NETL RWFI Energy 101- Hydrogen

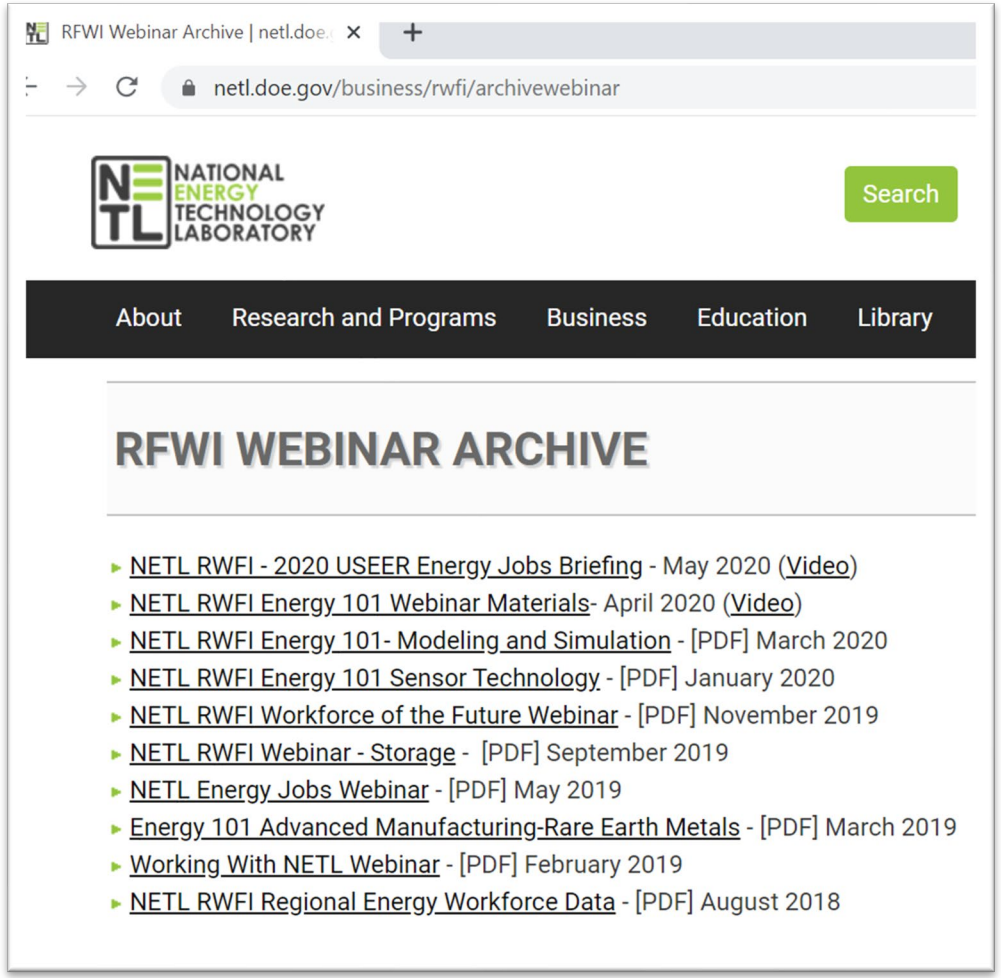
Welcome to the Webinar

Agenda

- The Regional Workforce Initiative - Anthony Armaly, Federal Coordinator NETL RWFI
- Hydrogen 101 - Nathan Weiland
- Hydrogen Workforce and Economic Development Question and Answer Panel

- Please Mute Your Line if you have not already
- We will have the presentation up on the NETL RWFI Website shortly after the webinar

NETL RWFI Energy 101- Hydrogen and the Low Carbon Economy



Energy 101 Webinars

The NETL RWFI Energy 101 Series provides a basic primer on the research and development conducted at NETL. Researchers at the Lab present information on their work in an easy-to-follow and thus easy-to-communicate fashion. Discussion topics include the potential economic and workforce development opportunities that successful research into these topics and their related challenges.

A YouTube page for recordings and Webinar Archive is at the RWFI webpage

NETL Regional Workforce Initiative (NETL RWFI)

NATIONAL ENERGY TECHNOLOGY LABORATORY

A Focus on Appalachia and the future of Energy and Advanced Manufacturing Regional Workforce Readiness and Economic Development

U.S. DEPARTMENT OF ENERGY

NETL RWFI Mission Statement

NETL RWFI is a platform for engagement and collaboration with key stakeholders who are critical for the deployment of U.S. DOE and NETL Energy and Advanced Manufacturing technological research.

Supporting Regional Economic and Workforce Development opportunities.

Key NETL RWFI Metrics

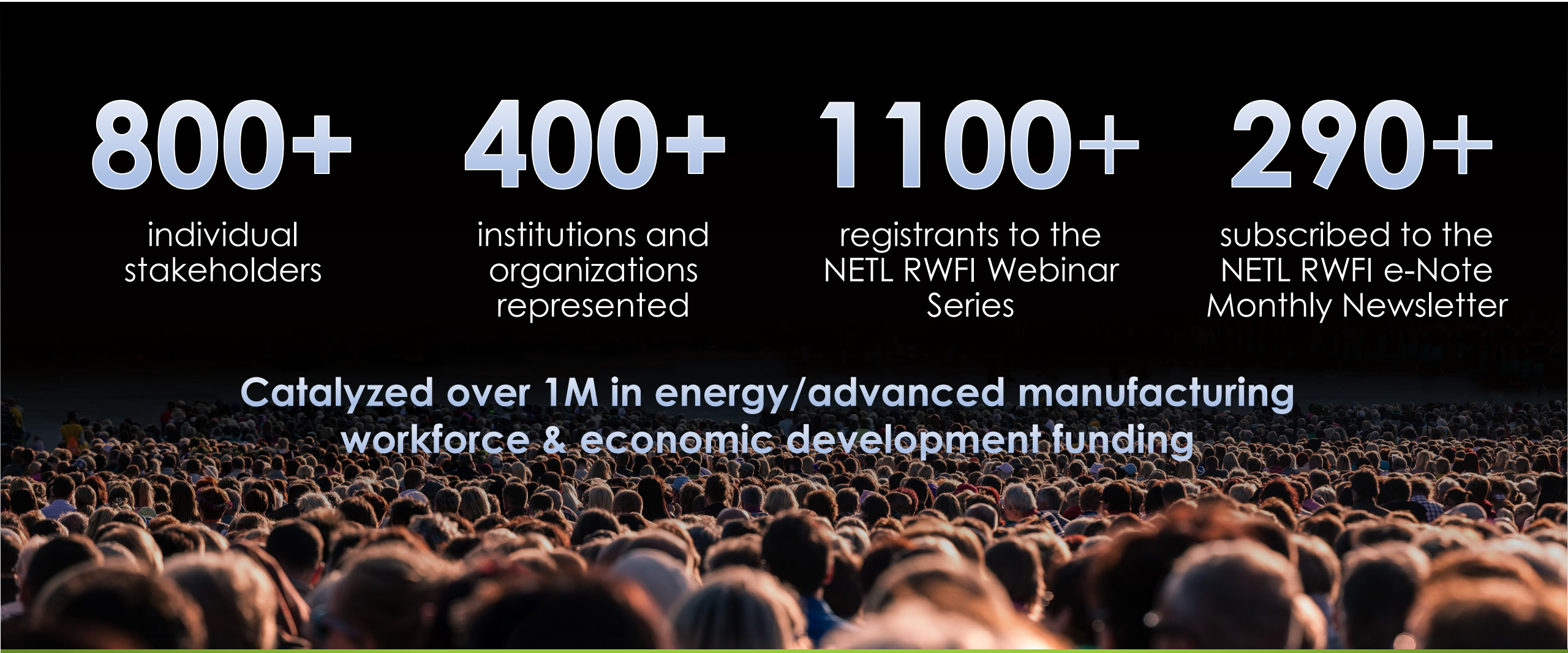
800+
individual stakeholders

400+
institutions and organizations represented

1100+
registrants to the NETL RWFI Webinar Series

290+
subscribed to the NETL RWFI e-Note Monthly Newsletter

Catalyzed over 1M in energy/advanced manufacturing workforce & economic development funding



Key Outcomes to Date

The Workforce Readiness Plan Pilot

- What occupations are needed & what skills/education is required for those occupations. (Future casting)
- NETL technology 3-5 years from commercialization 4 questions
- Effort to understand occupations and skills necessary for the future
- DOE now requires a statement of job creation on FOA's

APPENDIX H – WORKFORCE READINESS PLAN TEMPLATE

This is a suggested format. If it makes sense for the Recipient to present the information in a different format, it may do so provided all content is covered.
This document should generally be 1 – 2 pages in length.

Recipient Name:

PI Name:

Award Number:

Project Title:

Technology:

Availability and accessibility of training programs: *Describe the necessary skillset and training required to prepare the workforce needed to commercialize/deploy the technology. Discuss availability of training and educational programs to fill current or projected activity/commercialization need.*

Ongoing or planned collaborations with education and training providers: *Describe plans and approaches to access the necessary training for the workforce needed to commercialize/deploy the technology. This includes coordination with educational institutions such as community colleges, technical schools, and universities, company-led in-house training, union training, etc. Please identify any institutions with which working relationships exist.*

Identify any necessary certificates, certifications or other educational attainment involved in this technology/activity.

Examples include apprenticeships, certificates, certifications, academic training or other programs available through in-house training or in coordination with education institutions such as community colleges, technical schools, universities, unions or other professional associations.

Identify any Economically Distressed Communities or state or federal designated Opportunity Zones or other geographically defined empowerment zones where this activity may occur. *(example: Appalachian region distressed or defined counties)*

Workplan Skills and Occupation Database

Job/Career Field Name	Skills Needed	Education Requirements	Availability of Training Programs	Any Other Relevant Items Provided?
Big Data Programmer/Analyst	• Efficiently extract large scale complex business data (time series data, structured/unstructured) from various data sources and prepare them for data analytics. • Partner with product experts, leverage common open-source machine learning/deep learning packages for identifying data patterns/trends or building predictive models. • Deploy solutions to business units using software technologies to generate measurable values for businesses. • Grasp the application of the latest machine learning and artificial intelligence open-source packages, cloud, and distributed computing technologies to ensure the best technologies are implemented to meet businesses' data challenges.	• Undergraduate degree in Data Science, Computer Science, Math, or Statistics. • For candidates who hold an engineering degree, we require candidates have taken data science classes already. • 7 years of experiences with a minimum of 2 years experiences in extracting the data, using common classification or regression open-source packages through R or Python.	Yes	
Geologists	• Geologists with a passion for subsurface materials and skillsets such as geologic characterization, well log and core analysis, petrophysical calculations, geostatistics, model development, and field work are needed to quantify rock property estimations and integrate subsurface interpretations using different datasets.	• Undergraduate & Professional	Yes	

Skills involved in Welding

• Be able to perform welding on various materials at required position using different welding processes, including, but not limited to, GTAW, SMAW, FCAW, GMAW and SAW.

