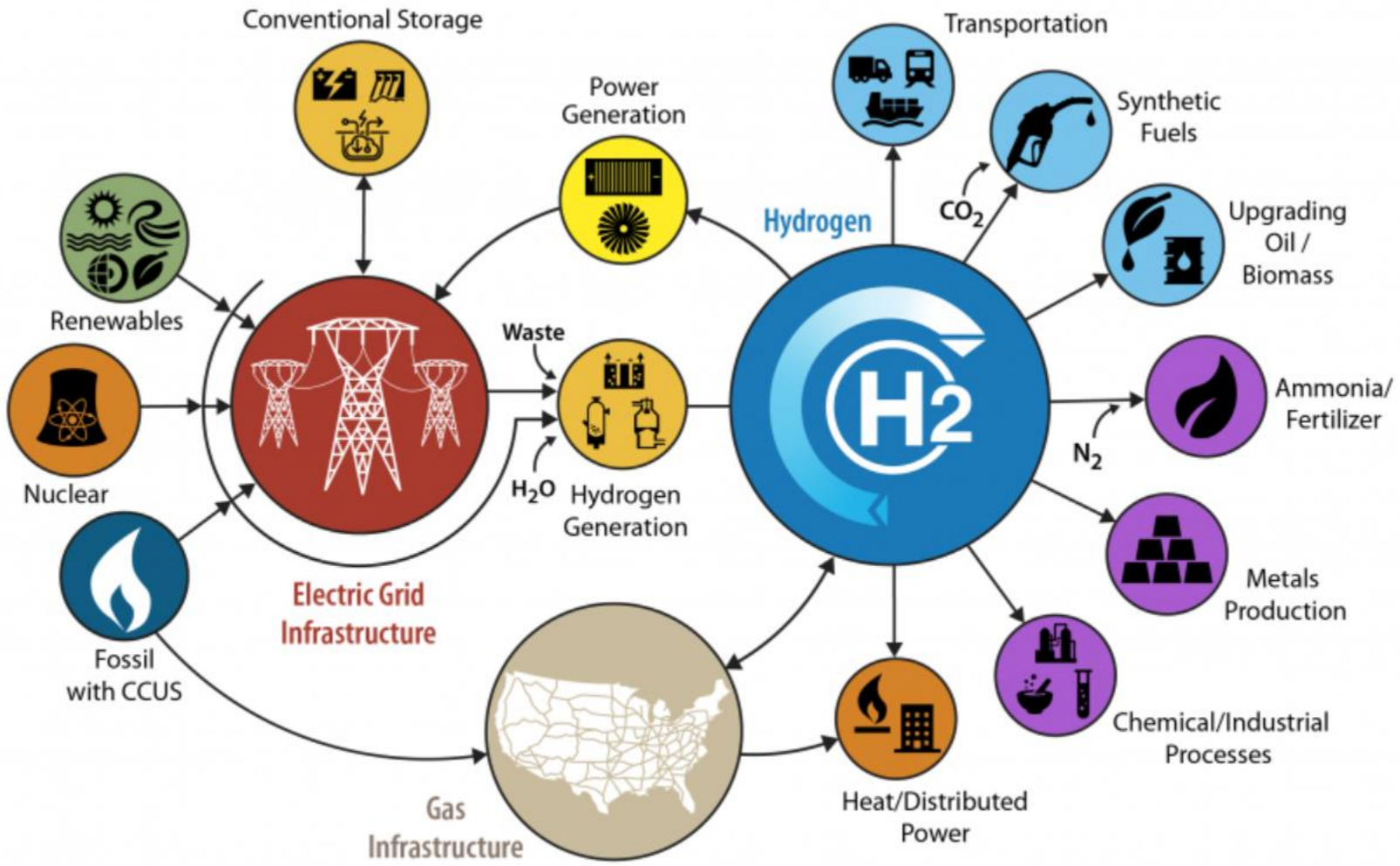
NETL-GTI Workshop – September 27-28, 2021

