ARCH2 Project, Community Benefits, and Workforce Development Overview

28th Annual Ohio Energy Savings and Management Conference
Session GG
Columbus, OH
February 28, 2024

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Agenda

- Energy Transition and the Federal Landscape
- Department of Energy's Vision for Hydrogen
- Financial Incentives for Hydrogen Production and Carbon Capture, Transport, Storage (CCTS)
- Appalachian Regional Clean Hydrogen Hub (ARCH2)
  - Scope
  - Community Benefits and Outreach
  - Workforce Development

Federal Landscape and the Energy Transition

Passage of BIL and IRA

Establishment of OCED

Commercialization of Technologies

Massive Federal Spend on The Energy Transition

November 15, 2021

PRESIDENT JOE BIDEN
BUILDING A BETTER AMERICA
BUILD.GOV

Clean Energy and Power:

$75 Billion (of $1.2 Trillion)

August 16, 2022

BUILDING A CLEAN ENERGY ECONOMY:

Clean Energy Technology, Manufacturing, and Innovation:

$370 Billion

Investment and Infrastructure Jobs Act (IIJA) often referred to as Bipartisan Infrastructure Law (BIL)

Inflation Reduction Act (IRA)

Goal:

40 percent reduction in economywide GHG emissions by 2030 (2005 baseline)

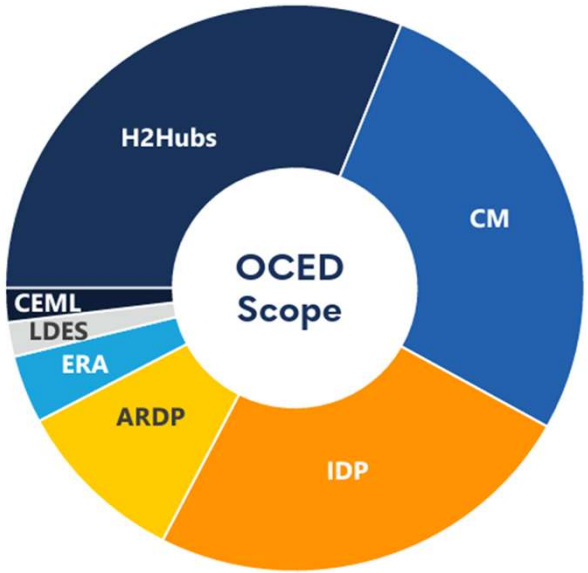
Department of Energy (DOE)

Office of Clean Energy Demonstrations (OCED)

- New office within DOE established by IRA
- Received more than $25 Billion in funding from BIL and IRA
- Clean energy demonstration projects

Project Portfolio

- Regional Clean Hydrogen Hubs (H2Hubs) $8 billion
- Carbon Management (CM) Regional Direct Air Capture Hubs, Carbon-Capture Demos & Large-Scale Pilot Projects $7 billion
- Industrial Demonstrations (IDP) $6.3 billion
- Advanced Reactor Demonstration Projects (ARDP) $2.5 billion
- Energy Improvements in Rural or Remote Areas (ERA) $1 billion
- Long-Duration Energy Storage Demonstrations (LDES) $505 million
- Clean Energy Demonstrations on Mine Land (CEML) $500 million



Tax Credits Help Advance BIL and IRA Objectives

Summary of Carbon Oxide Sequestration and Hydrogen Production Tax Credits			
Tax Provision	**Description**	**Benefits**	**Credit Amounts**
Credit for Carbon Oxide Sequestration **26 U.S. Code 45Q**	Provides a credit for carbon dioxide sequestration coupled with permitted end uses within the United States.	U.S. Direct air capture (DAC), electricity generating, and other facilities subject to facility-specific volume requirements	**Base:** $17/metric ton of carbon dioxide captured and sequestered; $12/metric ton for carbon dioxide that is injected for enhanced oil recovery or utilized. Those amounts are $36 and $26, respectively, for direct air capture facilities. **Bonus**: 5 times the base amounts if the facility meets prevailing wage and apprenticeship requirements.
Clean Hydrogen Production Tax Credit **26 U.S. Code 45V**	Provides a tax credit for the production of clean hydrogen at a qualified clean hydrogen production facility.	Producers of hydrogen in the United States.	**Base:** $0.60/kg multiplied by the applicable percentage. The applicable percentage ranges from 20% to 100% depending on lifecycle greenhouse gas emissions. The $0.60/kg is adjusted for inflation. **Bonus:** 5 times the base amounts if the facility meets prevailing wage and apprenticeship requirements.

