



**GTI ENERGY**

*solutions that transform*

LIVES

ECONOMIES

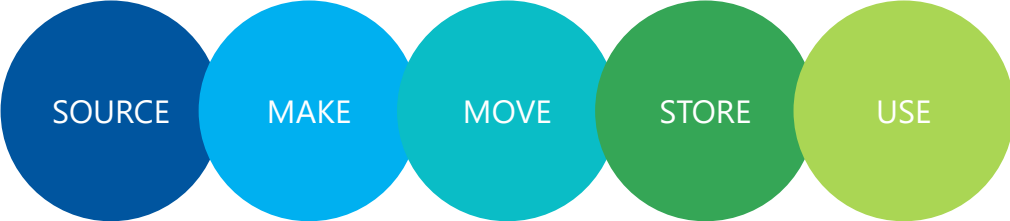
ENVIRONMENT

GTI Energy develops innovative solutions that transform lives, economies, and the environment

# 80-year history of turning raw technology into practical energy solutions



Across the entire energy value chain



**400+**  
Employees

World-class piloting facility in Chicago area



We work collaboratively to address critical energy challenges

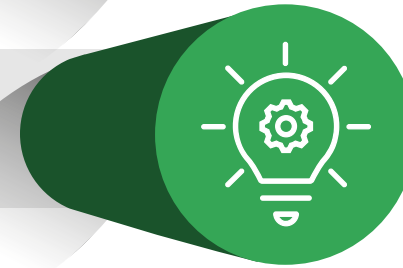


*Our approach:*

systems thinking



innovation



collaboration



# Natural Gas Low Greenhouse Gas Pathways

Near-Term  
(25-50+%)

Expanded use of high-efficiency gas equipment

Hybrid natural gas furnace/boilers and electric heat pump systems

Building envelope improvement



Next-Gen  
(40-60+%)

Gas heat pumps for space & water heating

Micro CHP systems

Deep building retrofits



Renewables  
(Added 10-30+%)

RNG & Hydrogen blends

Solar thermal/gas space & water heating systems

Lower Methane Emissions  
(5-10%)

Reducing full-cycle gas system methane emissions



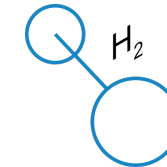
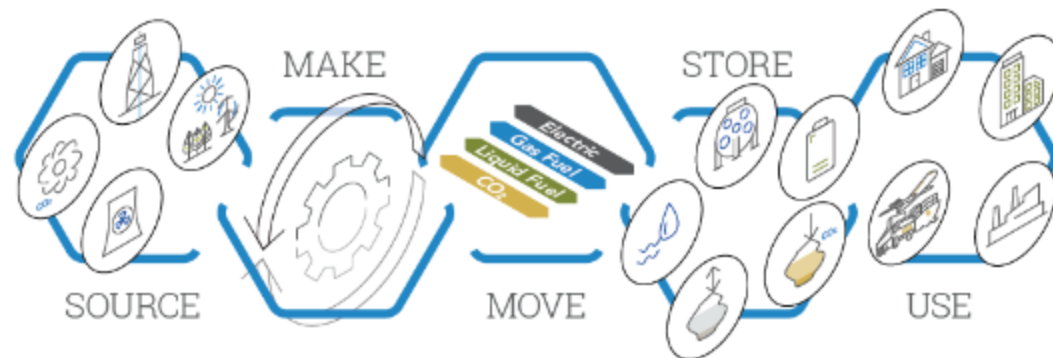
# Hydrogen Technology Center

- **Capabilities**

- Thought leadership
- Deep hydrogen expertise across the value chain
- Decades of experience and hydrogen technology projects
- Expanded labs and facilities

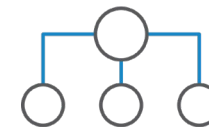
- **Enabling Technologies/Projects**

- Hydrogen Generator Technology
- Hydrogen Blending Impact Studies
- H2@Scale TX Demonstration
- Open Hydrogen Initiative