• Construction experience is required on wellhead platform, topsides, structure, piping, pressure vessels and practical knowledge of applicable codes and standards such as AWS, ISO, API, ASTM and ASME. Experience on construction yard is required.

• Comprehensive knowledge in welding, material, and NDE.

• Lay out, position, fit, and weld various piping and structural components, including pipes, flanges, fittings, valves, piping supports, structural plates, beams, etc., in accordance with the supplied piping/structural fabrication drawings.

• Set up, troubleshoot, and operate welding machines according to job specifications and welding procedures.

• Adjust valves, gauges, and flames as needed and be capable of handling compressed gas and oxygen cylinders safely.

• Operate air arc gouger, grinder, and other industry machines, tools, and equipment.

Occupations Identified

Occupations Identified		
Top 20 Occupations		
Geologists/Geophysicist	Fluids Engineer	Production Engineers
Electrician/Electronics technician	FPGA Programmer	Production Manager
Petroleum Engineer	Array Manufacturing Subcontractors	Project Life Cycle Management Engineer
Computer Aided Design/Engineer	GIS Mapping Specialist	Project Manager
Electrical Engineer	Health and Safety Operators	QA (Quality Assessment)
Pipeline Installer	HMI/SCADA Automation Engineer	Refinery Gaugers
Welder	Hydraulic Fracturing Engineers	Refinery Operators
Chemical Engineer	Instrument Technicians	Researcher/Entrepreneur
Mechanical Engineer	Instrumentation Engineer	Drillers
Reservoir Engineer	Legal Counsel	Rig Operator
Software engineers	Machine Learning Expert	Roustabouts
Big Data Anaylst	Man-Machine Interface Designer/Programmer	Safety Officer
Big Data Programmer	Data Scientists	Sensor Engineer
Civil Engineer	Network Designer	Drillers
Construction Engineer	Opto-Mechanical Systems Engineer	Survey Crew
Construction Safety Officer	Packaging Engineer	Technician (General)
Controls Engineer	Electritician/Electronics Technician	Board layout and Manufacturing Subcontractors
Controls Technician	Petroleum Pump System Operators	Welhead Operator
Driver-CDL	Physicist	Fiber Optic technician
Field Engineers	Environmental Safety Operators	Field Operators

Quick Facts: Chemical Engineers	
2020 Median Pay	$108,540 per year $52.18 per hour
Typical Entry-Level Education	Bachelor's degree
Work Experience in a Related Occupation	None
On-the-job Training	None
Number of Jobs, 2020	26,300
Job Outlook, 2020–30	9% (As fast as average)
Employment Change, 2020-30	2,400

Quick Facts: Welders, Cutters, Solderers, and Brazers	
2020 Median Pay	$44,190 per year $21.25 per hour
Typical Entry-Level Education	High school diploma or equivalent
Work Experience in a Related Occupation	None
On-the-job Training	Moderate-term on-the-job training
Number of Jobs, 2020	418,200
Job Outlook, 2020–30	8% (As fast as average)
Employment Change, 2020–30	34,100

Initial Pilot Conclusions

- Skilled technical workforce is essential part of high-tech workforce
- Technical workforce occupations are high paying & in demand
- Energy & Adv. Mfg. industries are rapidly evolving, & occupations & skills involved are also evolving towards high skilled & increased experience as technology advances
- Workforce workplans, effective tool in identifying emerging skills & occupations in energy industries

White House Interagency Working Group Coal and Power Plant Communities and Economic Revitalization

Interagency Working Group on Coal & Power Plant Communities & Economic Revitalization

- Interagency Working Group (IWG) on Coal and Power Plant Communities and Economic Revitalization Clearing House Webinar Announcement

Webinar, January 27, 2022, 2:00–3:00 p.m. EST

New Clearinghouse Helps Energy Communities Access Federal Funds: A How-To Webinar

This virtual session will include an overview of the 60+ open or planned funding opportunities currently on the clearinghouse, including many that do not require matching funds and a how-to guide for finding and filtering relevant funding opportunities based on a community's specific needs. Representatives from multiple federal agencies discussing notable funding sources that are both currently available and coming soon.

Find out more information at the IWG website: https://energycommunities.gov/

Contact Information

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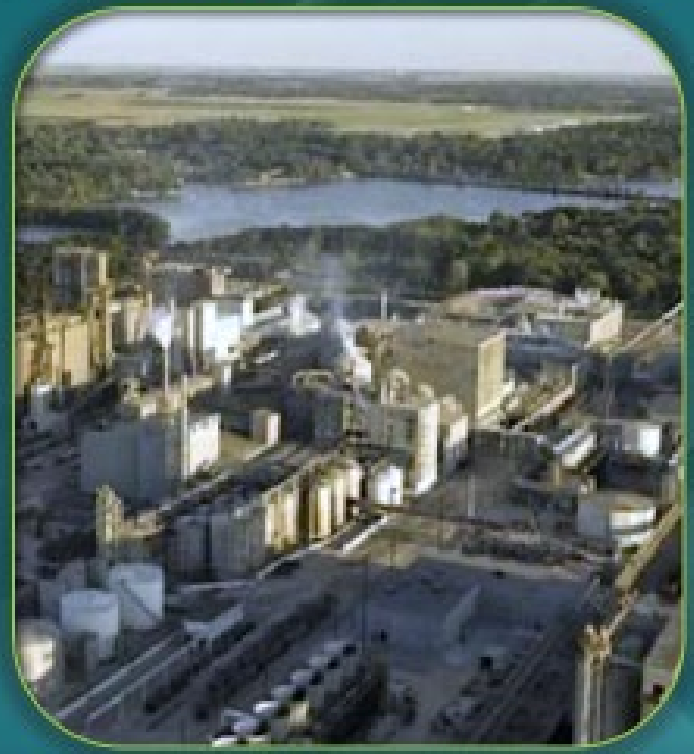
Clean Hydrogen 101: Basics and Research at NETL

Nate Weiland, Senior Fellow

NATIONAL ENERGY TECHNOLOGY LABORATORY

January 27, 2022



Today's Goals

1. Define what hydrogen is and why it is important

2. Share the latest on NETL's hydrogen work

Setting the Stage

> “We have the tools to put America on an irreversible path to achieve net-zero carbon emissions by 2050.”

- Jennifer M. Granholm
Secretary of the U.S. Department of Energy

Administration Priorities

2030 – 50-52 percent reduction in economy-wide new greenhouse gas pollution from 2005 levels

2035 – Carbon pollution-free electricity sector

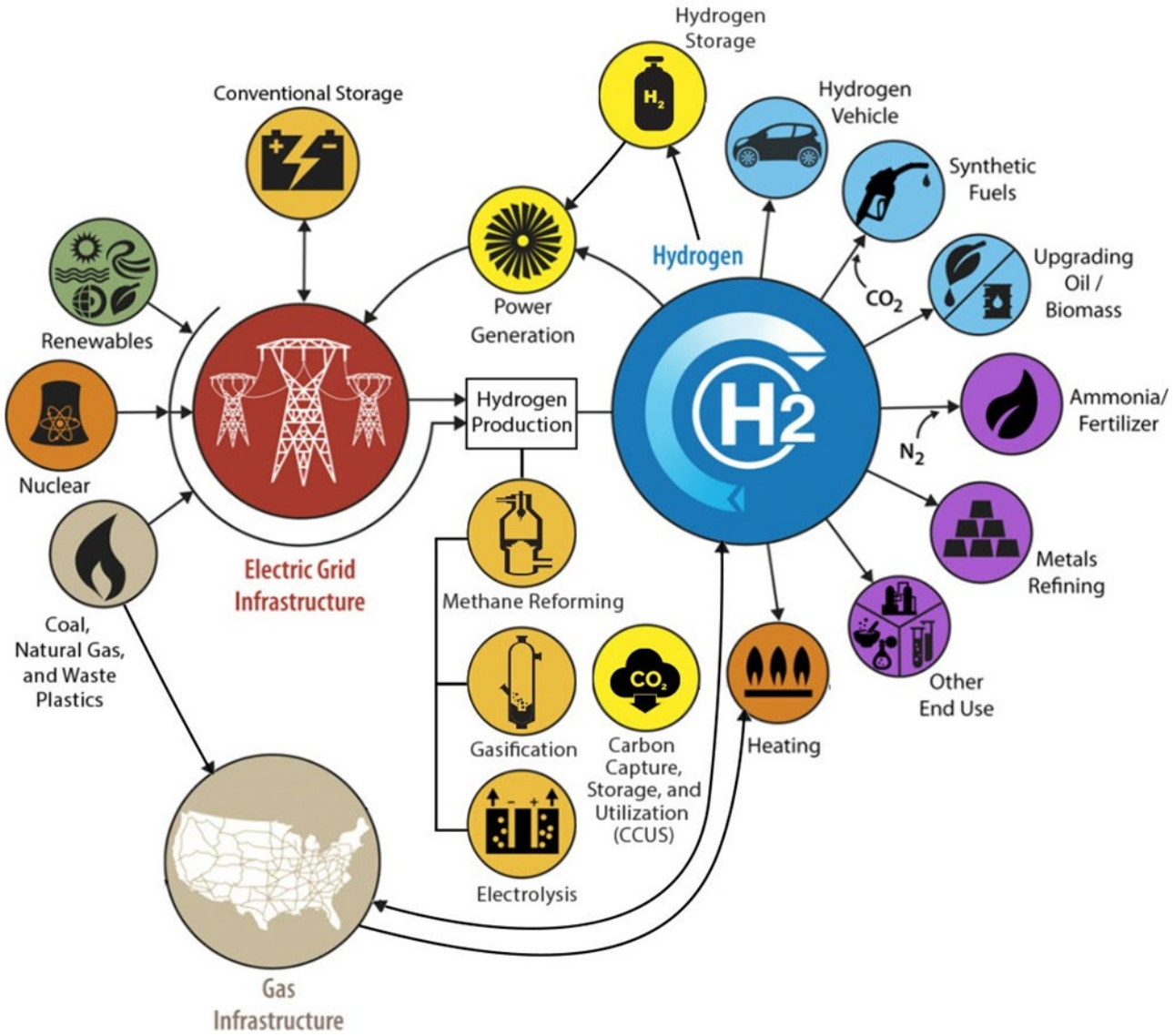
– Address environmental justice and job creation

2050 – Zero-carbon economy

Hydrogen is essential to meet ambitious GHG and zero-carbon economy goals

Advanced hydrogen technology development: job creation in multiple sectors

Hydrogen Economy



What is Hydrogen?