Commercialization of Clean Energy Technologies

- **BIL:**
  - Required DOE to establish a **Clean Hydrogen Production Standard** (CHPS):
    - Supports clean hydrogen production from a variety of sources
    - Defines the term 'clean hydrogen' to mean hydrogen produced with a carbon intensity equal to or less than 2 kilograms of carbon dioxide-equivalent produced at the site of production per kilogram of hydrogen produce (2 kg CO_2e/kg ~ 16.7 gCO_2e/MJ)
    - Takes into consideration technological and economic feasibility

- **IRA:**
  - Provided the statutory authority for DOE to establish the Hydrogen Hub Program under OCED
  - Adds new tax credits for hydrogen production (45V) and expands tax credits for carbon dioxide sequestration (45Q)

OCED
Office of Clean Energy Demonstrations

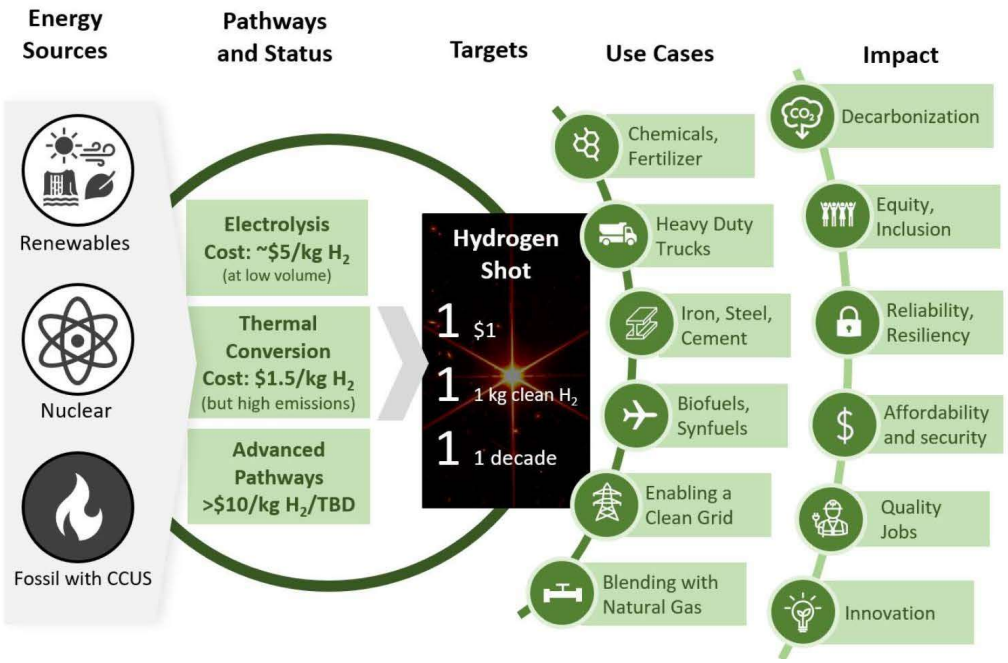
DOE's Vision for Hydrogen

DOE's Hydrogen Shot

What is a Hydrogen Hub?

Which Hydrogen Hubs received federal funding?

DOE Hydrogen Shot



Clean Hydrogen in the US could ...

Support economy-wide decarbonization

~10%

economy-wide emissions reductions by 2050

Create quality jobs to support the energy transition

100,000

jobs created by 2030

450,000

Cumulative job-years through 2030

Source: DOE U.S. National Clean Hydrogen Strategy and Roadmap

Clean Hydrogen Hubs Provide the Backbone for a Clean Hydrogen Economy

Production of Hydrogen
(various methods)

+

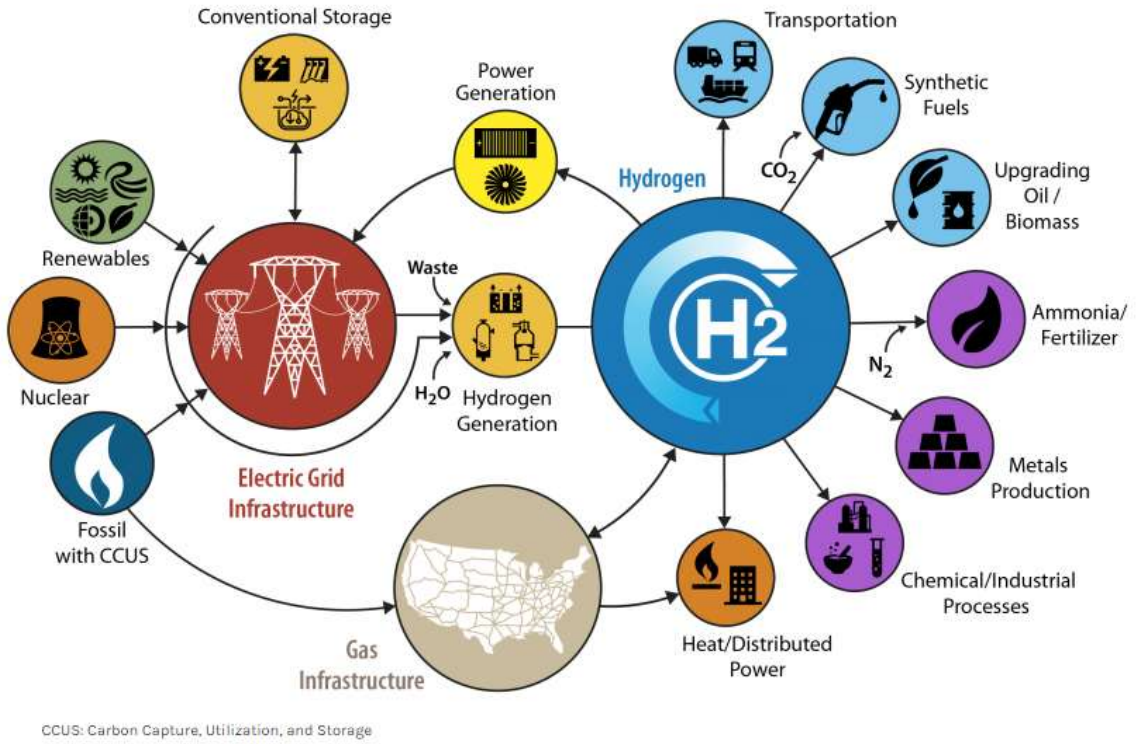
Carbon Capture & Storage
(if needed)

