Legislative Breakfast & Briefing

CCUS & Hydrogen: Exploring the Complexities & Opportunities

May 2, 2023

About Team Pennsylvania

- 501c3 nonpartisan nonprofit organization founded in 1997
- Statewide, public-private partnership co-chaired by the Governor and a PA private sector leader
- Accelerate economic growth through public-private partnership

Areas of Impact

A Cross-Sector Collaborative is...

An action-oriented public-private partnership leveraging business and government, nonprofit organizations, academic institutions, and organized labor **to realize economic opportunities through collective action**.

Pennsylvania Energy Horizons Cross-Sector Collaborative

- Statewide network of leaders from industry, government, labor, nonprofits, & academia
- Create the conditions for innovative, technological, and market-driven solutions to decarbonize PA's economy while creating jobs
- Public-private partnership
- Catalyst & enabler for investment
- Driver of sustained, long-term commitment

Opportunities for Carbon Capture and Storage (CCS) and Hydrogen in Pennsylvania

- **Max Drickey**, Team Pennsylvania
- **Matt Fry**, Great Plains Institute
- **Adam Walters**, Pennsylvania Department of Community and Economic Development

CCS and Hydrogen in Pennsylvania

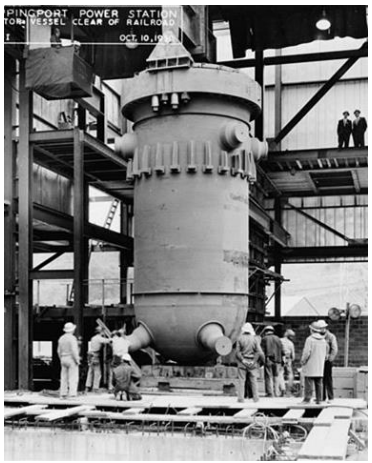
Max Drickey, Energy Policy Fellow
Team Pennsylvania Foundation

Pennsylvania’s Energy Mix

Energy Has a Long History in the Commonwealth

First US coal mine
Mt. Washington, 1740s

First Oil Well
Titusville, 1859



First Nuclear Reactor
Shippingport, 1957

First Hydraulic Fracturing
Warren Co., 1963

Energy is Still Critical to Pennsylvania's Economy

~20,000 jobs in **natural gas**, GRP of $11.8 billion in 2020

~15,000 jobs in **electricity**, GRP of $7 billion in 2021

~4,400 jobs in **coal mining**, GRP of $2 billion in 2020

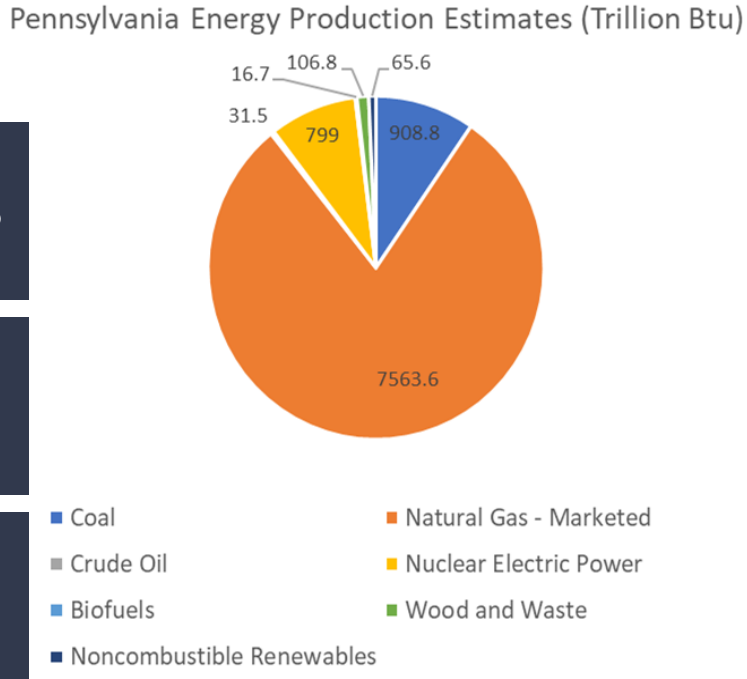
Source: Pennsylvania Department of Community & Economic Development

Pennsylvania is a Major Energy Exporter

2nd largest producer of energy in the US

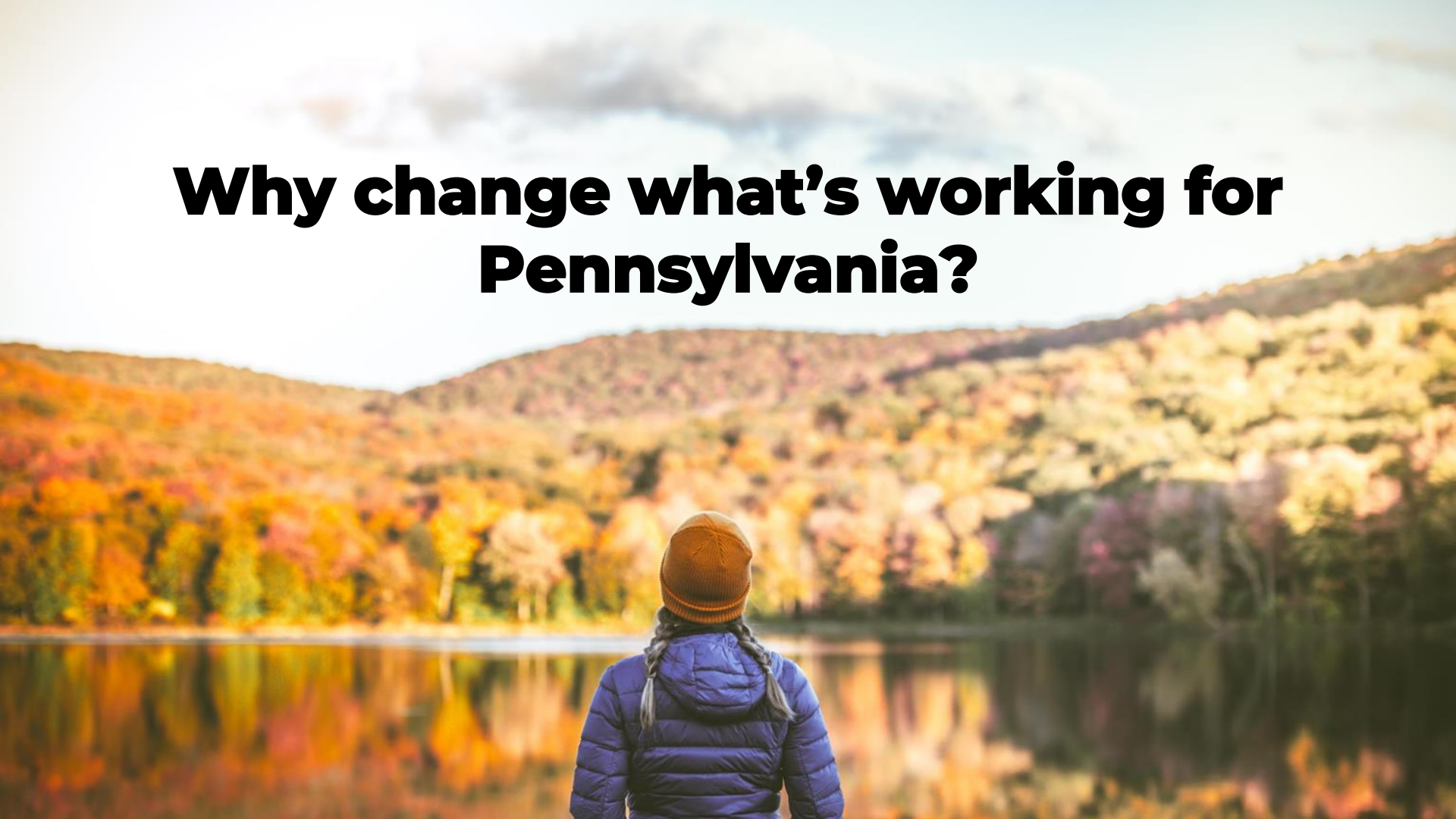
2nd largest producer of natural gas and nuclear power