Lightest of all gases and a versatile, clean and flexible energy carrier

Produced from diverse domestic resources and used in many applications

Energy Sources for Hydrogen

Most of today's hydrogen comes from natural gas

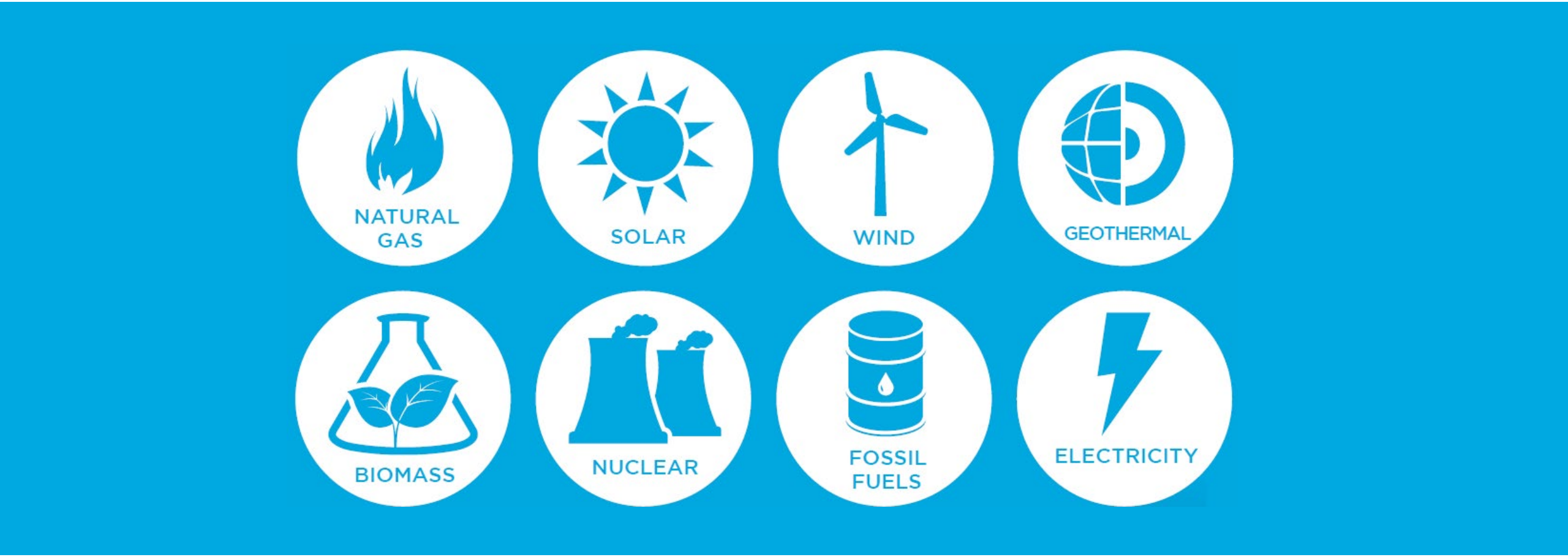
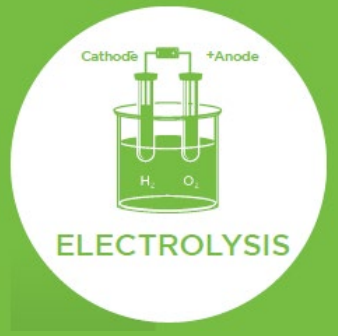


Image source: U.S. DOE Fuel Cell Technologies Office

Many Ways to Produce Hydrogen

Most of today's hydrogen is produced through steam methane reforming



Electricity separates water into oxygen and hydrogen

Energy from direct sunlight and sun heat splits molecules

Carbonaceous feedstocks react yielding hydrogen-rich synthesis gas

Steam and hydrocarbons come together under high temperature

Multiple Uses for Hydrogen

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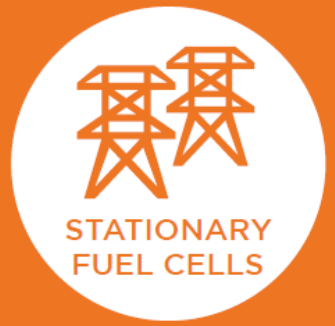
Hydrogen can be used in many sectors throughout the economy