+

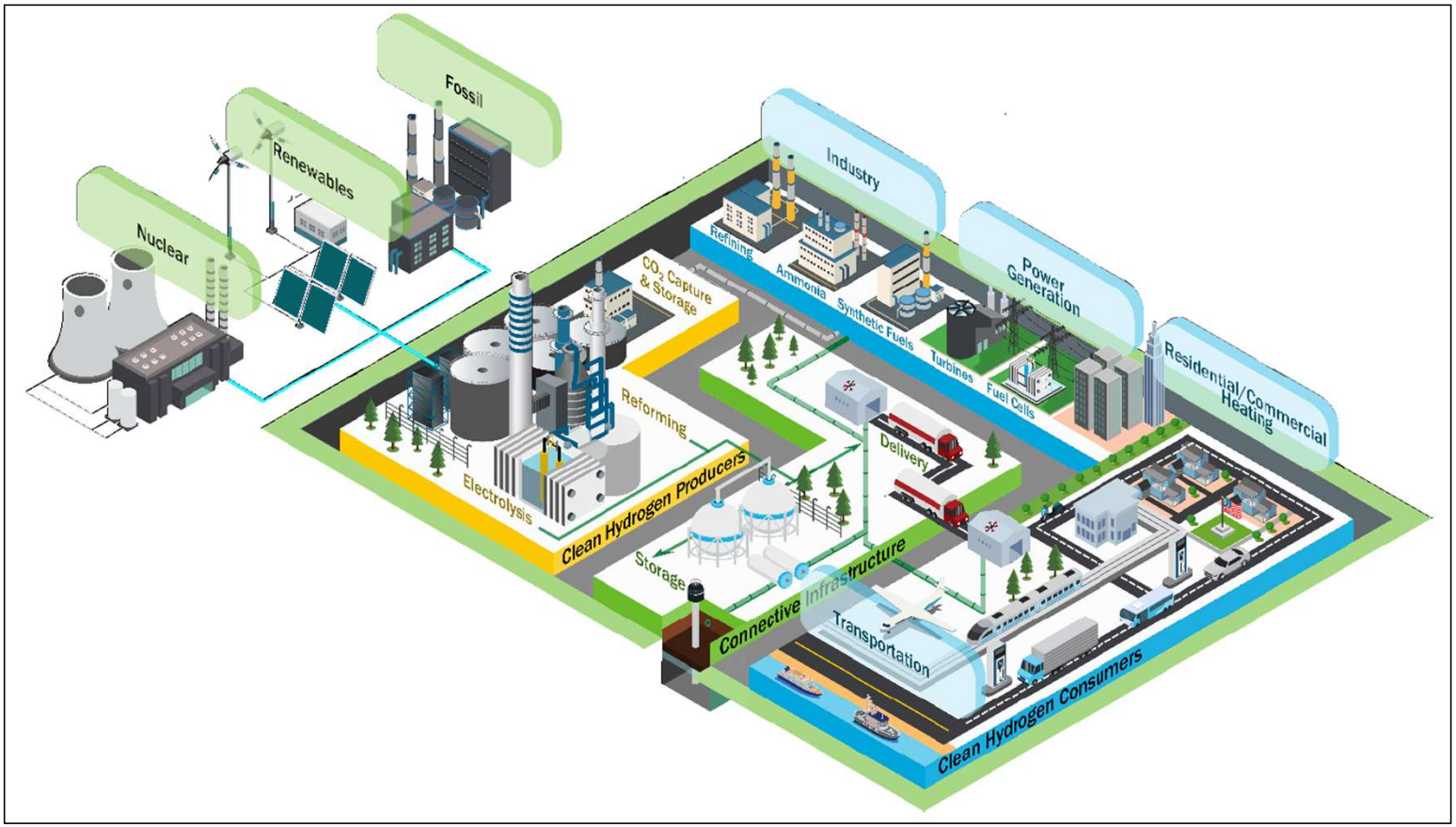
Storage and Distribution Networks

+

Utilization
(Transportation, Industry, Power, Fuels)



Clean Hydrogen Hubs Fully Integrate Production, Transportation, Storage and Offtake



Seven Hydrogen Hubs Were Selected

- RFI issued (Q1/22)
- FOA issued (9/22)
- 79 concept papers submitted (11/22)
- 33 encouraged to submit proposals (12/22)
- 20 proposals submitted (4/23)
- 13 interviews conducted (Q3/23)
- 7 hubs were selected for negotiation (10/13/23)
- Under Contract (5/1/24)