3rd largest producer of coal



Energy Information Agency, State Energy Profile: Pennsylvania

Why change what’s working for Pennsylvania?



Market Forces, Decarbonization, and The Role for CCS & H_2

Global Climate Change Requires Big Interventions

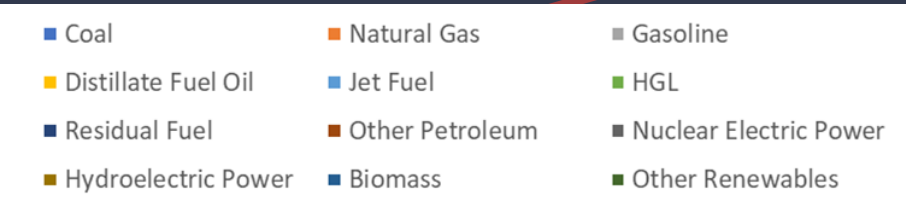
2021 US CO_2 goals:

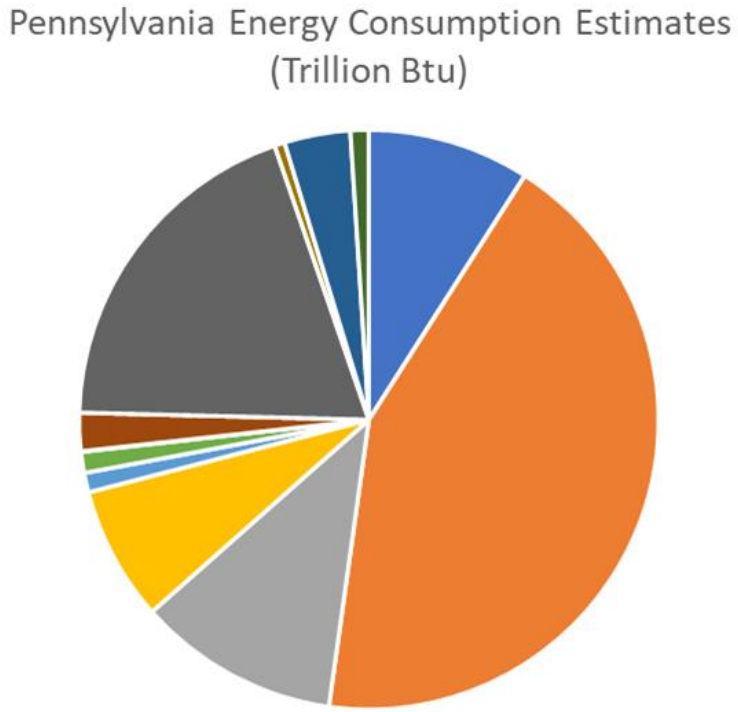
- 50% reduction by **2030**
- “Net zero” by **2050**

2021 PA Climate Action Plan

- 26% reduction by **2025**
- 80% reduction by **2050**

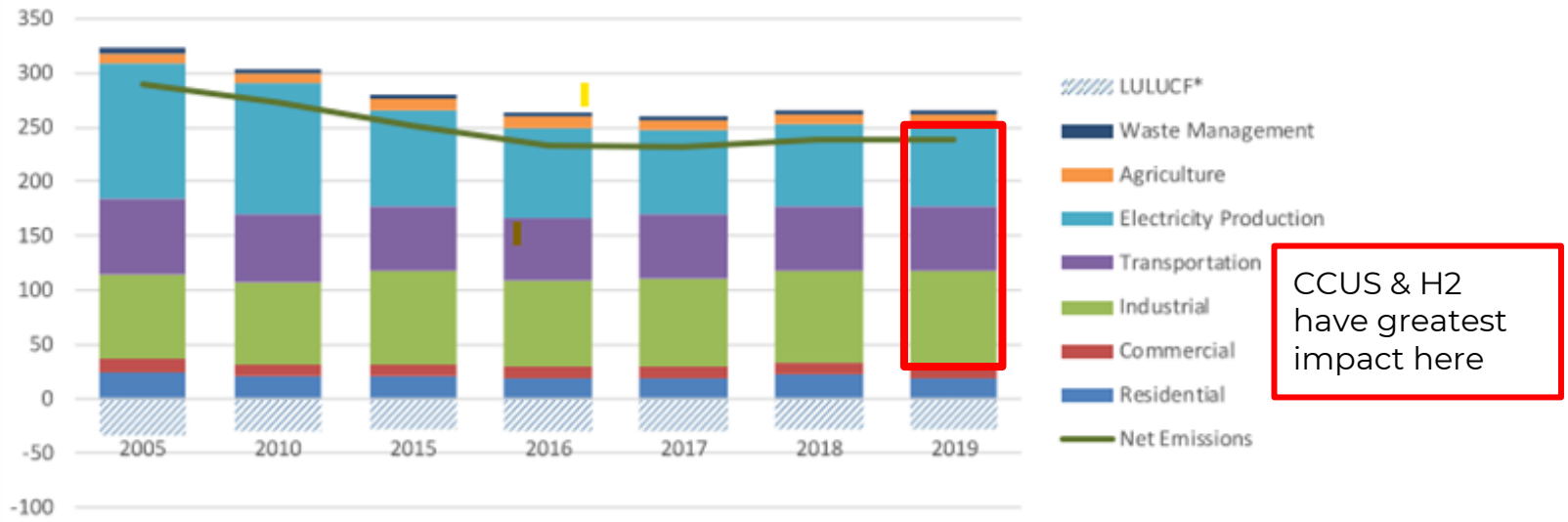
PA's Energy Demands Make Transition Difficult





Source: Energy Information Agency, State Energy Profile: Pennsylvania

Pennsylvania Statewide Emissions (MMTCO2e)



Source: 2022 Pennsylvania Greenhouse Gas Inventory Report, PA Department of Environmental Protection