- **Low-carbon, Low-Cost Production**

- Compact Hydrogen Generator
- Biomass gasification
- Liquid Phase Reformer



- **Compatibility with Natural Gas Delivery Infrastructure**

- Material impacts of blending
- Operational impacts
- Blending technology and standards



- **Use in Industry and Buildings**

- End-use equipment testing
- Codes and standards
- H2 sensors



- **Use in Transportation**

- HD Trucks
- H2 Locomotives
- Fueling station technology

# H2@Scale Demonstration Site



## Renewable H<sub>2</sub> generation

- ~100 kg/day from two SMRs
  - Renewable credits from landfill gas (RNG)
- ~40 kg/day PEM electrolyzers in two SimpleFuel units
  - Emulated wind and solar power through UT CEM microgrid

## Large scale, industry H<sub>2</sub> user

- 100kW fuel cell powering Texas Advanced Computing Center

## Vehicle refueling

- Fueling fleet of Toyota Mirai's
- Hydrogen powered drones



# OPEN HYDROGEN INITIATIVE

*What is the Open Hydrogen Initiative*



## The Mission

The **Open Hydrogen Initiative** is laying the foundation for low-carbon hydrogen marketplaces

## The Objective

OHI will develop an analytical toolkit to assess the carbon intensity of hydrogen production

- **Facility Level**
- **Cradle-to-Gate**
- **Compatible with International Norms & Best Practices**
- **Comprehensive Stakeholder Engagement**
- **Open Sourced**

# OPEN HYDROGEN INITIATIVE

Stakeholders and Sponsors



OPEN HYDROGEN INITIATIVE

## Leadership



## Foundational Sponsors



## Technical Sponsors



## NGOs, Academic Partners, and Observers







**Methane emissions measurement protocols** enabling verifiable emissions reductions through a consistent measurement approach



The protocols...

- Calculate **methane emissions** for natural gas systems by six segments
- Consistent approach to demonstrate emissions reductions in a transparent way
- Now available online for everyone to use: [Veritas.com](https://www.veritas.com)