Appalachian Regional Clean Hydrogen Hub (ARCH2)

ARCH2 Management

ARCH2
APPALACHIAN REGIONAL CLEAN HYDROGEN HUB

TRC

Program Management Office

BATTELLE

GTI ENERGY

NATIONAL ENERGY TECHNOLOGY LABORATORY

AST Allegheny Science & Technology

TRC

Safety, Security and Regulatory Function

15 Project Development Partners

Air Liquide

EQT

MARATHON

Hope Gas

CNX

TC Energy & Chemours

Dominion Energy

KeyState Energy

EMPIRE DIVERSIFIED ENERGY

plug

Independence Hydrogen

FIRST MODE

FIDELIS NEW ENERGY CLIMATE POSITIVE & CARBON NEGATIVE

HOG LICK AGGREGATES

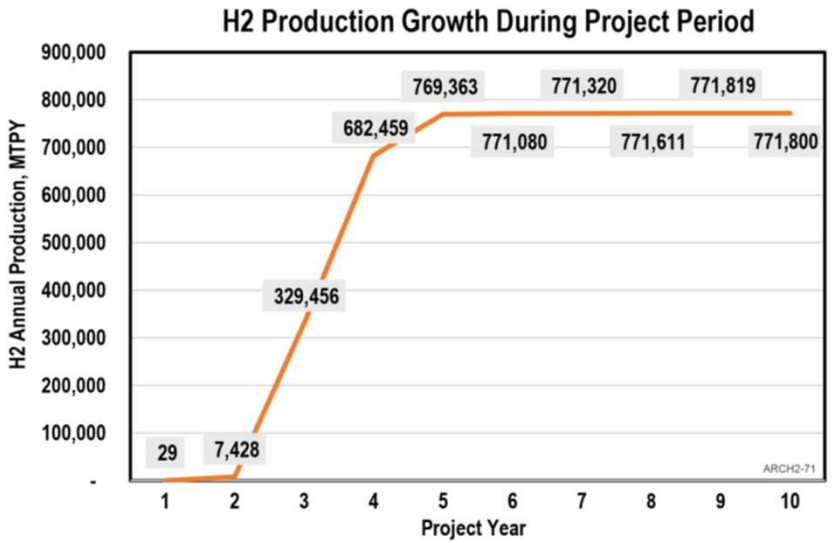
10/13/2023
ARCH2 Selected to Negotiate $925 Million Award

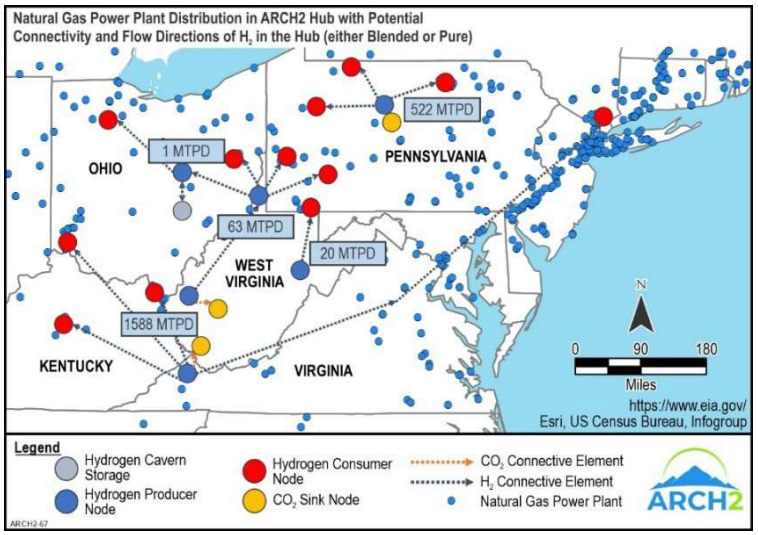
Safety, Security and Regulatory Function:
Each Phase Subject to Negotiation with DOE

TRC Responsibilities for Phase 1:

1) Drive **safety and cybersecurity** culture, provide programmatic guidance and coordinate development of plans
2) Manage and support **regulatory engagement** with federal, state and local permitting agencies
3) Prepare the NEPA **Environmental Information Volume**
4) Assist with Community Benefit Plan and Workforce Development efforts

ARCH2 Growth and Expansion





AT TIME OF INTERVIEWS

- ARCH2 advances a national clean H_2 network by use of scalable and replicable technology approaches for H_2 production and utilization
- Connects within region and to adjacent hubs allowing transfer of feedstocks and products
- ARCH2 ammonia projects will supply products to eastern states.
- H_2 offtake potential in NG combined cycle power plants is significant
- Mobility projects part of regional and national networks of refueling systems
- Total revenues from H_2 and product sales alone can exceed $2B annually.