CCUS and Hydrogen Solve Two Different Problems

CCUS

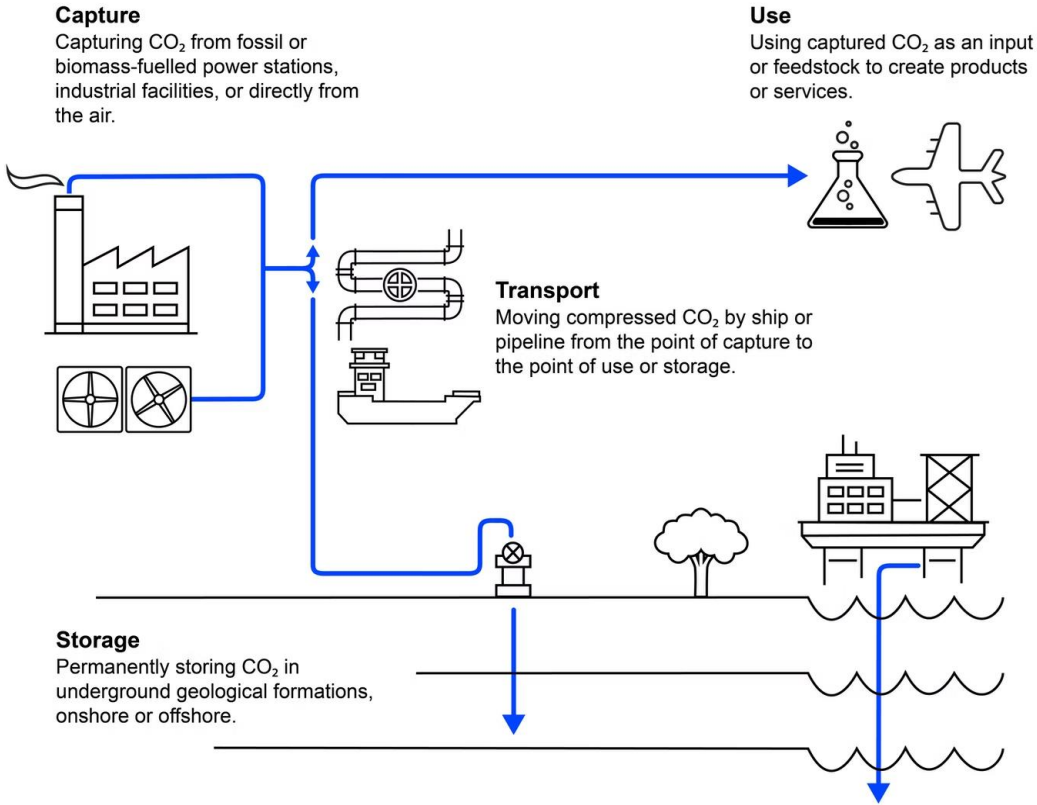
How do we make our current energy infrastructure cleaner?

Hydrogen

What is the future for carbon-intensive industries?

What is CCS?

Carbon
Capture and
Sequestration



Source: IEA

The Role for Hydrogen

- 2.5x the energy of natural gas
- Combustion produces H_2O, not CO_2
- Familiar Tech & Infrastructure
- Storable and dispatchable

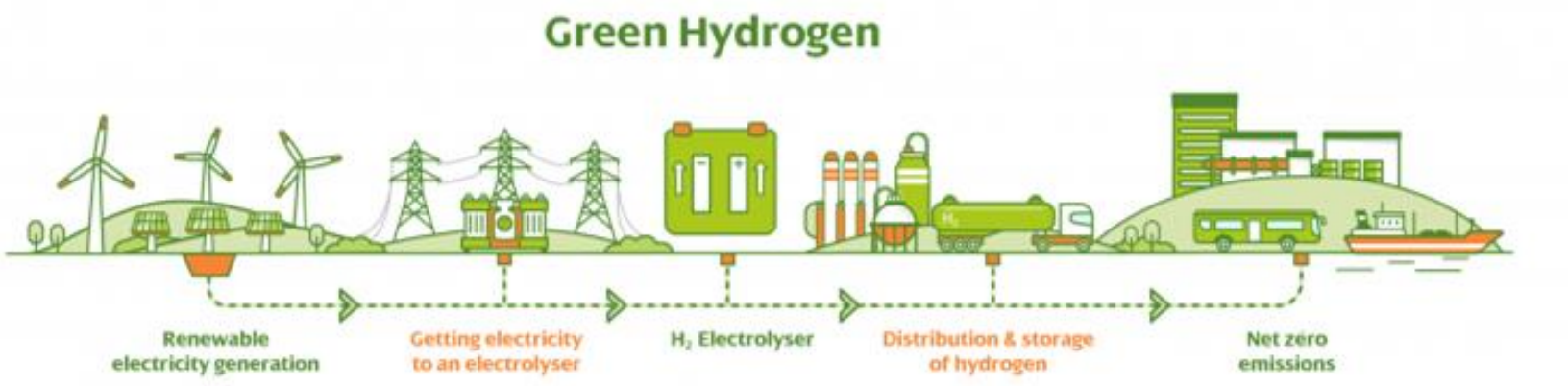
Possible Applications Include

Power generation

Heavy industry

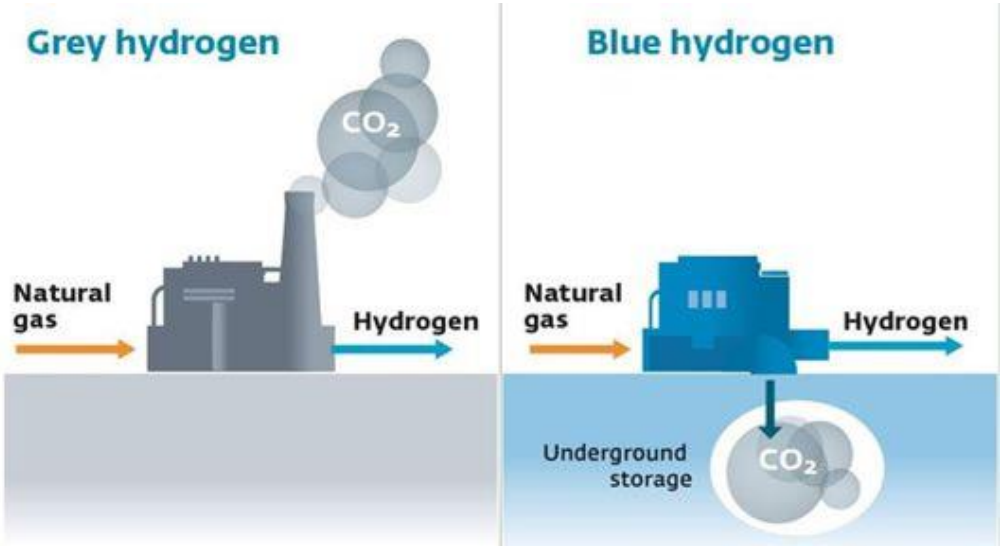
Green Hydrogen

Clean electricity (wind, solar, hydro) is used to split 2H2O → 2H2 + O2



Blue or Grey Hydrogen

$CH_4 + H_2O \rightarrow CO + 3H_2$, THEN $CO + H2O \rightarrow CO_2 + H_2$



Opportunities for CCS & H_2, Nationally & in Pennsylvania

Kickstarting a new economic segment takes investment:

- Capital
- Technical expertise
- Policymaking

Momentum is building in Pennsylvania:

- Pre-competitive cooperation between industry, labor, universities, and state government
- Strong federal support
- 3 highly competitive H2 Hub applications in Pennsylvania, and over 50 across the US

CCUS and Hydrogen Exploring Complexities and Opportunities

May 2, 2023

Matt Fry
Senior Policy Manager, Carbon Management
Great Plains Institute

Background on GPI

Overview and Mission

- Independent nongovernmental organization focused on energy policy and technology.
- Goal is to transform the energy system to benefit the economy and the environment.