Including mobile applications like buses, trucks, and forklifts

Good for limiting renewable power curtailing and stabilizing grid



Interest from cell towers, data centers, hospitals, supermarkets

Largest use of hydrogen today

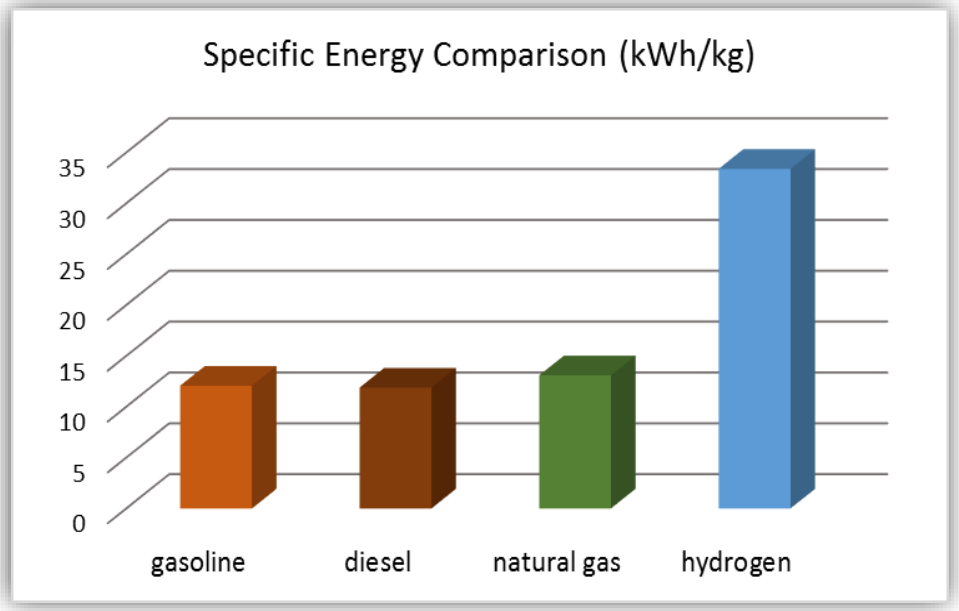
2nd largest use of hydrogen today

Image source: U.S. DOE Fuel Cell Technologies Office

Hydrogen Challenges—Energy Density

High energy by mass, low energy by volume

Approx.
3X more
energy content
by mass
than gasoline



Approx.
4X less
energy content
by volume
than gasoline

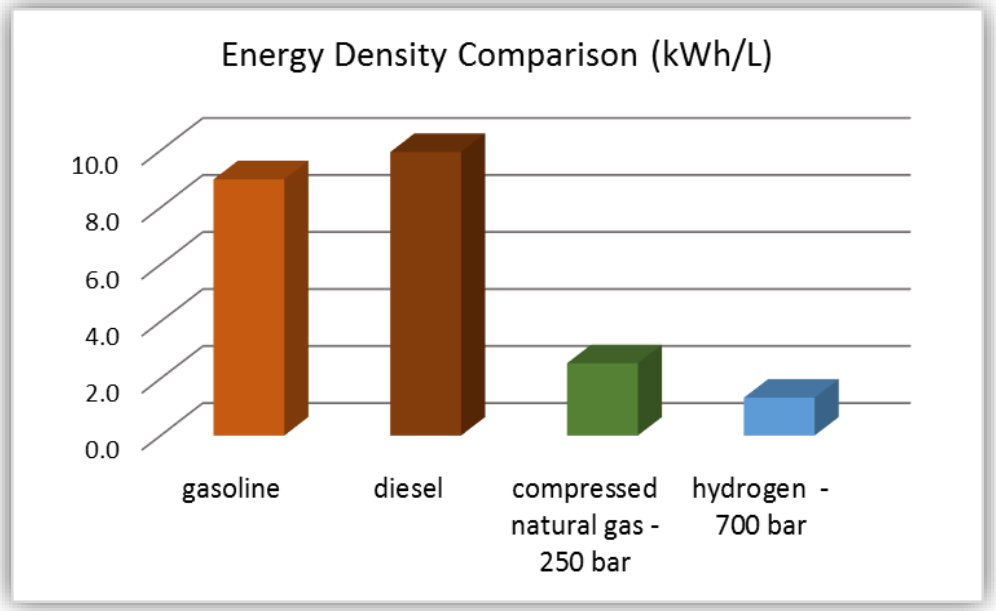
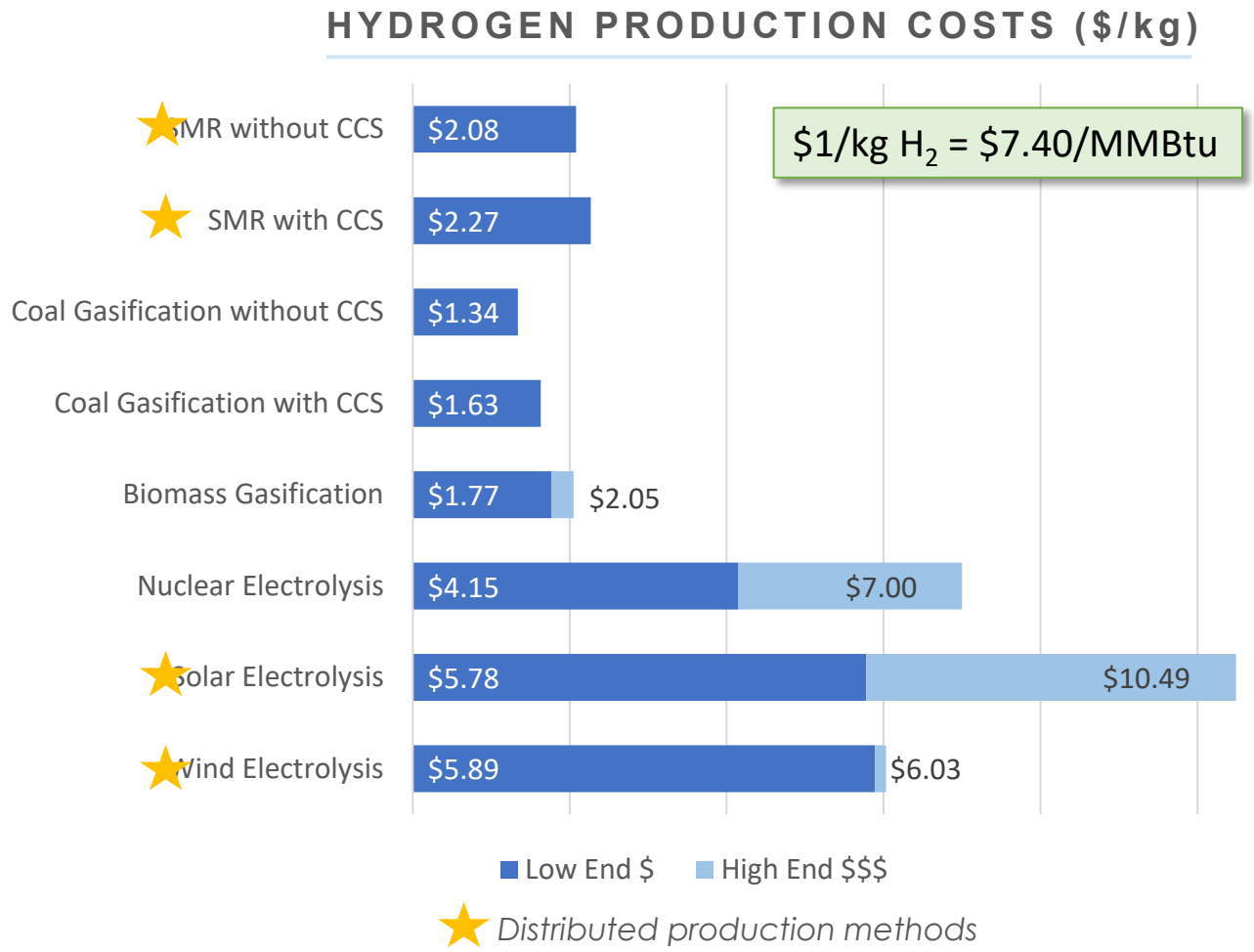


Image source: U.S. DOE Fuel Cell Technologies Office

Hydrogen Challenges—Economic

Clean hydrogen is expensive. Costs must be reduced to reach ambitious cost targets.

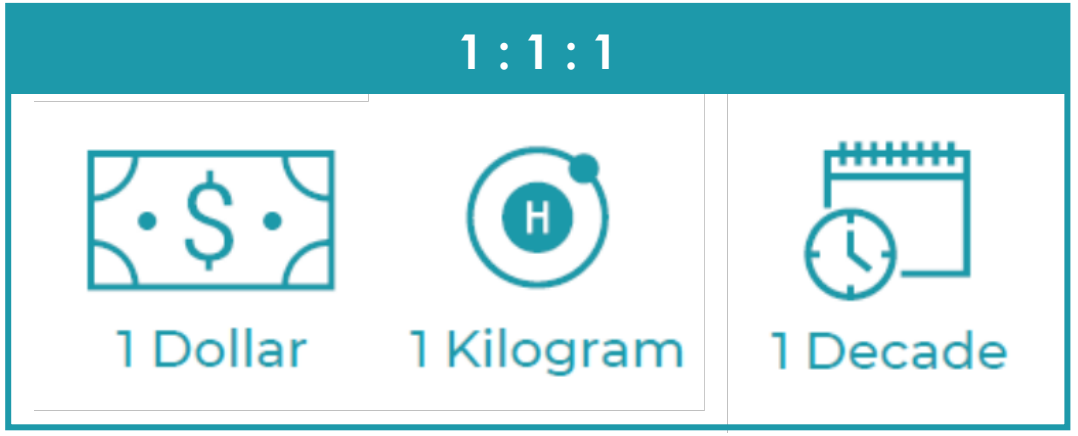
ENERGY SOURCE & FEEDSTOCK	PRODUCTION PROCESS	SHARE OF GLOBAL PRODUCTION
NATURAL GAS	STEAM METHANE REFORMING (SMR) with and without carbon capture	76%
COAL	GASIFICATION with and without carbon capture	22%
BIOMASS	GASIFICATION or direct conversion	2%
NUCLEAR + WATER	ELECTROLYSIS Thermal splitting of H2O	
SOLAR + WATER	ELECTROLYSIS	
WIND + WATER	ELECTROLYSIS	



Energy Earthshots Initiative: Hydrogen Shot

ENERGY earthshots U.S. DEPARTMENT OF ENERGY | Hydrogen

- Accelerate breakthroughs
- Reduce clean hydrogen cost by 80%
- **Hydrogen Shot:** 5-fold increases in clean energy use
- $140 billion revenues and **700,000 jobs** by 2030



***Earthshot** seeks **$1/kg** Clean Hydrogen within the Decade*

Administration Priorities

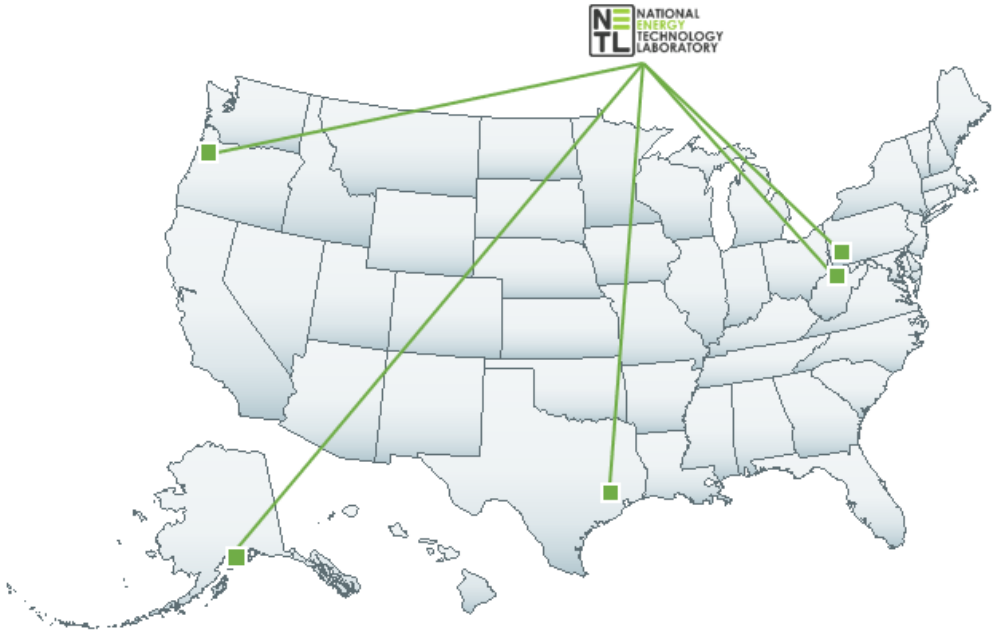
"Sourcing low-carbon hydrogen will be critical to produce fuels and chemicals with CO_2 as a feedstock. There's potential for applying carbon capture to help advance a low-cost and low-carbon hydrogen economy."

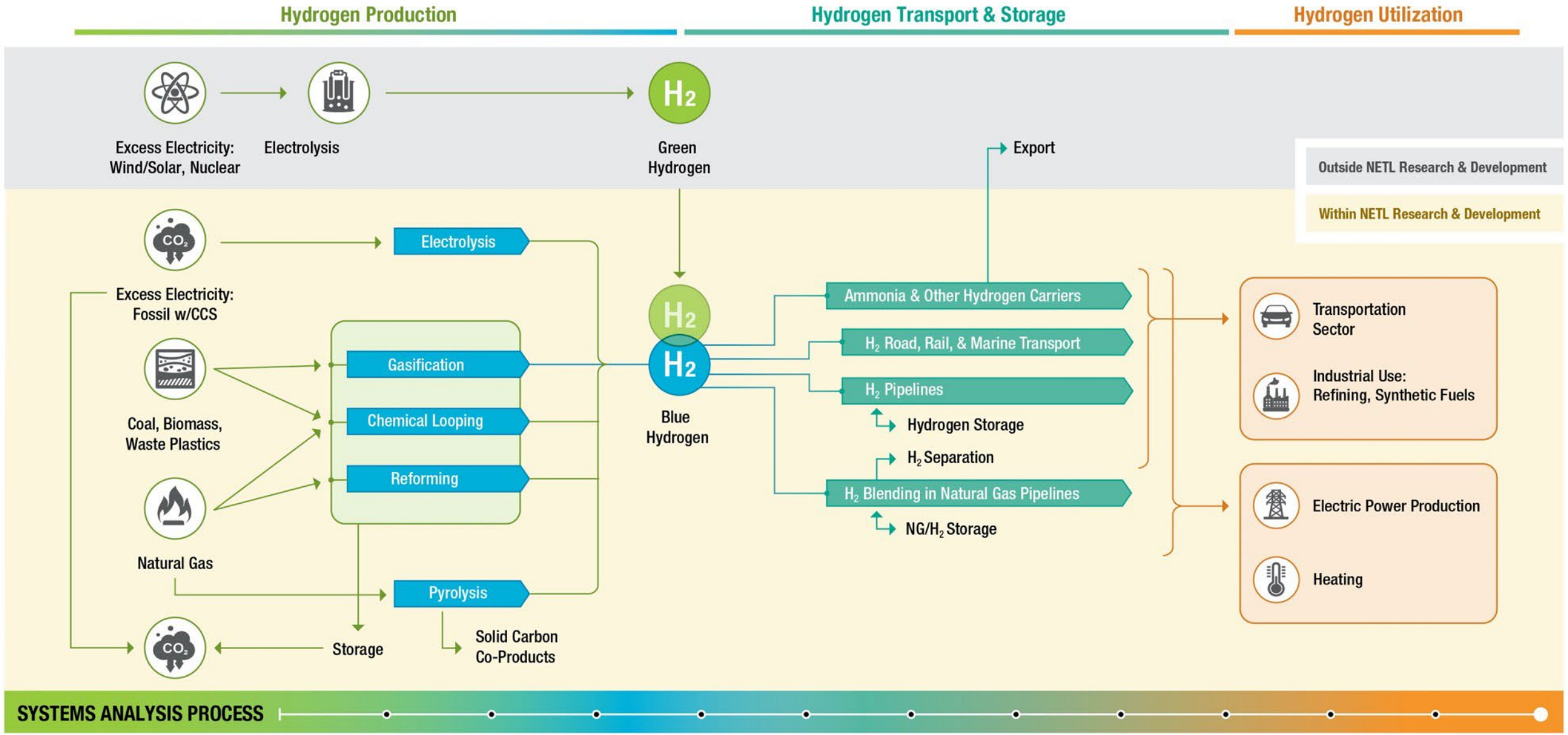
- Jennifer Wilcox
Acting Assistant Secretary
U.S. DOE Office of Fossil Energy and Carbon Management