ARCH2 Hub Integrates Diverse Technologies

15 Project Development Partners

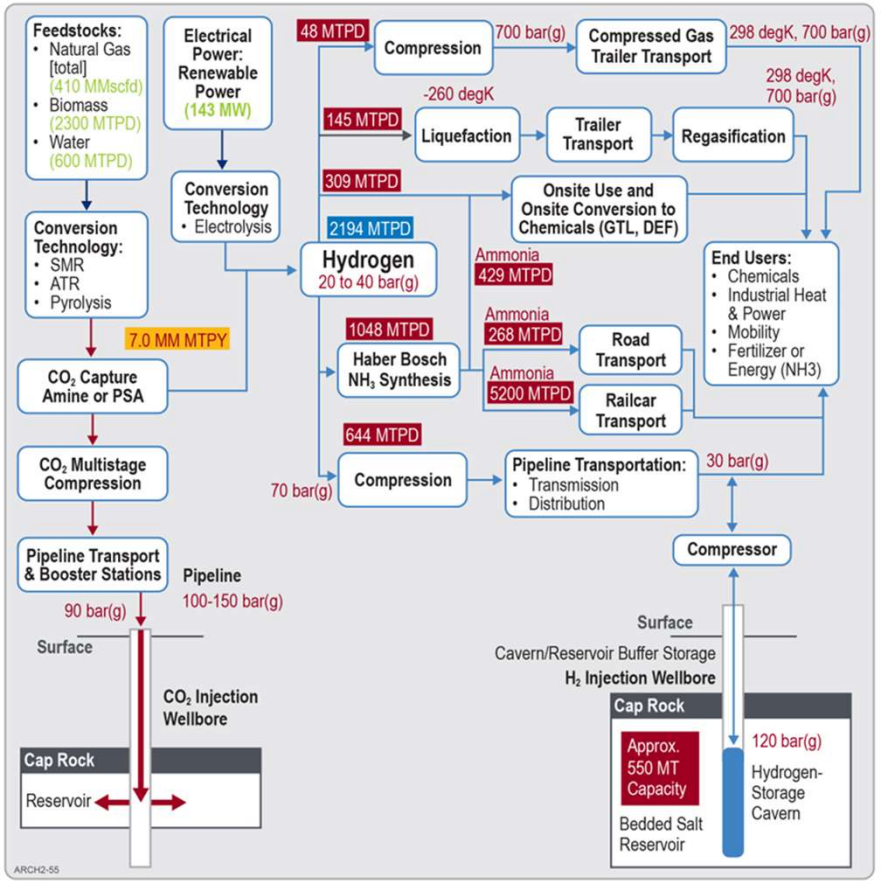
Air Liquide · EQT · Marathon · Hope Gas · CNX · TC Energy & Chemours · Dominion Energy · KeyState Energy · Empire Diversified Energy · plug · Independence Hydrogen · First Mode · Fidelis New Energy · Hog Lick Aggregates