NATIONAL ENERGY TECHNOLOGY LABORATORY

Pacific Northwest NATIONAL LABORATORY

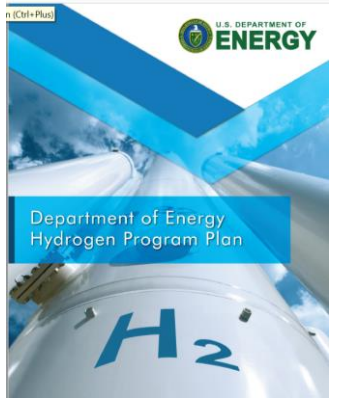
Lawrence Livermore National Laboratory

DOE's hydrogen program plan



https://www.energy.gov/eere/fuelcells/h2scale

- Hydrogen's potential to meet existing and emerging market demands across multiple sectors
- Envisions how innovations to produce, store, transport, and utilize hydrogen can help realize that potential and achieve scale to drive revenue opportunities and reduce costs



https://www.hydrogen.energy.gov/pdfs/hydrogen-program-plan-2020.pdf

DOE's hydrogen program plan

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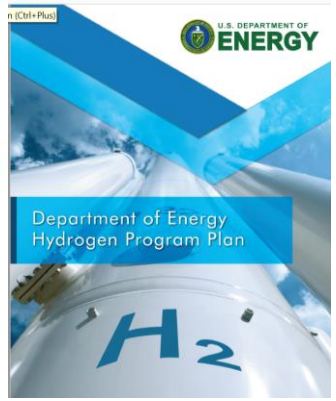
	NEAR-TERM	LONGER-TERM
Production	Gasification of coal, biomass, and waste with carbon capture, utilization, and storage Advanced fossil and biomass reforming/conversion Electrolysis (low-temperature, high-temperature)	Advanced biological/microbial conversion Advanced thermo/photoelectro-chemical H_2O splitting
Delivery	Distribution from on-site production Tube trailers (gaseous H_2) Cryogenic trucks (liquid H_2)	Widespread pipeline transmission and distribution Chemical H_2 carriers
Storage	Pressurized tanks (gaseous H_2) Cryogenic vessels (liquid H_2)	Geologic H_2 storage (e.g., caverns, depleted oil/gas reservoirs) Cryo-compressed Chemical H_2 carriers Materials-based H_2 storage
Conversion	Turbine combustion Fuel cells	Advanced combustion Next generation fuel cells Fuel cell/combustion hybrids Reversible fuel cells
Applications	Fuel refining Space applications Portable power	Blending in natural gas pipelines Distributed stationary power Transportation Distributed CHP Industrial and chemical processes Defense, security, and logistics applications Utility systems Integrated energy systems

Figure 2. Key hydrogen technology options



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SHASTA project overview

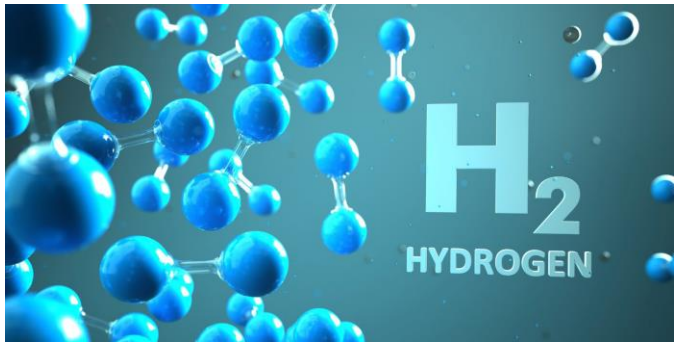
SHASTA
Subsurface Hydrogen Assessment, Storage, and Technology Acceleration

Objective

Identify and **address key technological hurdles** and **develop tools and technologies** to enable broad public acceptance for **subsurface storage** of pure hydrogen and hydrogen/natural gas mixtures

- Elucidate ***operational risks***, quantify the ***potential for resource losses***, develop ***enabling tools, technologies, recommended practices***, and develop a ***collaborative field-scale test*** plan in partnership with at least one natural gas storage industrial partner
- Focus on ***reservoir performance*** and ***well component compatibility*** in the storage system
  - *Pipelines and surface components upstream from the wellhead are covered by separate DOE research activities*

- Multi-National Lab Effort: Leverages unique capabilities and demonstrated expertise in subsurface energy systems
  - NETL (Angela Goodman)
  - PNNL (Nik Huerta)
  - LLNL (Josh White)