Objectives

- Increase energy efficiency and productivity.
- Decarbonize electricity production.
- Electrify the economy and adopt zero and low-carbon fuels.
- Capture carbon for beneficial use and permanent storage.

Carbon Management Program

Our goal is to expand and accelerate economywide commercial deployment of the entire suite of carbon management and industrial solutions by 2030, so that projects and infrastructure can then be scaled to meet midcentury climate goals.

Road Map for the Deployment of Carbon Management and Hydrogen Projects in the Commonwealth of Pennsylvania

October 2022

PA Energy Horizons Cross-Sector Collaborative

Prepared by the Great Plains Institute Carbon Management Team on behalf of Team Pennsylvania

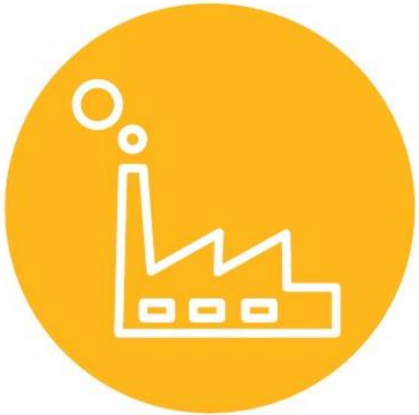
TEAM PENNSYLVANIA

GREAT PLAINS INSTITUTE

Bipartisan Infrastructure Investment and Jobs Act

- **Signed into law November 15, 2021**
- **Includes core carbon management priorities:**
  - Full text of the SCALE Act
  - Funding for 2020 Energy Act authorizations to support commercial-scale demonstrations and FEED studies for carbon capture
  - Regional direct air capture hubs and hydrogen hubs
  - Direct Air Capture technology prize
  - Carbon capture demonstration projects
  - Grants for the commercialization of products and technologies utilizing CO_2

Technology Deployment & Cost Reductions



Bipartisan Infrastructure Investment & Jobs Act:	
Large Scale Pilot Projects	**$937 M** over four-year period
Demonstration Programs	**$ 2.537 B** over four-year period
Direct Air Capture Technologies Prize Competitions	a) PRECOMMERCIAL.— **$15,000,000** for fiscal year 2022 (b) COMMERCIAL.— **$100,000,000** for fiscal year 2022.
Carbon Utilization Program	**$310 M** over five-year period
Carbon Capture Technology Program (front-end engineering and design program)	**$100 M** over five-year period
Direct Air Capture Hubs (creates 4 regional DAC hubs)	**$3.5 B** over five-year period
Regional Clean Hydrogen Hubs (supports at least 4 hydrogen hubs)	**$8 B** DOE must select hubs by May 15, 2023

Transport, Storage Infrastructure & Market Development

CO_2 Transport & Storage

The Infrastructure Investment and Jobs Act, enacted this November, contains the bipartisan SCALE Act in its entirety.

- Carbon dioxide transportation infrastructure finance and innovation (CIFIA): $2.1 billion over five-years
- Carbon storage validation & testing: $2.5 billion over five years
- Secure geologic storage permitting (Class VI & primacy): $75 million over 5 years

Inflation Reduction Act of 2022
Enhancements to 45Q

Multiyear Extension of the Commence Construction Window:

- Moving forward, any carbon capture, DAC, or carbon utilization projects that commence construction ***before*** January 1, 2033, will qualify for 45Q.

Direct Pay:

- Domestic manufacturing projects will receive direct pay for the first 5 years **after the carbon capture equipment is placed in service** (no direct pay for final 7 years of the credit).
- Nonprofit organizations and co-ops can receive direct pay for all 12 years of the credit.

Expanded Transferability:

- Allows the owner of the carbon capture equipment to transfer the credit to any other taxpaying entity. Under this option, the capture owner could receive a cash payment to transfer those credits and the cash payment would not be included in the capture owner's taxable income.

Inflation Reduction Act of 2022
Enhancements to 45Q (continued)

Dramatically Lower Capture Thresholds:

- Direct Air Capture: 1,000 metric tons/taxable year
- Electric Generating Facility: 18,750 metric tons/taxable year **and** paired with design capacity requirement below
- Any other facility: 12,500/taxable year

Enhanced Credit Values for Industry, Power and Direct Air Capture:

- **Industrial & power facilities:** $85 per metric ton for industrial and power facilities that store captured CO2 in saline geologic formations, $60 for utilization of captured CO2 and its precursor carbon monoxide to produce low and zero-carbon fuels, chemicals, building materials and other products, and $60 for EOR.
- **Direct air capture facilities:** $180 per metric ton for direct air capture projects that store captured CO2 in geologic formations, $130 for CO/CO2 used to produce products and $130 for EOR.

Design Capacity Requirement:

- Point-source capture projects on electric generating units will be required to design capture equipment to capture at least 75% of unit CO_2 production, subject to a review if facility emissions increase in future years.