H_2 Production Technologies used in ARCH2 Hub

- Autothermal Reforming (ATR)
- Electrolysis
- Biomass Gasification

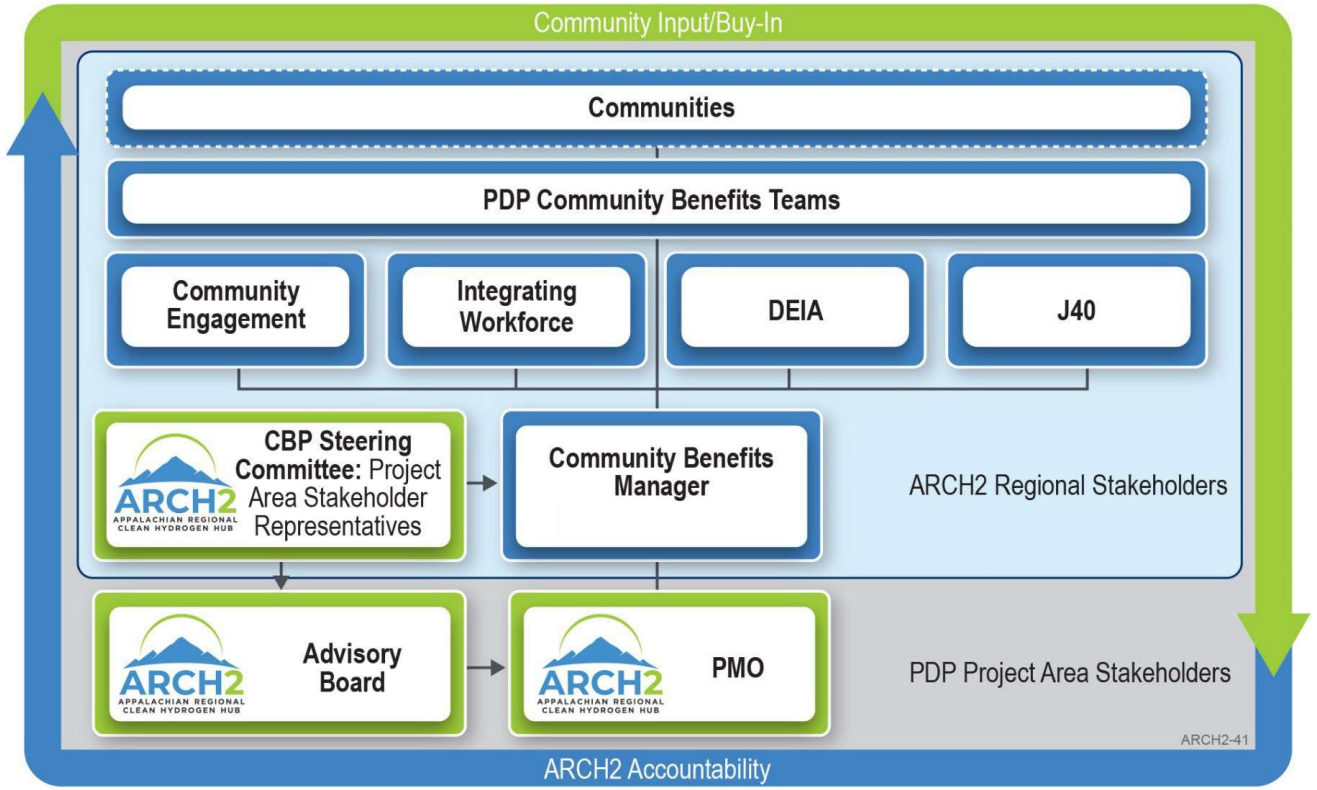
Products

- Gaseous and Liquified H_2
- Ammonia, Urea, and Diesel Exhaust Fluid
- Low Carbon Aviation Fuel (LCAF)
- Carbon Black



ARCH2
Community Benefits Plan

ARCH2 Communities First Approach



ARCH2 Community Benefits Plan

- Initial CBP was submitted with application
- CBP includes:

- Engaging Community and Labor
- Investing in the American Workforce
- Advancing DEIA
- Implementing the Justice40 Initiative

ARCH2 Regional Outreach

Labor / Trades / Workforce Development

> 10 unions, trades organizations, and employment agencies

Business Development / Industry Organizations

> 40 service providers

Community / Environment / Non-Profits

> 15 environmental, special interest groups, and faith-based organizations

Academia

> 15 universities, community colleges, and trade schools

Government

> 25 federal, state, local, and tribal

Community Impact

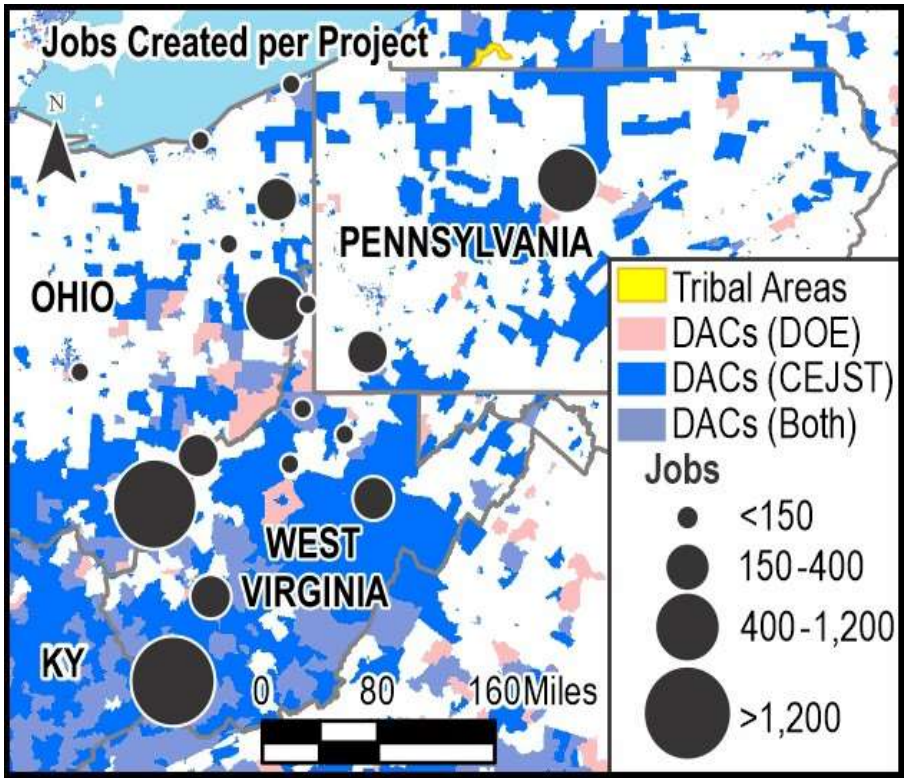
- DOE funds will foster a just energy transition in a region disproportionately impacted by the loss of extractive industry jobs through:
  - Environmental and economic benefits
  - Community engagement
  - Jobs creation and
  - Workforce development

Community engagement is paramount; an inclusive Advisory Board composed of regional governments, labor/trade organizations, NGOs, academia, and community groups will keep communities first.

ARCH2
Job Quality & Workforce Development

ARCH2 Jobs Impact

- Jobs will occur at project sites, with job growth also occurring with industry suppliers, leading to broader impacts throughout the region



AT TIME OF INTERVIEWS

Industry Commitment

DOE funds unlock >$6B in investments in clean H_2 (>80% cost share)

Industry is motivated to co-invest with DOE in this region.