# Accelerating Hydrogen Market Development



Department of Energy

## DOE Launches Bipartisan Infrastructure Law's \$8 Billion Program for Clean Hydrogen Hubs Across U.S.

JUNE 6, 2022

EnergySource | September 20, 2022

## The Inflation Reduction Act will accelerate clean hydrogen adoption

By Joseph Webster

Hydrogen and Fuel Cell Technologies Office

## Clean Hydrogen Production Standard

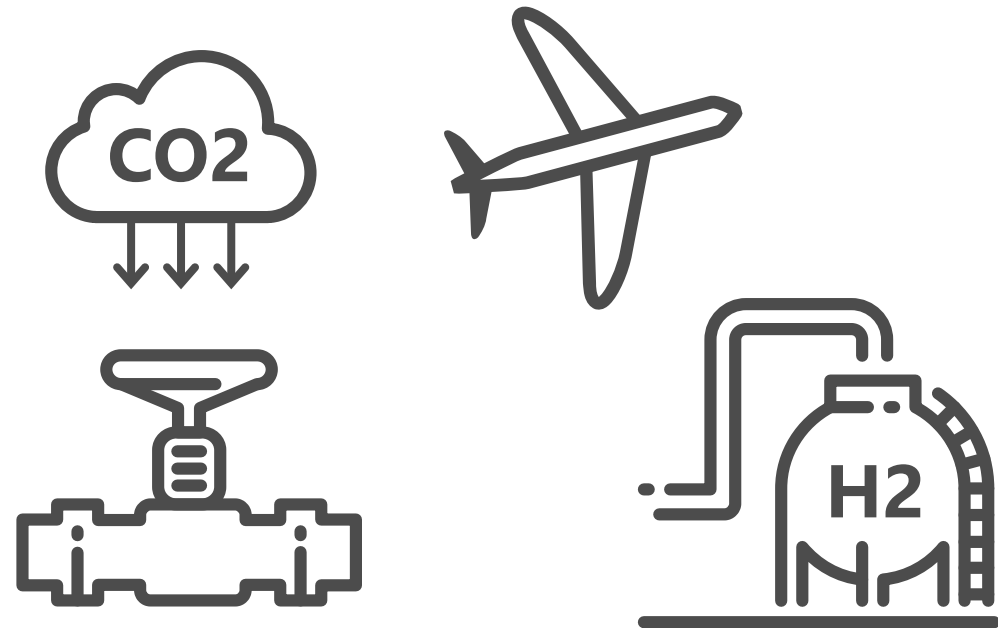
SEPTEMBER 22, 2022

# Inflation Reduction Act & Infrastructure Bill

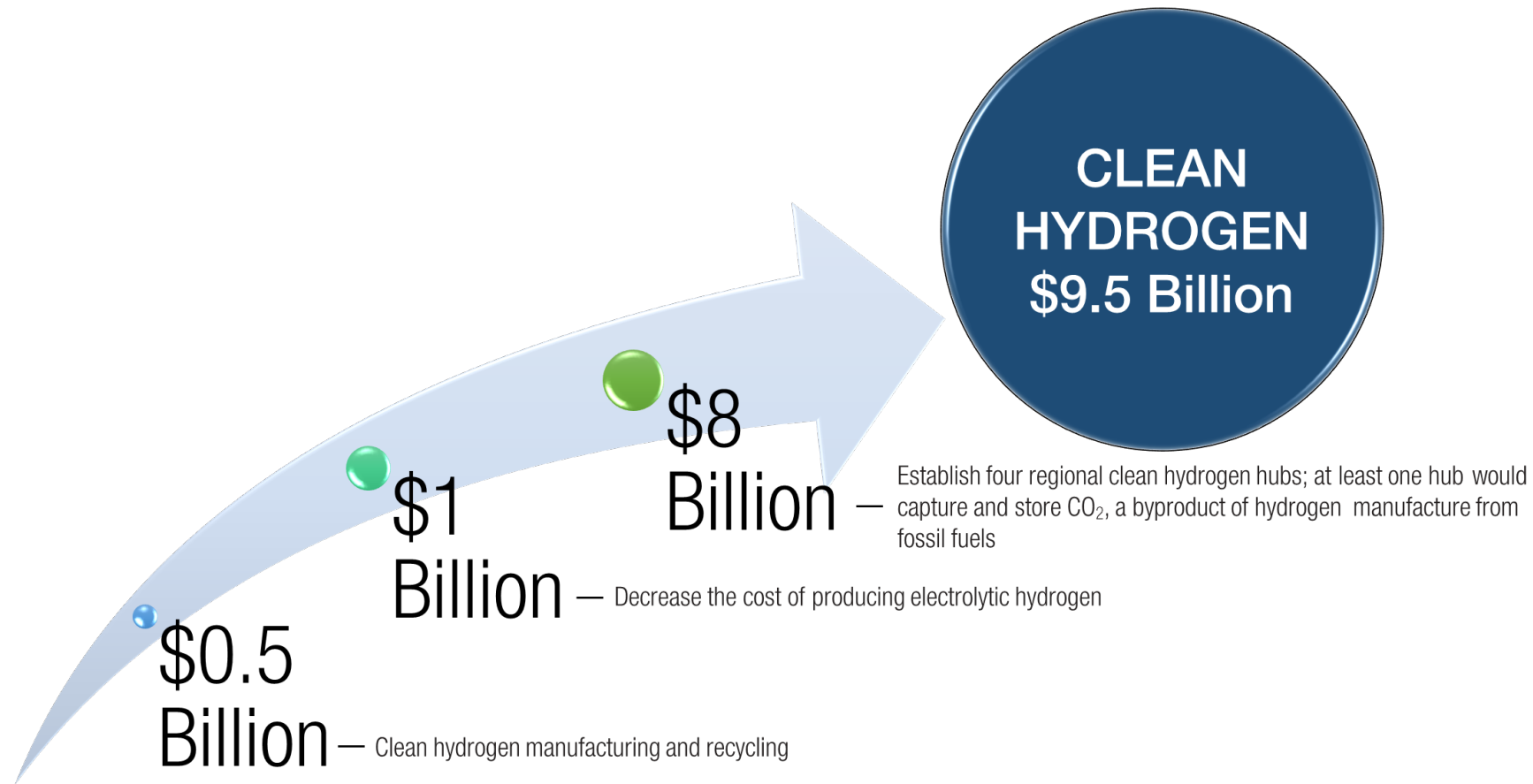
## **This legislation maps the next decade of industrial policies**