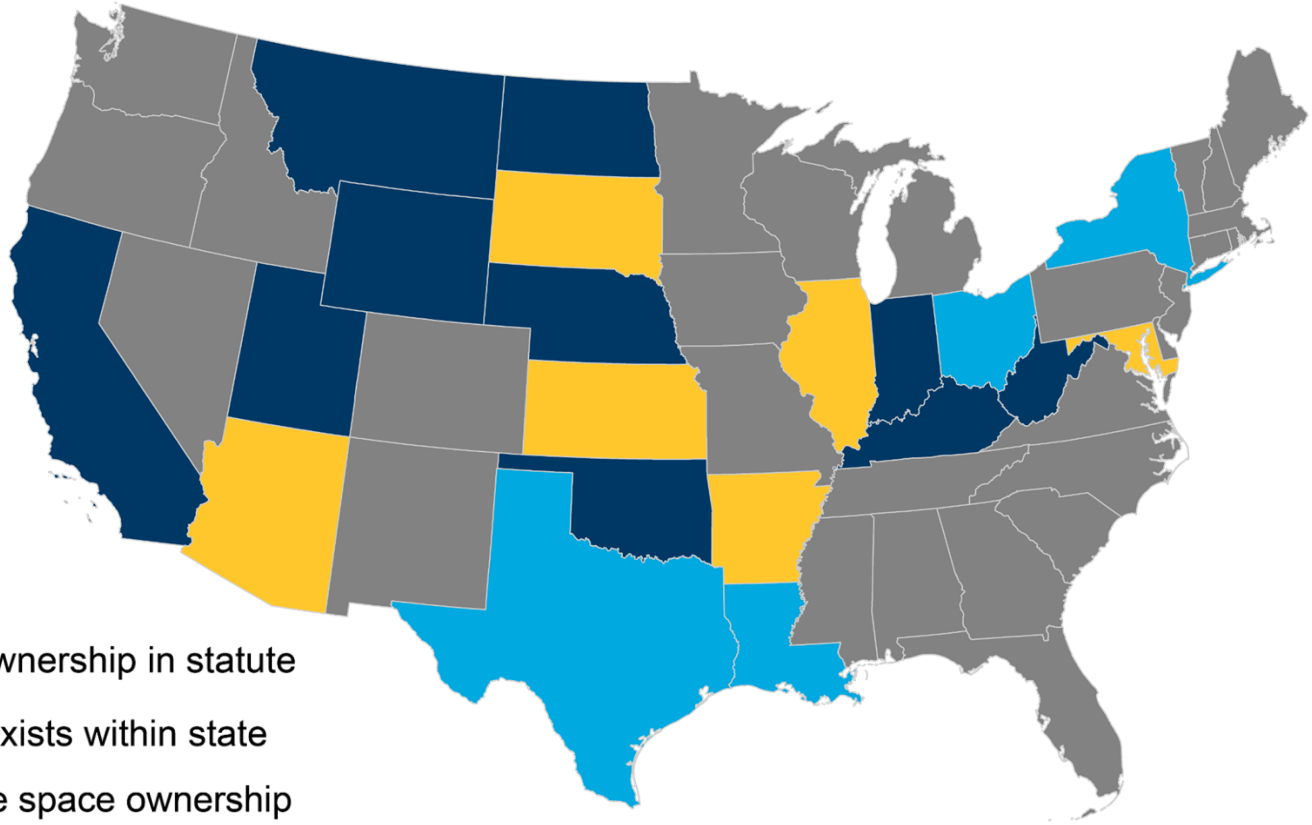
Inflation Reduction Act of 2022
Clean Hydrogen Production Tax Credit

Hydrogen Production Tax Credit equivalent to kilograms of "clean" hydrogen produced multiplied by the applicable amount ($0.60) multiplied by the applicable percentage *(rate below)*

Applicable percentage is determined by lifecycle GHG rates:

- Between 4kg and 2.5kg CO_2e / kg H_2 = 20%
- Between 2.5kg and 1.5kg CO_2e / kg H_2 = 25%
- Between 1.5kg and 0.45kg CO_2e / kg H_2 = 33.4%
- Less than 0.45kg CO_2e / kg H_2 = 100%

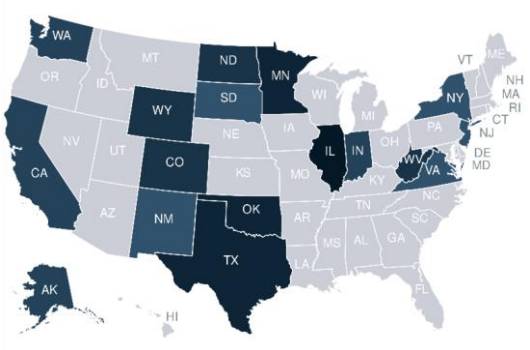
Pore Space Ownership Addressed in Statute



- Established pore space ownership in statute
- No statute, but case law exists within state
- Statute introduced for pore space ownership but not passed
- No statute or regulations were found

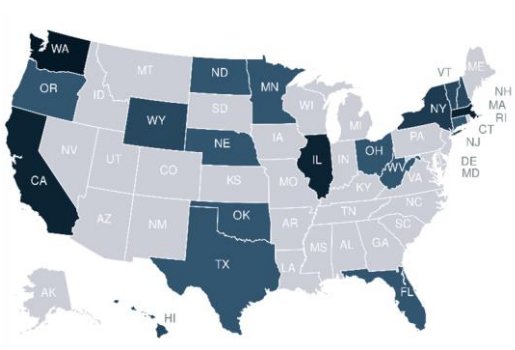
Underway: State Legislative Tracking

Carbon Management



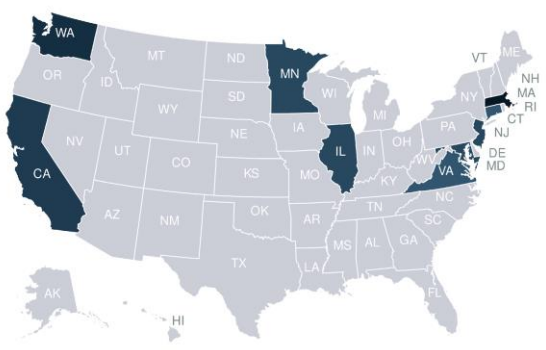
States are advancing bills related to Class VI Primacy, pore space ownership, liability, and regulatory frameworks.

Hydrogen



States are advancing bills related to workforce development, task force creation and strategic planning, clean heat standards, state grants and tax incentives, and federal funding.

Procurement



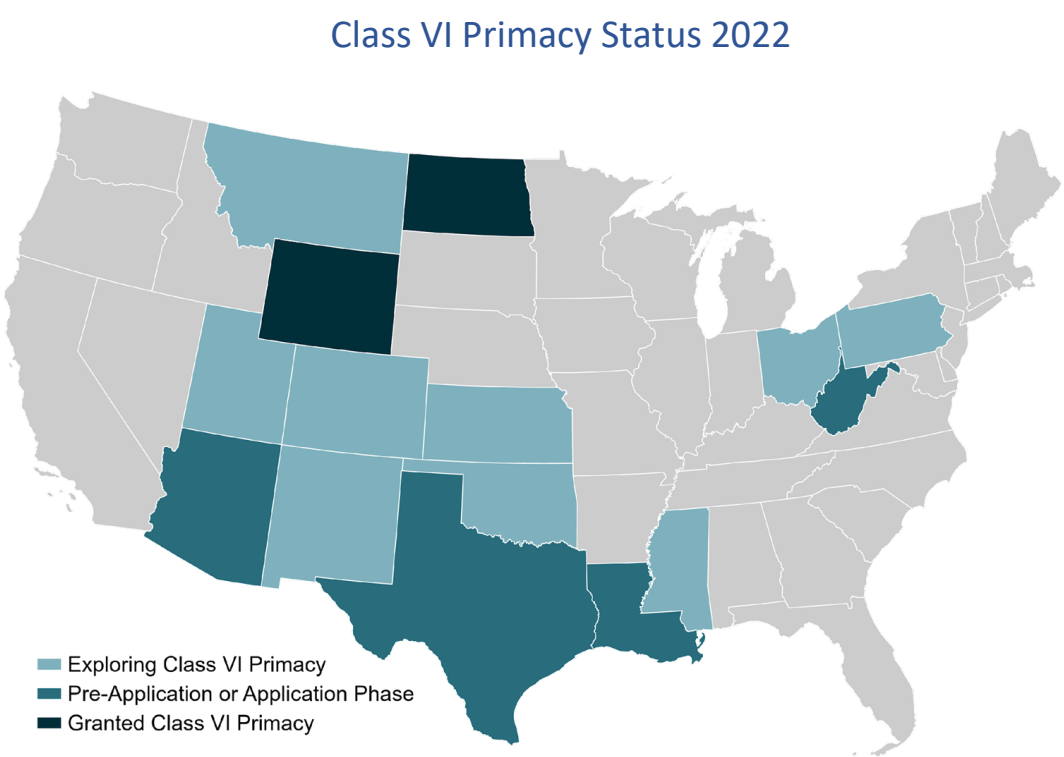
States are advancing bills related to environmental and labor reporting, and tax incentives for low-carbon materials.