- High Impact
  - ARCH2's diverse project portfolio neutralizes DOE risks.
  - Multiple projects will catalyze growth of many H_2 businesses, benefiting many communities.

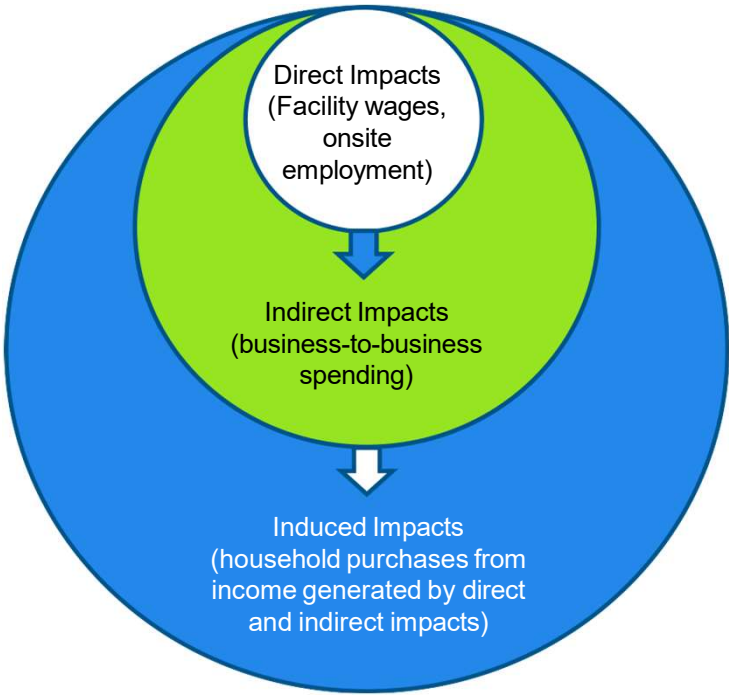
Workforce Development

- Assessment of workforce needs and relevant labor unions and training partners in the Appalachian Region
  - Coordination with labor unions
  - Economic impact assessment (EIA) provides detailed workforce understanding
  - Collaboration with partnering universities for apprenticeships and scholarship opportunities
  - Development of workforce training to fill gaps
- Assessment of jobs and benefits and improvements in job quality
  - EIA provides detailed wage and benefits estimates
- Assessment of potential negative impacts for workers

Measurable Impacts

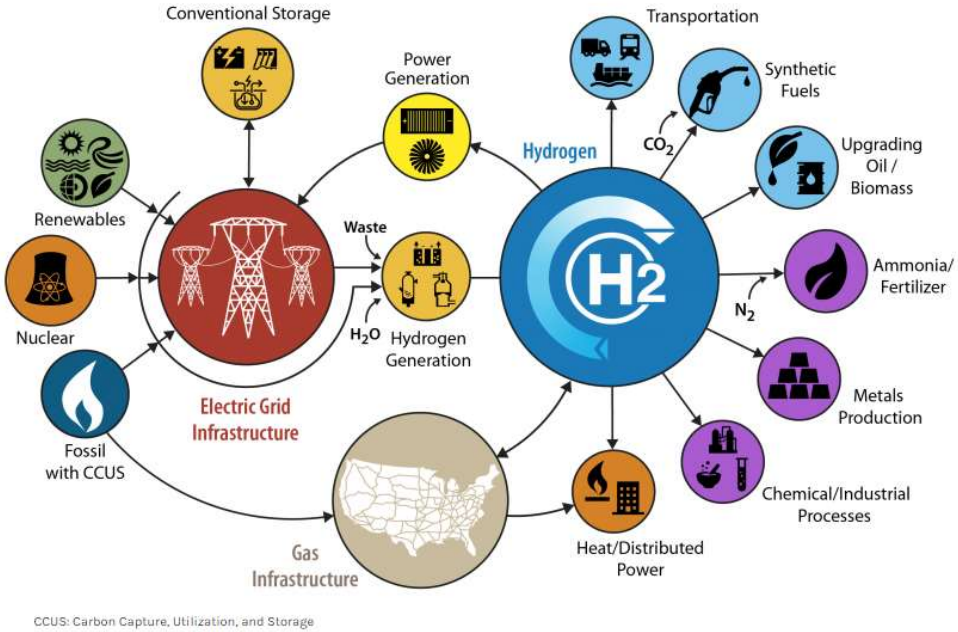
Goal: Use Economic Impact Analysis to allow CBP to tell the story of a Project's positive impacts and ID workforce gaps

- Economic Impact Analysis provides results with data inputs (such as total facility cost)
- Results include:
  - Output (value of production) by industry,
  - Employment by industry and occupation
  - Community skills and abilities, along with Project requirements (to identify training and worker gaps)



Summary

- Hydrogen hub development provides significant decarbonization opportunities across the US and establishes the foundation for a hydrogen economy with significant economic benefits.
- ARCH2 reflects a range of hydrogen production technologies distributed across the Appalachian Region to produce a broad impact.
- Community benefits planning has been at the forefront of ARCH2 development.
- ARCH2 workforce development efforts will create an engaged, qualified workforce for clean energy jobs.