*Systems of tomorrow will be built on systems of today & expand beyond renewables*

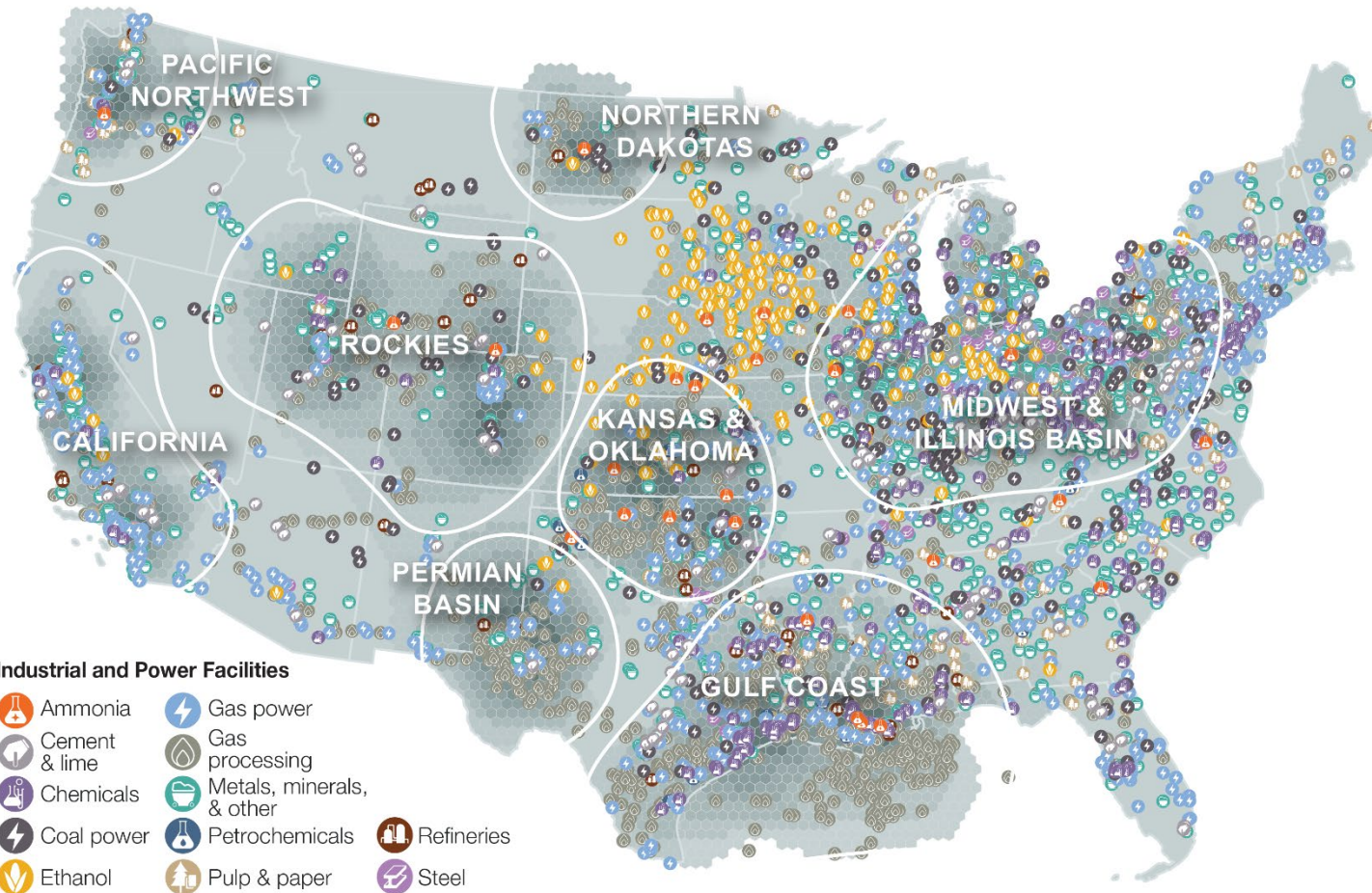
- Decarbonize traditional energy infrastructure
- Hydrogen production credits based on carbon intensity
- Aviation fuel credits for clean fuel production and low-emission aviation technology
- Carbon capture tax credit – broadened
- Methane fees directly taxing GHG emissions