State Carbon Management Work Group

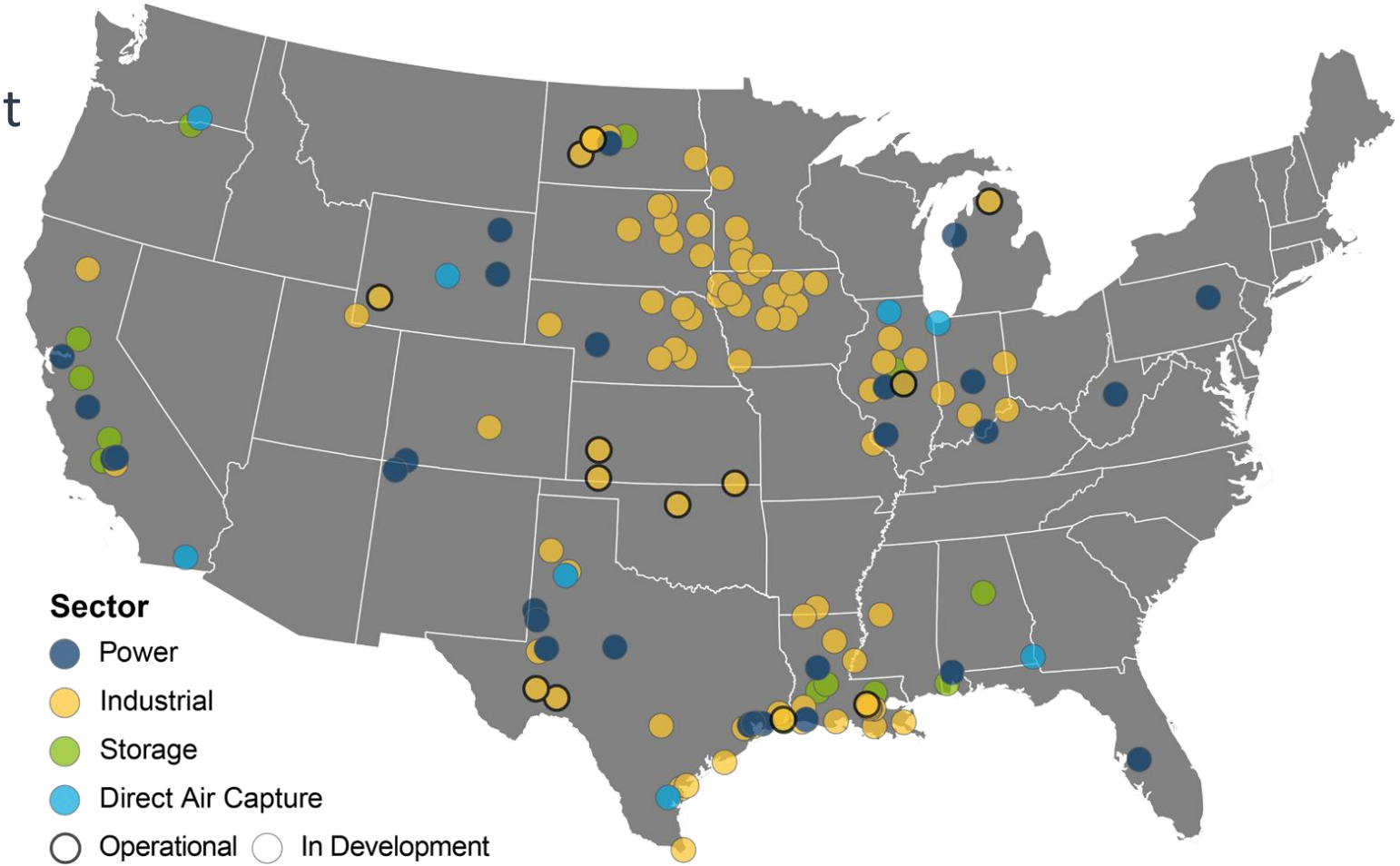
Explore our Tracker *for more detail on key bills enacted or under consideration in states this legislative session. The tracker is neither exhaustive nor complete. If you're aware of legislation that is not listed, please email us.*

Class VI Primacy: Top Priority in Several States

- Assisting and elevating states Class VI efforts is a critical element for enabling saline storage under the current authorization of the reformed 45Q tax credit.
- States such as Louisiana, Oklahoma and Wyoming are laying the groundwork for carbon capture projects and associated infrastructure to become an integral part of our state, regional and national energy economy.
- States seek to create options for companies with significant CO_2 emissions to have the alternative to put that CO_2 to beneficial use and/or safely store it underground through EOR storage or saline storage.