NETL's Role

Production | **Transport & Storage** | **Utilization** | **Systems Analysis**

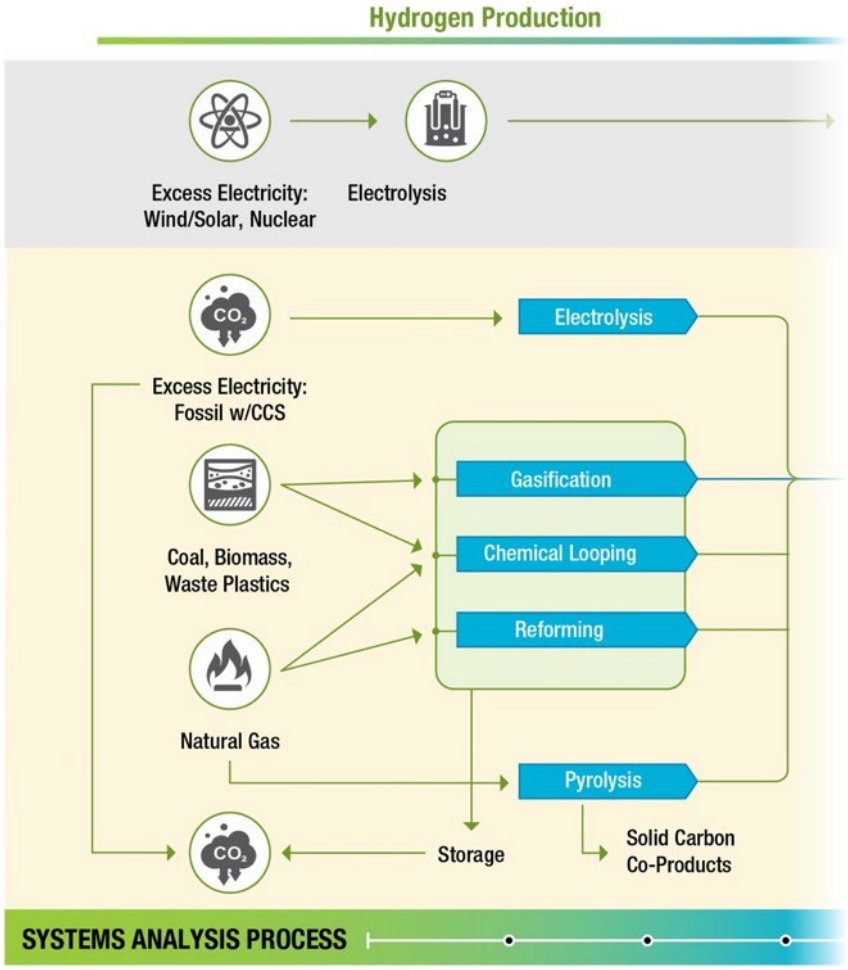
- Enable a rapid, cost-effective transition to a hydrogen economy
- Decades of research on carbon capture and storage (CCS) and large-scale fossil fuel production, infrastructure and power systems
- Deliver solutions to challenging hydrogen R&D problems across the hydrogen value chain




Hydrogen Production
Hydrogen Transport & Storage
Hydrogen Utilization
Excess Electricity: Wind/Solar, Nuclear
Electrolysis
Green Hydrogen
Export
Outside NETL Research & Development
Within NETL Research & Development
Electrolysis
Excess Electricity: Fossil w/CCS
Gasification
Chemical Looping
Reforming
Coal, Biomass, Waste Plastics
Natural Gas
Pyrolysis
Storage
Solid Carbon Co-Products
Blue Hydrogen
Ammonia & Other Hydrogen Carriers
H2 Road, Rail, & Marine Transport
H2 Pipelines
Hydrogen Storage
H2 Separation
H2 Blending in Natural Gas Pipelines
NG/H2 Storage
Transportation Sector
Industrial Use: Refining, Synthetic Fuels
Electric Power Production
Heating
SYSTEMS ANALYSIS PROCESS

Clean Hydrogen from Fossil Fuels with CCS

Production | Transport & Storage | Utilization | Systems Analysis



- Coal and natural gas are the primary sources of hydrogen today
- NETL R&D is improving the efficiency, cost-effectiveness, and carbon intensity of clean hydrogen production

Clean Hydrogen from Fossil Fuels with CCS

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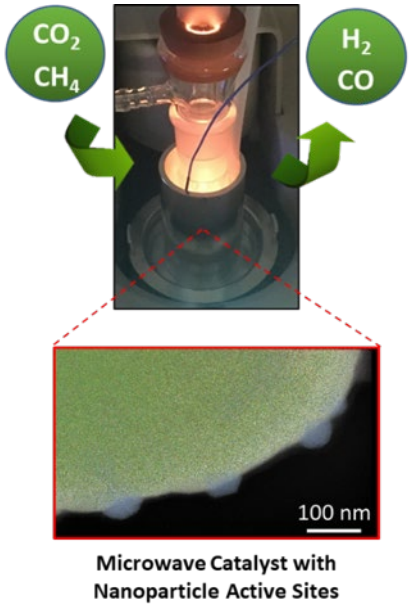
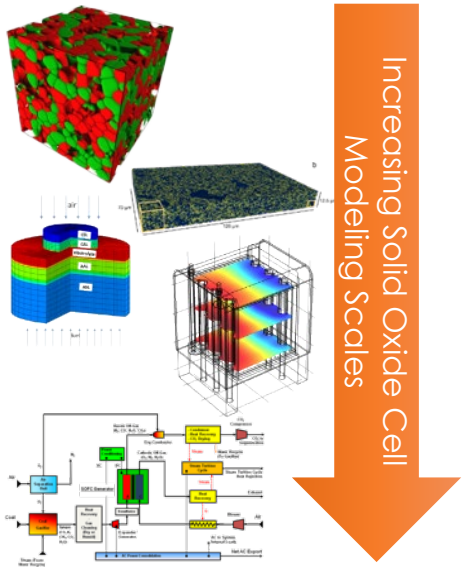
Production | Transport & Storage | Utilization | Systems Analysis

Advanced **natural gas reforming** technologies



Microwave Catalyst with Nanoparticle Active Sites

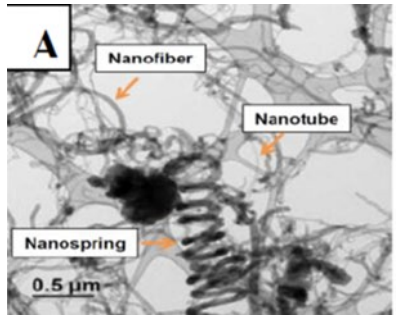
Hydrogen production from water and excess electric power using **solid oxide electrolysis cells**



Multi-phase reforming and gasification with inherent CCS

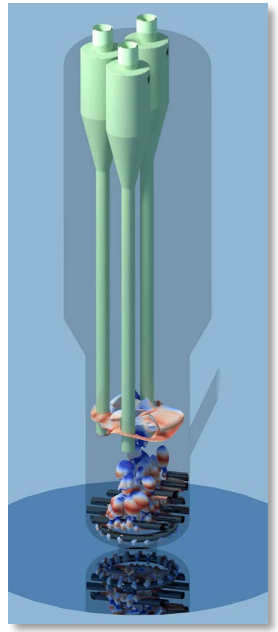
50 kW Chemical Looping Reactor

Methane pyrolysis for hydrogen and solid carbon co-products



Solid carbons recovered from a catalytic natural gas pyrolysis process

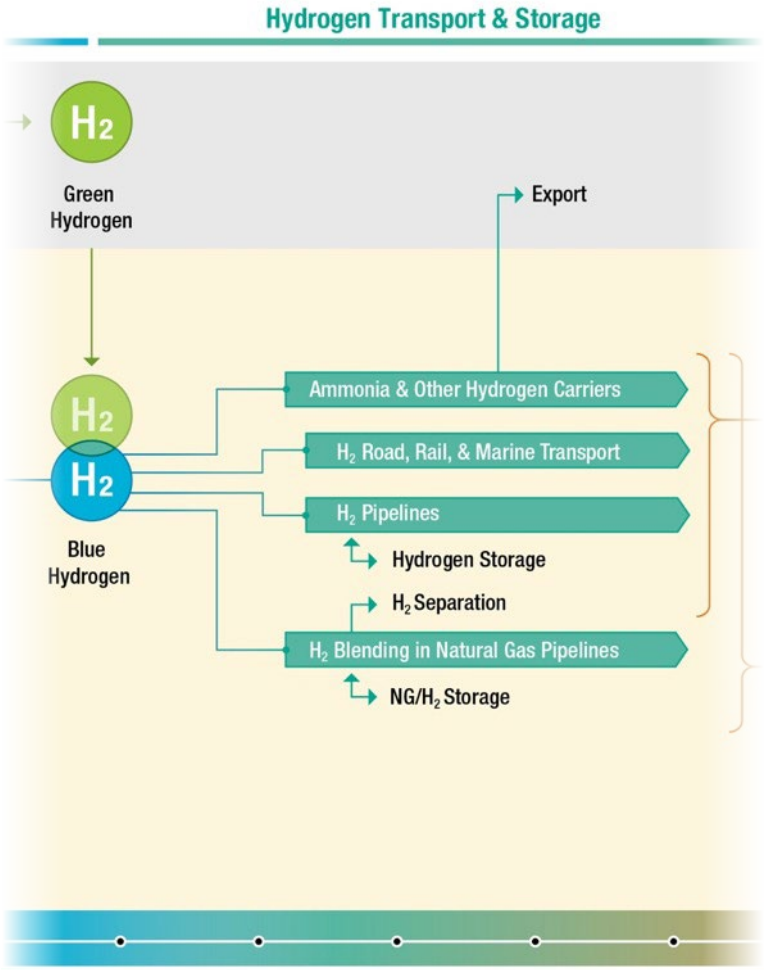
Co-gasification of coal, biomass and waste plastics