# Infrastructure Investment and Jobs Act (IIJA) Clean Hydrogen Programs



# Regional Hub Development for Hydrogen Market



**Demonstration Focus:** Funding projects at demonstration phase (IEA definition: “operation of a prototype at or near commercial scale”)

**Emissions Reduction:** Implementing Infrastructure Bill’s definition of “clean hydrogen” through a carbon intensity standard (2kg CO<sub>2</sub>/kg H<sub>2</sub> at site of production)

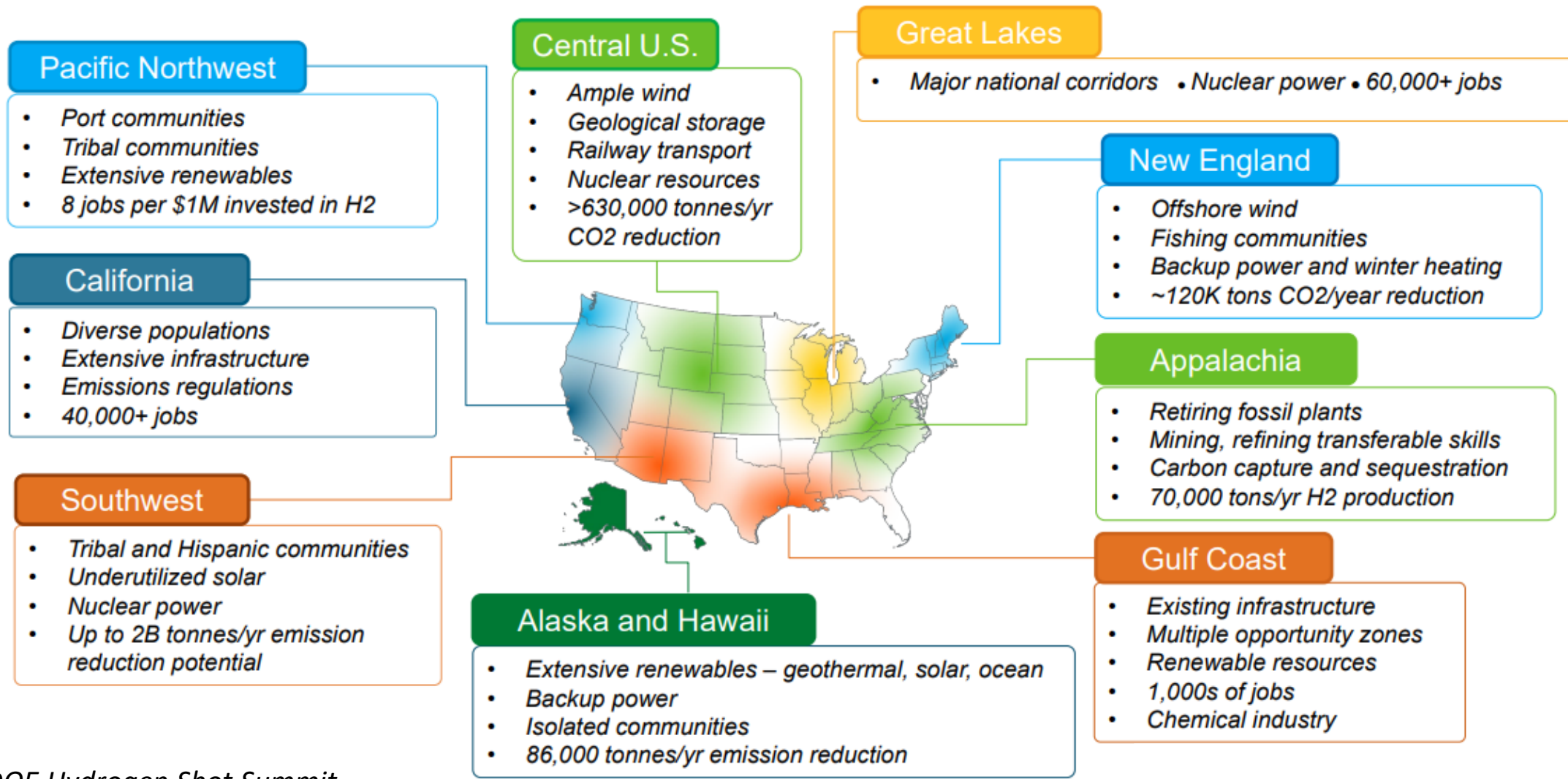
**Clean Hydrogen Cost Targets:** Implementing cost targets for “clean hydrogen” of \$2/kg by 2025 and \$1/kg by 2030