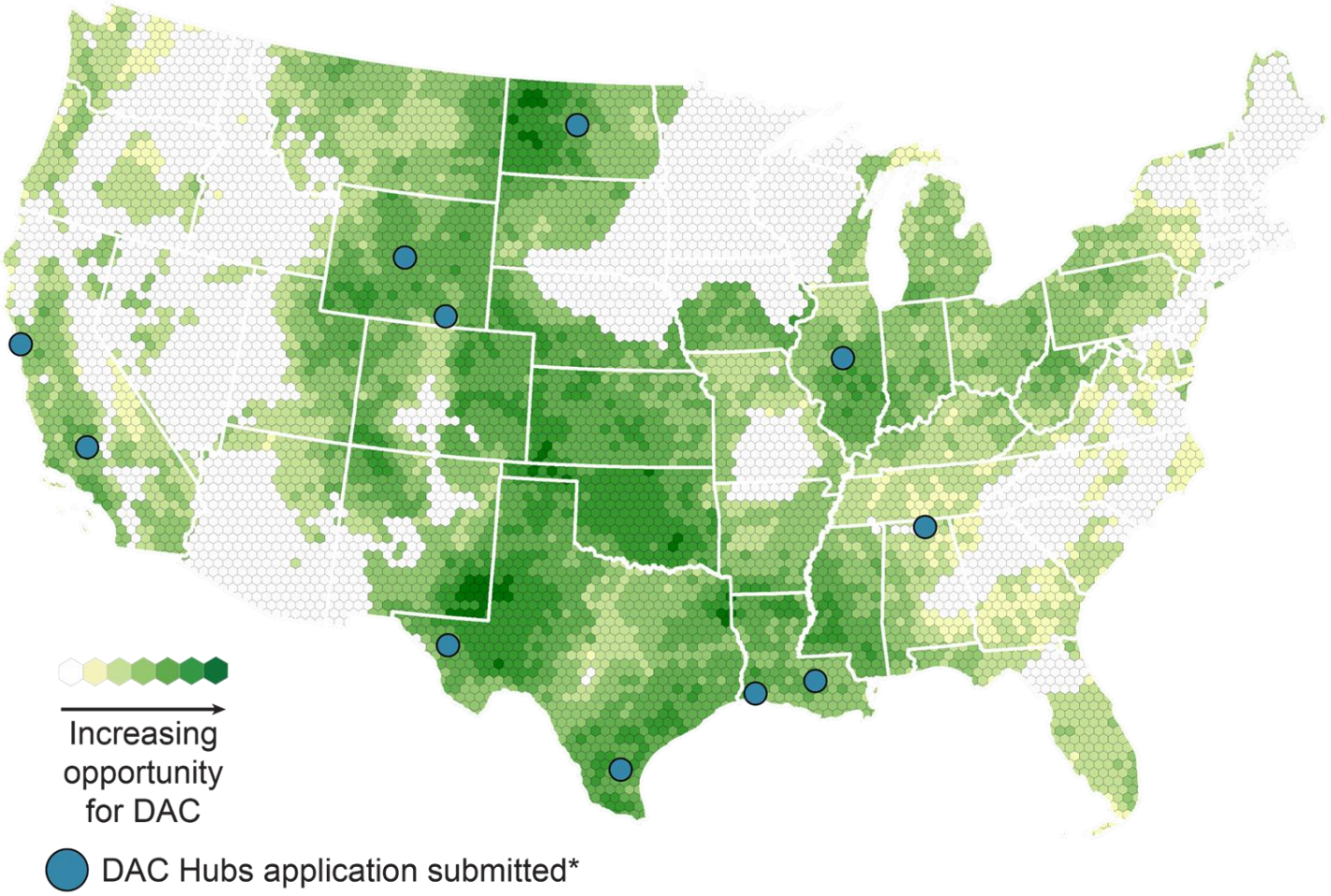


US carbon management projects



Source: CATF US Carbon Capture Activity and Project Table.
Accessed May 1, 2023

Regional DAC Hubs Applications and GPI's Atlas of Direct Air Capture



*According to Reuters, April 18, 2023 (https://www.reuters.com/world/us/facing-brutal-climate-math-us-bets-billions-direct-air-capture-2023-04-18/)

Figure 1. Identified Encouraged Hydrogen Hubs in the United States

1. Pacific Northwest Hydrogen Hub
2. Obsidian Pacific Northwest Hydrogen Hub
3. Alliance for Renewable Clean Energy Systems (ARCHES)
4. Southwest Clean Hydrogen Innovation Network (SHINe)
5. Western Interstate Hydrogen Hub (WIH2)
6. Heartland Hydrogen Hub
7. Hawai'i Pacific Hydrogen Hub
8. Trans Permian Hydrogen Hub
9. Horizons Clean Hydrogen Hub
10. HyVelocity Hydrogen Hub
11. HALO Hydrogen Hub
12. HARVEST Hydrogen Hubs Coalition
13. Mid-Continent Hydrogen Hub
14. Midwest Alliance for Clean Hydrogen (MachH2)
15. Northwest Indiana Hydrogen Hub
16. Southeast Hydrogen Hub
17. Great Lakes Clean Hydrogen Hub
18. Appalachian Regional Clean Hydrogen Hub (ARCH2)
19. Decarbonization Network of Appalachia
20. Mid-Atlantic Hydrogen Hub (MAAH)
21. Mid-Atlantic Clean Hydrogen Hub
22. Northeast Hydrogen Hub

Thank You

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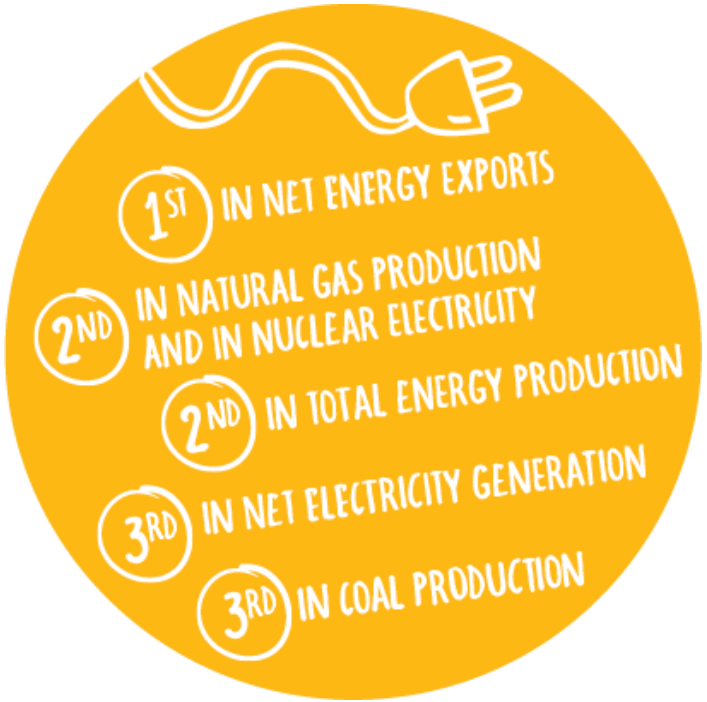
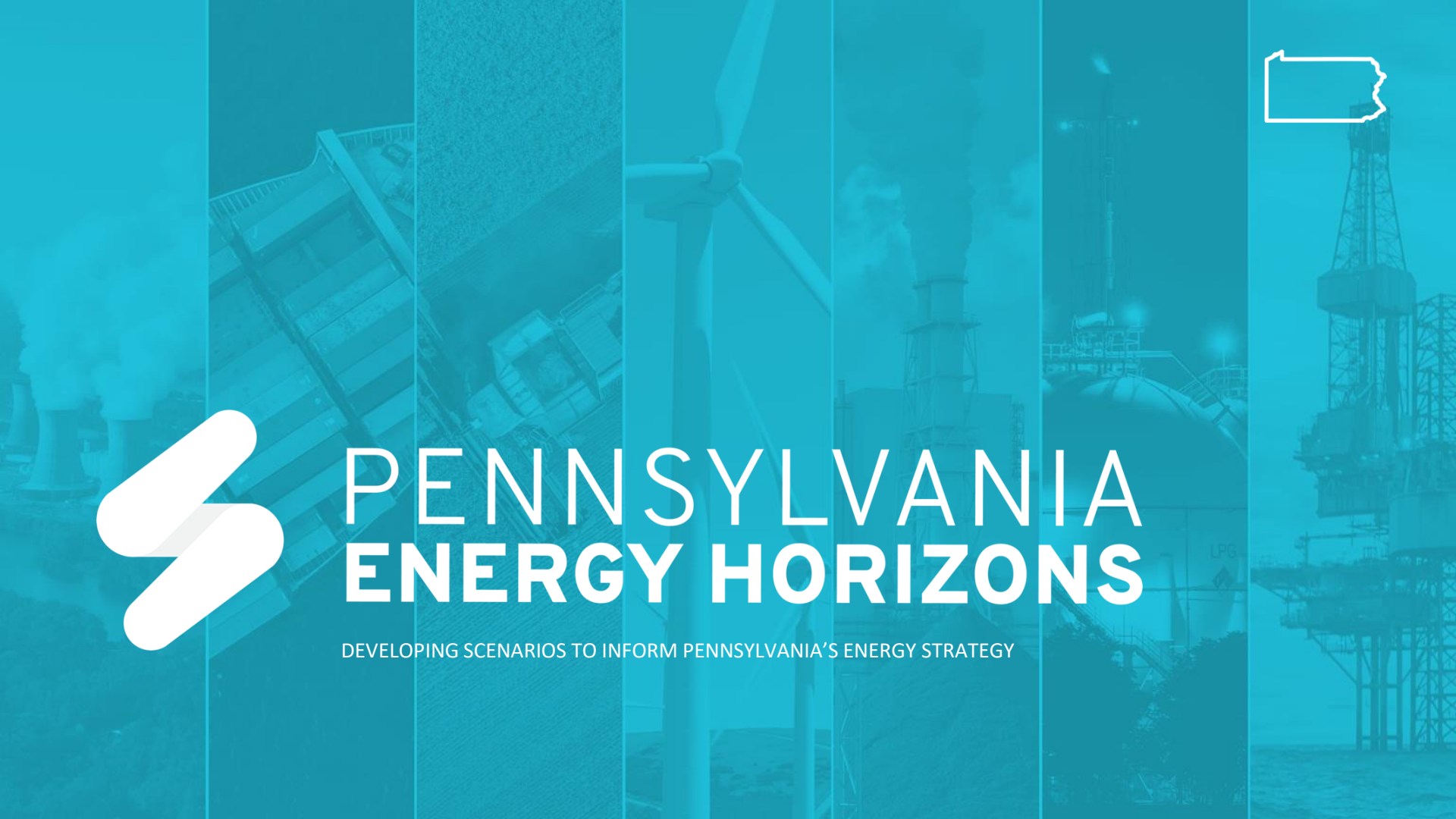
POWERING PENNSYLVANIA'S ECONOMY