MFIX simulation of IWTU's DMR Reactor

Leveraging Parallel NETL Research

Production | **Transport & Storage** | Utilization | Systems Analysis

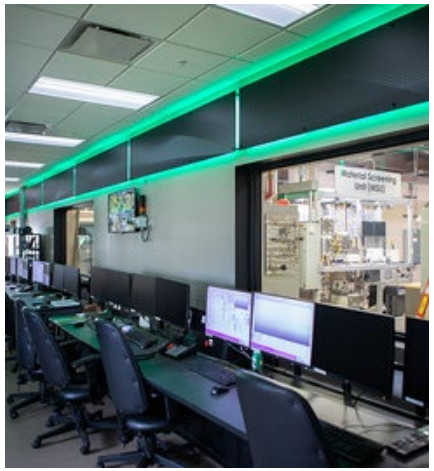


- High costs associated with short- and long-distance hydrogen transportation **+** long term bulk hydrogen storage **=** major barrier to a hydrogen economy
- NETL is leveraging its research in other topical areas to solve these R&D challenges

Leveraging Parallel NETL Research

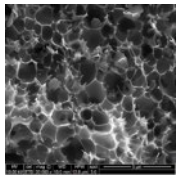
Production | **Transport & Storage** | Utilization | Systems Analysis

Microwave-enabled **modular ammonia production** from hydrogen

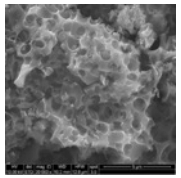


NETL's ReACT Laboratory

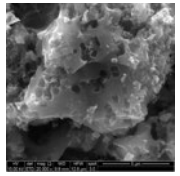
Development of metal hydride, liquid organic hydride, metal oxide, and sorbent-based **hydrogen carriers**



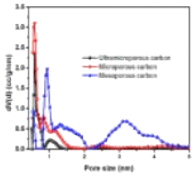
Ultramicroporous carbon



Mesoporous carbon



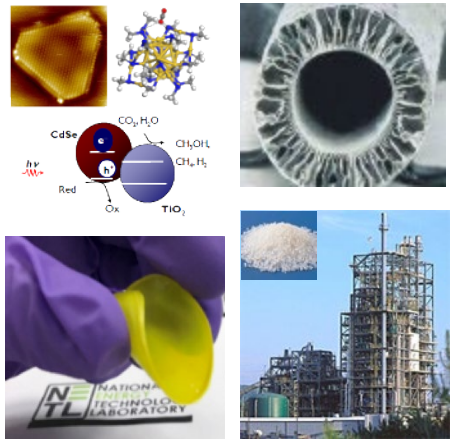
Mesoporous carbon



Pore size distribution

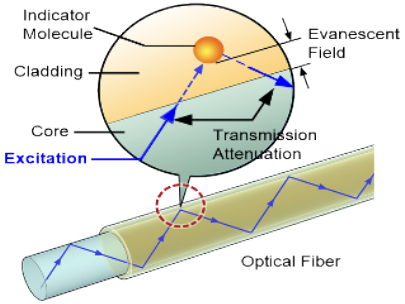
NETL's porous carbons synthesized from coal and their pore size distributions

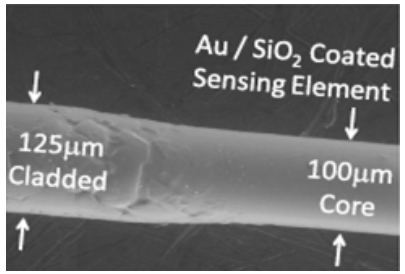
Materials research for hydrogen/natural gas transport



Material discovery, synthesis, and testing

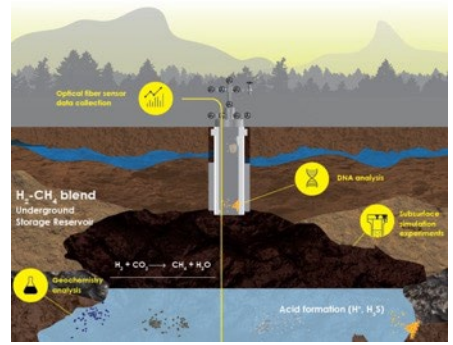
Sensors for real-time pipeline monitoring and **hydrogen safety**





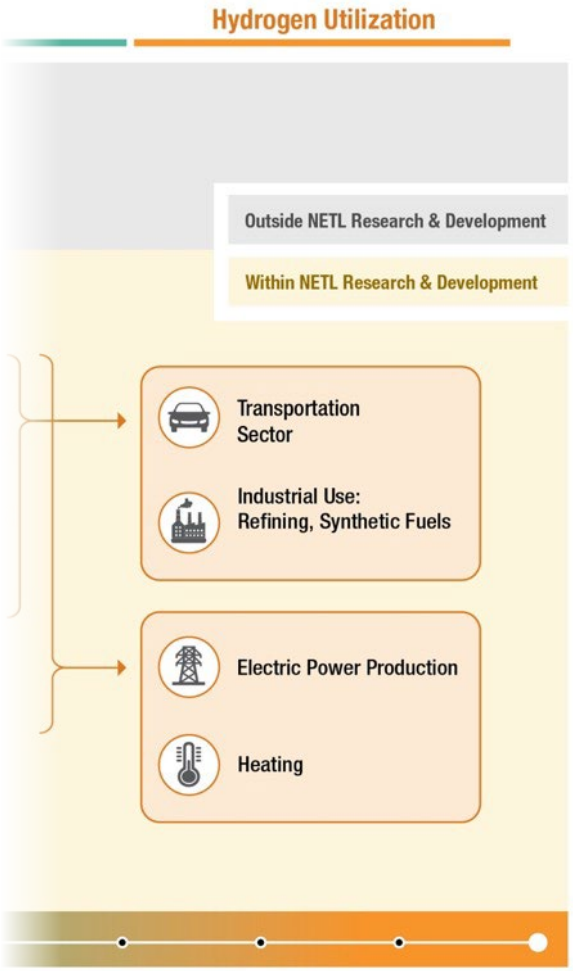
Distributed Fiber Optics Sensors for temperature, strain, gas chemistry, pH, corrosion, and acoustic vibration

Subsurface hydrogen storage in permeable rock formations



NETL's Subsurface Hydrogen Storage R&D

Electric Power & Chemicals from Hydrogen



New and retrofit downstream technologies for efficient utilization of hydrogen and hydrogen/ natural gas blends

- Transportation
- Industrial
- Electric power
- Heating

Electric Power & Chemicals from Hydrogen

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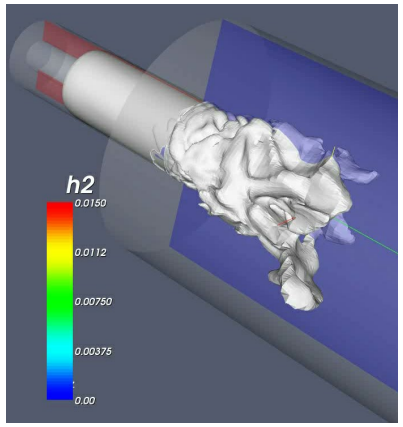
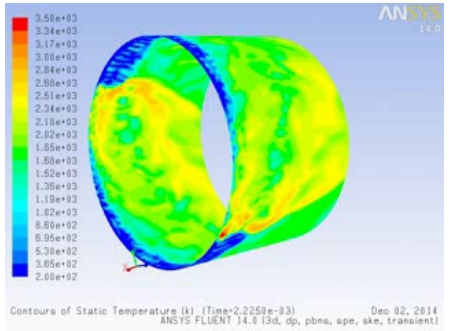
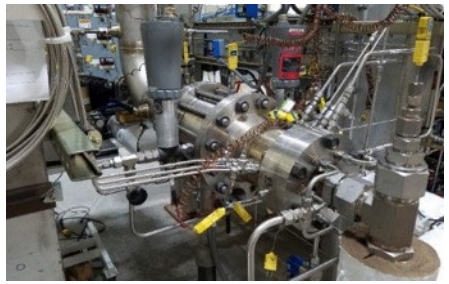
Hydrogen and ammonia **gas turbine combustion**



LES Simulation of combustor flashback with increasing H2 content in natural gas

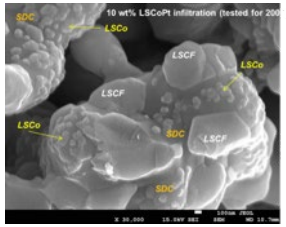
Hydrogen-fueled **rotating detonation combustion** for turbine efficiency increases

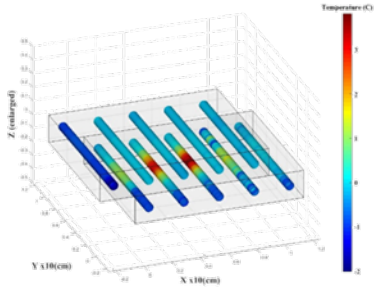




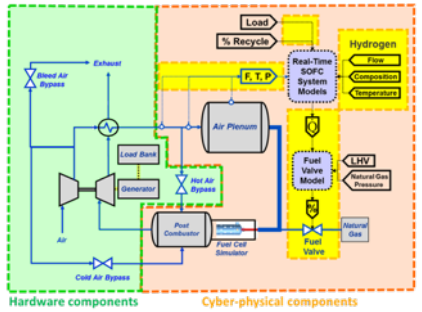
Simulations and high-pressure experiments on rotating detonation combustion