Project impacts

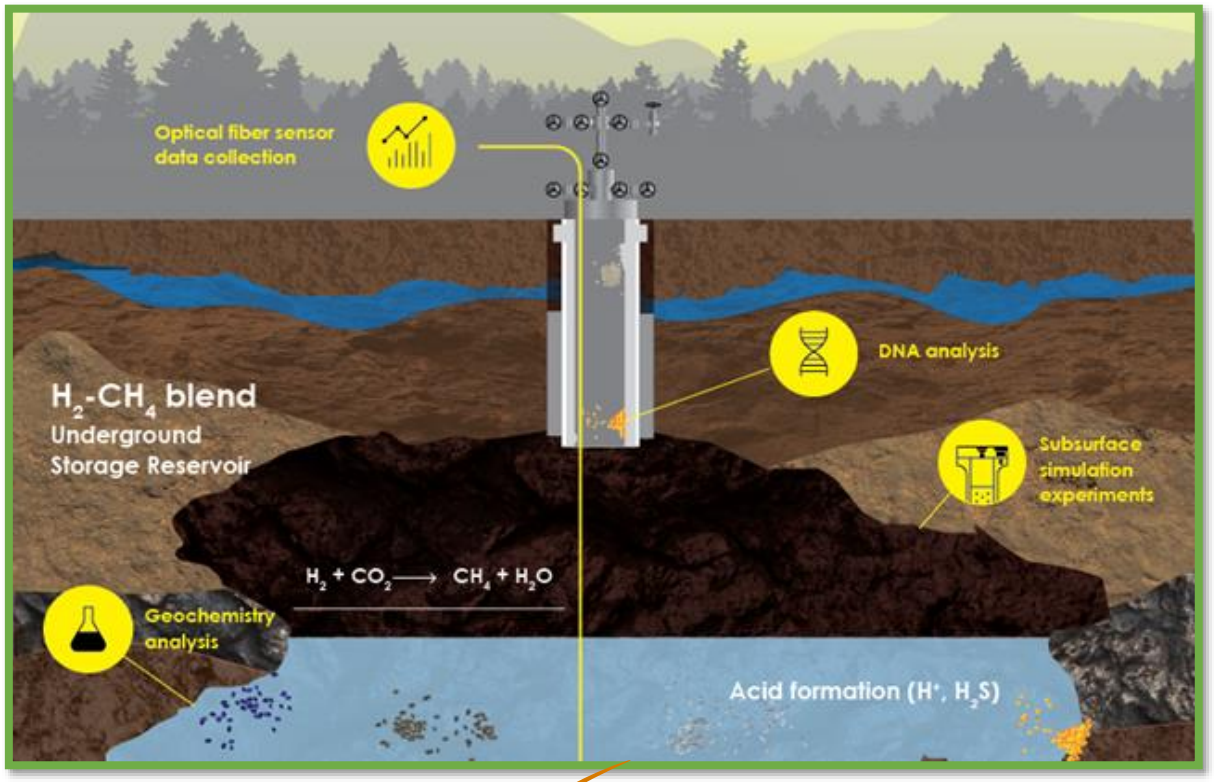
- **Assess and address the operational risks associated with reservoir storage**
  - Determine the ***technical practicability and quantify operational and production risks associated with H_2 gas storage*** in subsurface systems
  - Quantify materials compatibility, elucidating core- and reservoir-scale performance, and characterizing microbial interactions
  - Address key operational uncertainties
    - Potential for well integrity loss from interaction with hydrogen and microbial communities
    - Deleterious near-well biogeochemical reactions
    - Reservoir-performance issues due to multicomponent flow in porous media

- **Develop enabling technologies and tools**
  - Enable technologies to enhance H_2 subsurface storage success by reducing risks and costs, including advanced real-time sensor technologies, reservoir simulator tools, well surveillance, and facility screening tools.
- **Develop a *scientifically informed* field test plan to reduce remaining uncertainties in system performance**
  - Efforts will help accelerate and expand the use of H_2 by leveraging existing facilities (e.g., existing natural gas storage facilities) as storage sites across the United States.
  - Fill an important industry need by ***accelerating the technology along the development path*** (recommended practices) and enabling an industry partner to advance to the critical development step of conducting field-scale tests.

SHASTA

Subsurface Hydrogen Assessment, Storage, and Technology Acceleration

GOAL: Identify and address key technological hurdles and develop tools and technologies to enable broad public acceptance for subsurface storage of hydrogen blended with natural gas and pure hydrogen



1. **RISK QUANTIFICATION (EXPERIMENT & SIMULATION)**
   - ✓ SURVEY STATE OF KNOWLEDGE
   - ✓ CAPABILITIES ESTABLISHMENT
   - ✓ FUNDAMENTAL WORK
   - ✓ RISKS
2. **ENABLING TECHNOLOGIES TO MANAGE H_2 STORAGE**
   - ✓ TECHNOLOGY TRANSFER THROUGH SOFTWARE DEVELOPMENT
   - ✓ ADVANCED TECHNOLOGY SUITE TO SUPPORT H_2 SUBSURFACE STORAGE SYSTEM
3. **RECOMMENDED PRACTICES AND INDUSTRY ENGAGEMENT**
   - ✓ KNOWLEDGE TRANSFER THROUGH RECOMMENDED PRACTICES
   - ✓ TECHNOECONOMICS AND THE BUSINESS CASE
   - ✓ INDUSTRY ENGAGEMENT AND PILOT STUDY PREPARATION

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