- Pennsylvania's energy resources play important role in national energy production
- Opportunities for unparalleled economic growth:
  - Energy sector
  - Manufacturing
  - Reducing emissions throughout the economy
- Emerging as a national leader in energy transition

ENERGY-ENABLED ECONOMIC DEVELOPMENT

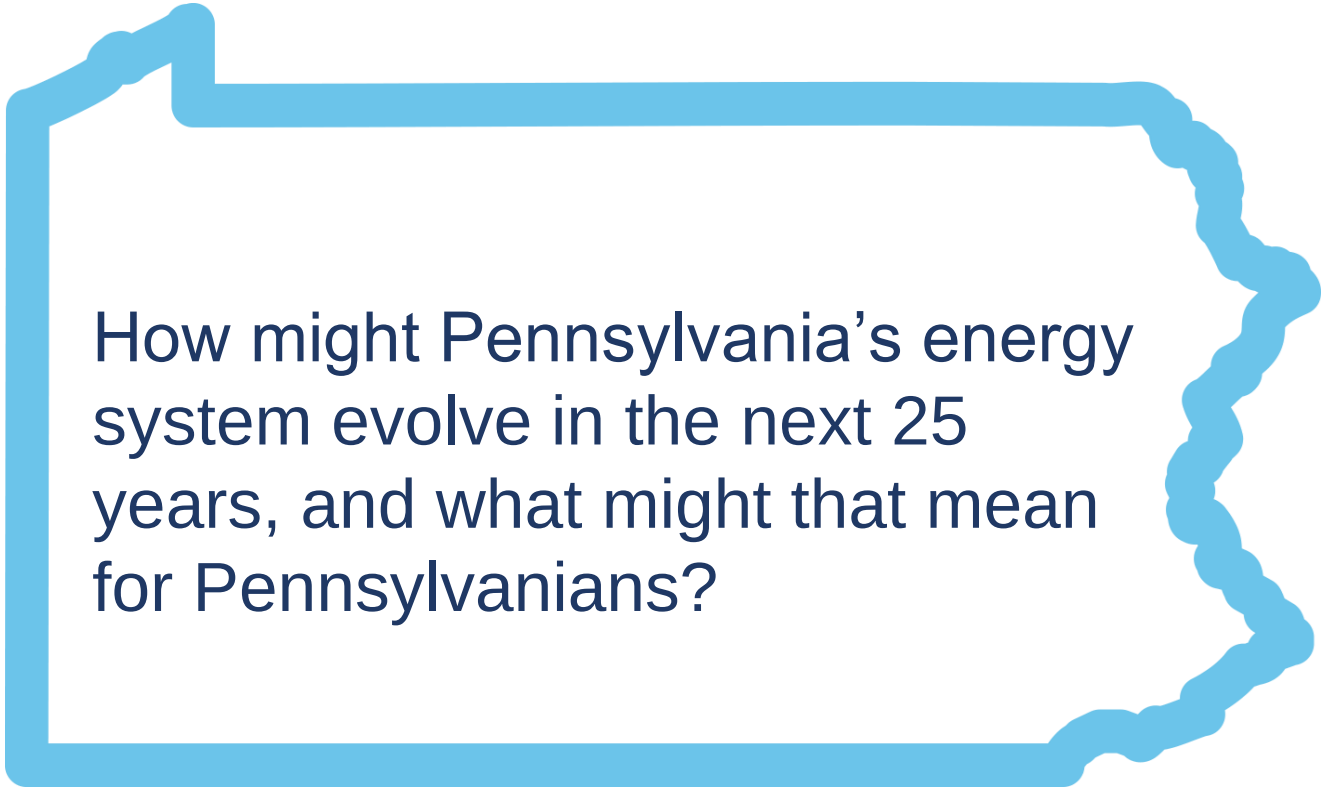
- Renewable Energy Deployment
- Distributed Generation
- Redevelopment Playbooks for Priority Brownfield Sites
- Carbon Capture, Utilization, and Storage
- Hydrogen Production and End-Use



PENNSYLVANIA ENERGY HORIZONS

DEVELOPING SCENARIOS TO INFORM PENNSYLVANIA'S ENERGY STRATEGY


BROTHERS.
LOFTS
1884


How might Pennsylvania’s energy system evolve in the next 25 years, and what might that mean for Pennsylvanians?

WHY IS THIS A PIVOTAL MOMENT FOR PENNSYLVANIA?

- Convergence of interest among public and private sectors
- Pennsylvania Energy Horizons Cross-Sector Collaborative
- Will need to engage in this work with a long-term outlook
- Luckily, we have everything we need to lead in energy transition
- Solutions developed in Pennsylvania will be nationally and globally relevant

Panel Discussion

- **Matt Fry**, Great Plains Institute
- **Jacquie Fidler**, CONSOL Energy
- **Ed Hill, Jr.**, International Brotherhood of Electrical Workers
- **Chris Masciantonio**, U.S. Steel Corporation
- **John Walliser**, Pennsylvania Environmental Council

Interested in Participating?

Visit https://teampa.com and
https://pennsylvaniaenergyhorizons.org/

Contact our team at energy@teampa.com