Solid oxide fuel cells and reversible solid oxide cells





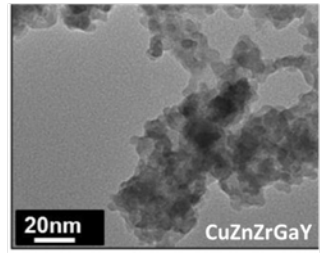
Operability of SOFCs with **integrated energy systems**

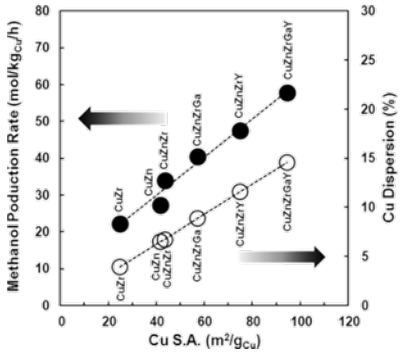


Hybrid Performance Cyber-Physical Test Facility

Improved catalysts for methanol and DME **chemical synthesis from hydrogen**

$3\ H_2 + CO_2 \rightarrow CH_3OH + H_2O$

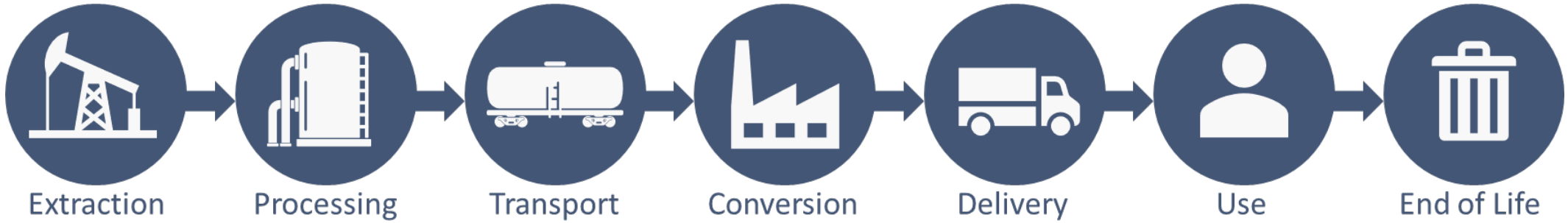




NETL's optimized methanol synthesis catalyst

Analyses Across Hydrogen Value Chain

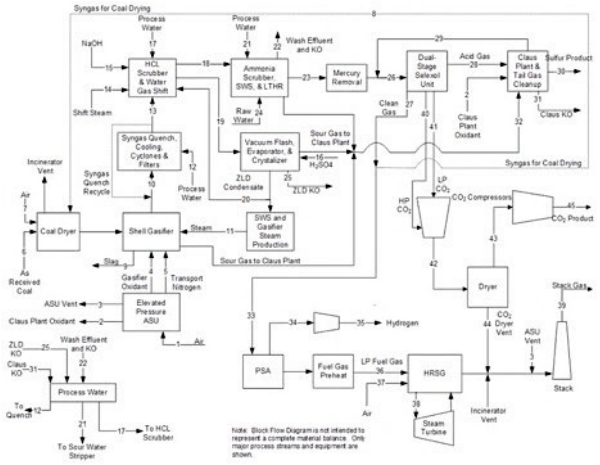
- Comprehensive systems analyses to minimize cost and GHG emissions of a national hydrogen economy
- NETL is evaluating the deployment, integration, and operability of the full hydrogen value chain



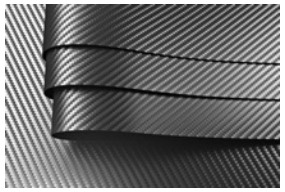
Analyses Across Hydrogen Value Chain

Production | Transport & Storage | Utilization | **Systems Analysis**

Modeling and **techno-economic analyses** of hydrogen production methods



Market assessment of solid carbon co-products to offset hydrogen production costs

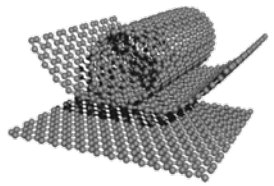


Carbon Fiber

Source: News Atlas, USA

Synthetic Graphite

Source: International Mining, England



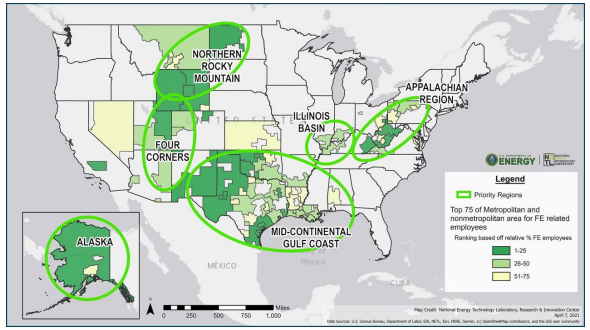
Carbon Nanotubes

Source: Nanowerk

Carbon Black

Source: PentaCarbon, Germany

Assessment of regional hydrogen **infrastructure buildout** and **job impacts**



Regions vulnerable to impacts from fossil energy job losses

Life-cycle analyses to determine the greenhouse gas emissions and water impacts of hydrogen pathways

Hydrogen Economy Value Chain

NETL Competencies Map

ENERGY SOURCE & FEEDSTOCK	PRODUCTION PROCESS	STORAGE & COMPRESSION	TRANSPORT	USE
NATURAL GAS	STEAM METHANE REFORMING (SMR) with and without carbon capture	*Physical-based* GEOLOGIC	PIPELINES (Pure H2 or Blended)	POWER GENERATION
COAL	GASIFICATION with and without carbon capture	COMPRESSED GAS CONTAINMENT	TRUCKING	TRANSPORTATION
BIOMASS	GASIFICATION or direct conversion	*Material-based* ADSORBENTS	RAIL	INDUSTRIAL ENERGY
NUCLEAR + WATER	ELECTROLYSIS Thermal splitting of H2O	HYDRIDES	WATER	BUILDING HEAT AND POWER
SOLAR + WATER	ELECTROLYSIS	CHEMICAL HYDROGEN		INDUSTRY FEEDSTOCK
WIND + WATER	ELECTROLYSIS			

Alignment with NETL technology strengths across the value chain.

Hydrogen Earthshot Initiative RFI

NATIONAL ENERGY TECHNOLOGY LABORATORY

What

Inputs on hydrogen demonstration and deployment projects that enable clean hydrogen production, infrastructure and end uses

Responses

Industry, investors, technology developers, academia, research laboratories, government agencies, and other stakeholders

Topics

Regional Hydrogen Production, Resources, and Infrastructure

End Users for Hydrogen in the Region, Cost, and Value Proposition

Greenhouse Gas and Pollutant Emissions Reduction Potential

Diversity, Equity, Inclusion (DEI), Jobs, and Environmental Justice

Science and Innovation Needs and Challenges

Hydrogen RFI Findings

NATIONAL ENERGY TECHNOLOGY LABORATORY

Pacific Northwest

- *Port communities*
- *Tribal communities*
- *Extensive renewables*
- *8 jobs per $1M invested in H_2*

California

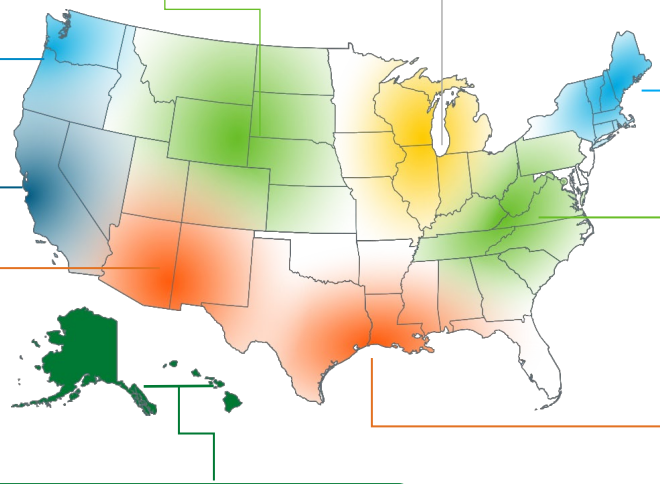
- *Diverse populations*
- *Extensive infrastructure*
- *Emissions regulations*
- *40,000+ jobs*

Southwest

- *Tribal and Hispanic communities*
- *Underutilized solar*
- *Nuclear power*
- *Up to 2B tonnes/yr emission reduction potential*

Central U.S.