**Regionality:** “at least 4” (but most likely 6-10) regional hubs

**Supply and Demand Diversity:** Seek diverse H<sub>2</sub> production technologies (fossil fuels, renewables or nuclear) and diverse sectors (power generation, industrial, residential and commercial heating, and transportation).

**Stimulate Clean Hydrogen Demand:** Use demand side tools (such as contract for differences) to encourage fuel switching

# Hydrogen Hub Initiatives in the U.S.



Source: DOE Hydrogen Shot Summit

# Advancing the Hydrogen Ecosystem Across the U.S.

MIDWEST ALLIANCE FOR CLEAN  
**HYDROGEN**



HyVelocity Hub



GTI ENERGY

**ARCH2**

Appalachian Regional Complex for Hydrogen Hub

# Hydrogen Production Tax Credit 45V in Inflation Reduction Act (IRA)



- Precludes facilities from utilizing both the PTC and 45Q; renewable and nuclear electricity credits allowed
- To Qualify construction must begin before January 1, 2033
- Direct pay
  - Taxable entities: available for the first five tax-years after the project is placed in service with enhanced transferability thereafter
  - Tax-exempt entities/Coops/Munis: Line of the credit
- Maximum credit value is \$3.00 per kg of clean hydrogen if the hydrogen production facility meets the prevailing wage and apprenticeship requirements
- One-year for rulemaking by Treasury on lifecycle analysis and other issues

Lifecycle GHG Intensity (kg CO2e/kg H2)	PTC \$Value per kg (% of max credit)	ITC % Value (% of max credit)
< 0.45 kg	\$3.00 (100%)	30% (100%)
< 1.5 and $\geq$ 0.45 kg	\$1.00 (33.4%)	10.2% (34%)
< 2.5 and $\geq$ 1.5 kg	\$0.75 (25%)	7.5% (25%)
<4 and $\geq$ 2.5 kg	\$0.60 (20%)	6% (20%)



# IRA Hydrogen Related Programs

- Alternative Refueling Property Credit
- Renewable/Clean Energy **Credits** (PTC, ITC)
- Clean Vehicle Investment Tax Credits
- Advanced Manufacturing Tax Credits
- Advanced Industrial Facilities Deployment Program
- Loan Program Office Authorization

# Questions About Presentation Contact



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