- *Ample wind*
- *Geological storage*
- *Railway transport*
- *Nuclear resources*
- *>630,000 tonnes/yr CO_2 reduction*



Alaska and Hawaii

- *Extensive renewables – geothermal, solar, ocean*
- *Backup power*
- *Isolated communities*
- *86,000 tonnes/yr emission reduction*

Great Lakes

- *Major national corridors*
- *Nuclear power*
- *60,000+ jobs*

New England

- *Offshore wind*
- *Fishing communities*
- *Backup power and winter heating*
- *~120K tons CO_2/year reduction*

Appalachia

- *Retiring fossil plants*
- *Mining, refining transferable skills*
- *Carbon capture and sequestration*
- *70,000 tons/yr H_2 production*

Gulf Coast

- *Existing infrastructure*
- *Multiple opportunity zones*
- *Renewable resources*
- *1,000s of jobs*
- *Chemical industry*

Source: Wieliczko, Harting, et al, DOE HFTO

Appalachia Regional Cluster Responses

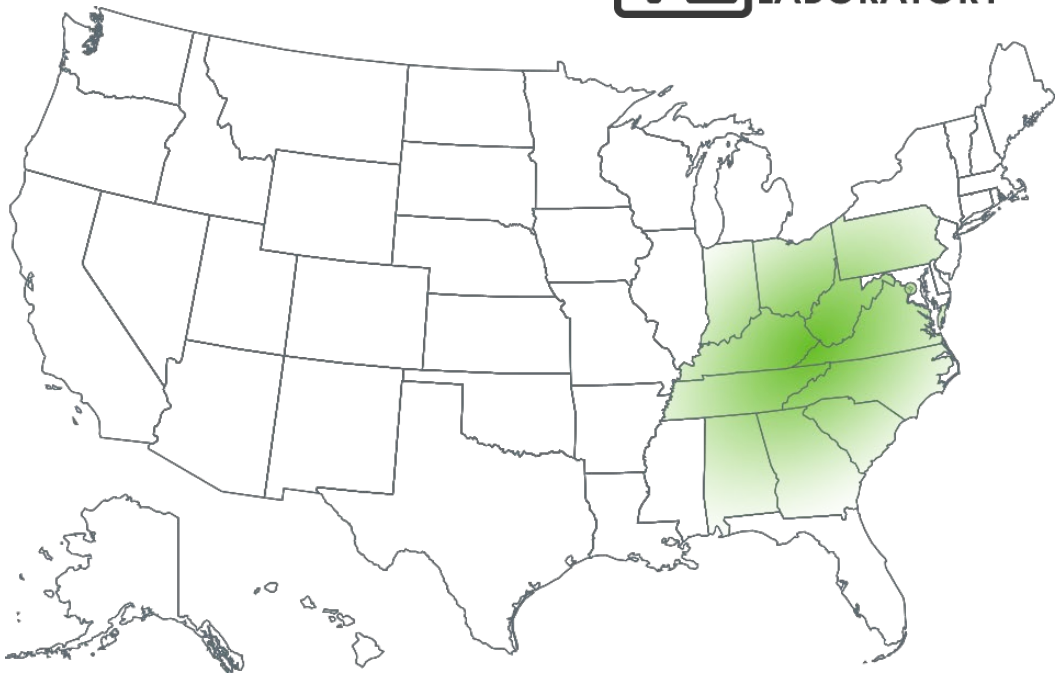
NATIONAL ENERGY TECHNOLOGY LABORATORY

Regional Resources for Production and Infrastructure

- Overlap with Great Lakes region, especially Western OH
- Primarily fossil resources with CCS, with future transition to renewables
- Access to significant NG and saline storage of CCS
- Salt, limestone, and sandstone formations for potential CCS or H_2 storage throughout

End Users, Cost, Value Proposition

- H_2 for power generation, industry, backup power
- Steel, cement, and chemical industries; decarbonizing refining facilities
- Need for policy incentives to address cost premium versus traditional fossil



Emissions Reduction Potential

- 0.9 MT CO_2/year with NG reforming + 1-4 MT with additional CCS in a single project
- Decarbonization of current processes and possible negative emissions

DEI, Jobs, EJ

- Many distressed communities based on unemployment rates, per capita market income, and poverty rates
- Coal industry employment in that period has declined 54% in 15 years
- High dependence on mining as a portion of overall economic activity, e.g., one mine closure lost 2000 jobs

Co-location Potential

- Nuclear plants near transportation arteries, warehouses, and distribution facilities
- Wastewater treatment, ammonia production
- Environmental, architectural, archaeological studies completed; active work site for powerplant and other facility developments

Source: Wieliczko, Harting, et al, DOE HFTO

Bipartisan Infrastructure Law (BIL)

$9.5B for clean hydrogen:

- **$8B for at least four regional clean hydrogen hubs**
- **$1B for electrolysis RD&D**
- **$500M for clean hydrogen technology manufacturing and recycling R&D**

- Aligns with Hydrogen Shot priorities to reduce the cost of clean hydrogen to $2 per kilogram by 2026
- Requires developing a National Hydrogen Strategy and Roadmap

Hydrogen Hubs: Definition & Emphasis

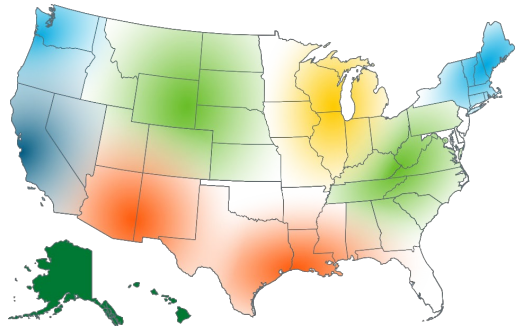
Hub Definition: a network of clean hydrogen producers, potential clean hydrogen consumers, and connective infrastructure located in close proximity

Purpose:

1. Demonstrably aid the achievement of the **clean hydrogen production standard;**

Metrics & Measurement

2 kg CO_2/kg H_2



2. Demonstrate the **production, processing, delivery, storage, and end-use of clean** hydrogen;

All components needed and must be clean H_2

3. Can be **developed into a national clean hydrogen network** to facilitate a clean hydrogen economy.

Criteria for Hub Selection

Provisions from BIL Section 40314

Feedstock Diversity (at least one hub of each)	Fossil fuels
	Renewable energy
	Nuclear energy
End-Use Diversity (at least one hub of each)	Electric power generation sector
	Industrial sector
	Residential and commercial heating sector
	Transportation sector
Geographic Diversity	Different regions of the U.S. and use local abundant resources
Natural Gas-producing Regions (at least 2 hubs)	Regions of the U.S. with the greatest natural gas resources
Employment	Create skilled training and long-term employment for greatest number of residents

Job Opportunities Involved with Hydrogen

Anticipated Jobs Creation

- Hydrogen Production Plants
  - Fossil, electrolysis via renewables/nuclear
  - Construction & operations
- Hydrogen Utilization (end-use) Plants & Applications
  - Construction & operations
- Hydrogen Infrastructure
  - Pipeline retrofits for hydrogen
  - New hydrogen pipelines construction
  - Geologic storage development
  - Other advanced storage development & construction

Skills Needed

- Process plant engineering & design
- Power/chemical/industrial plant construction & operations trades
- Engineering prototype building & testing capability
- Pipeline construction and operations trades
- Mining trades (salt caverns, etc.)
- Hydrogen safety training

THANK YOU!

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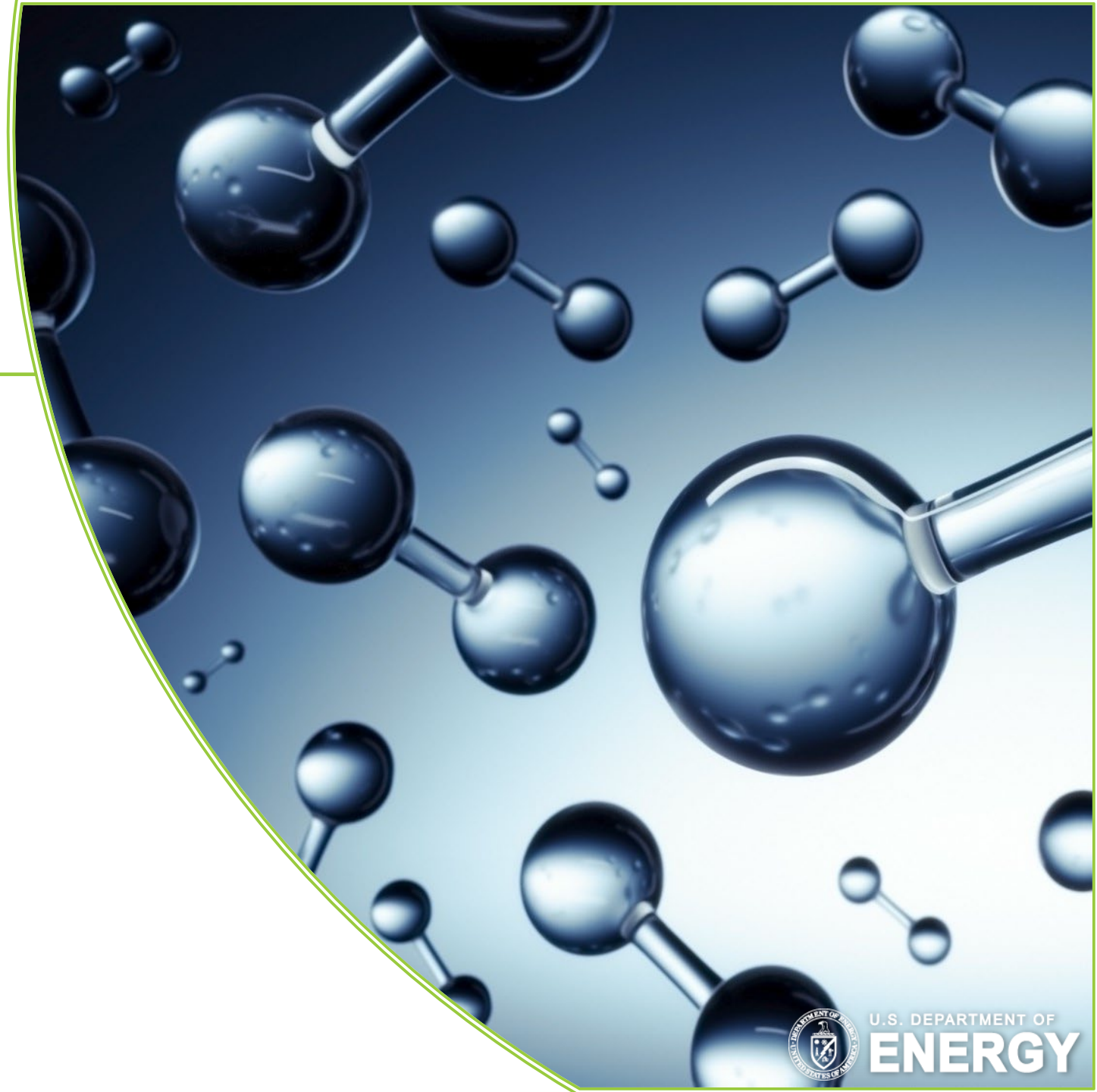

NETL RWFI Energy 101- Hydrogen

Thanks for your participation!

- The Regional Workforce Initiative - Anthony Armaly, Federal Coordinator NETL RWFI
- Hydrogen 101 - Nathan Weiland
- Hydrogen Workforce and Economic Development Question and Answer Panel

- Please Mute Your Line if you have not already
- We will have the presentation up on the NETL RWFI Website shortly after the webinar