Thank you!

TRC - Tyler LaSusa
Market Director

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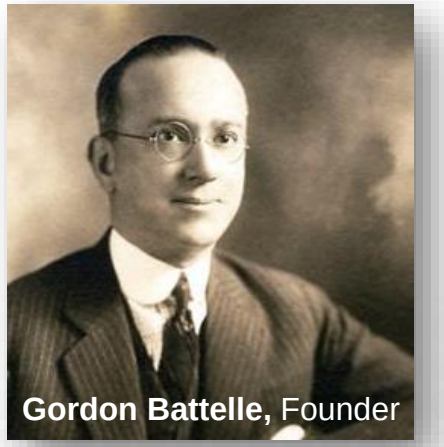
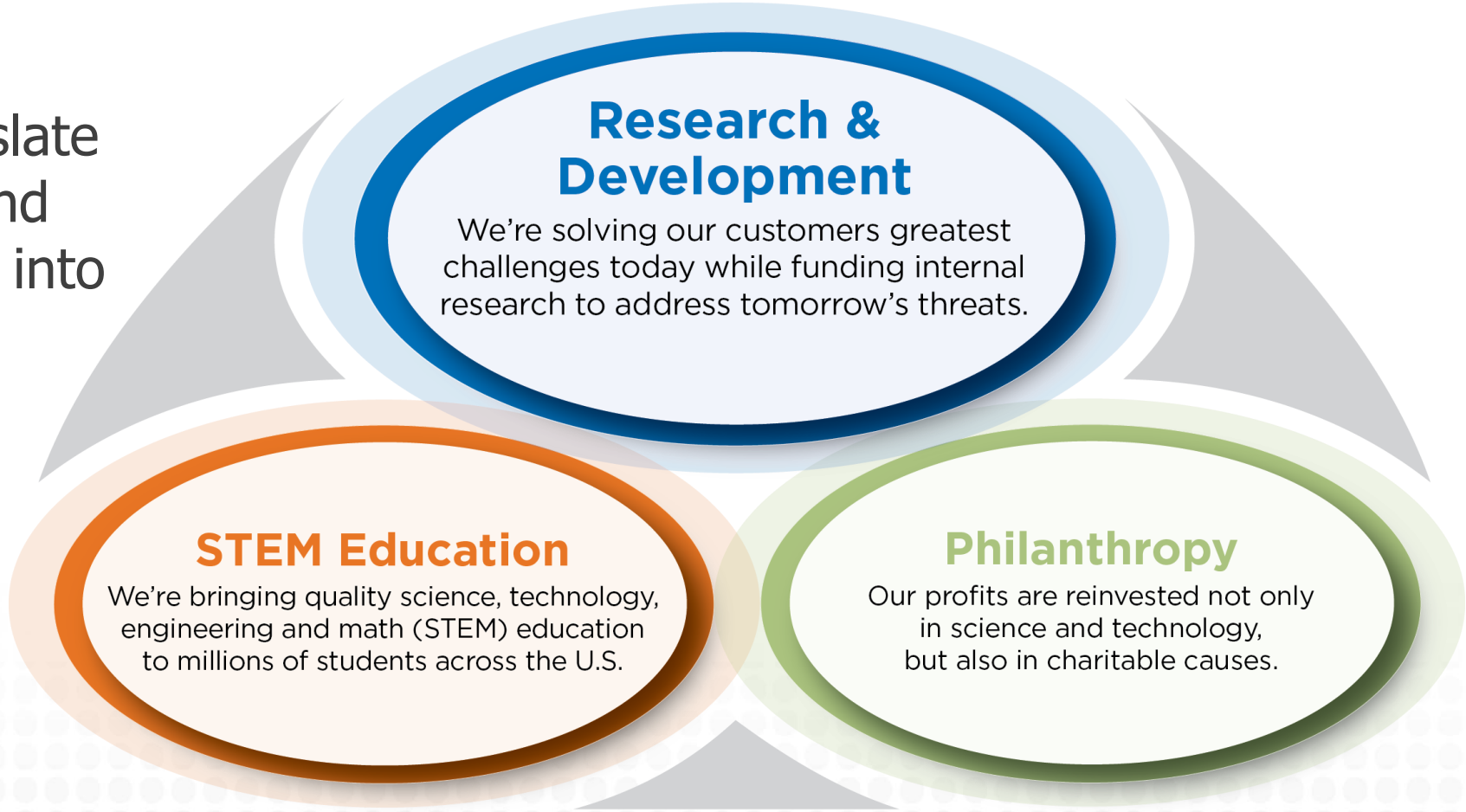
Appalachian Regional Clean Hydrogen Hub (ARCH2)

Our mission and purpose

- Nonprofit, charitable trust formed in 1925
- Our mission: To translate scientific discovery and technology advances into societal benefits



Gordon Battelle, Founder



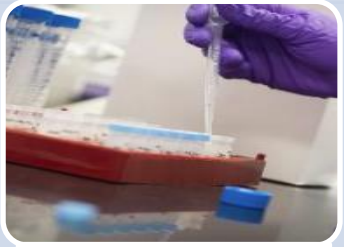
Applied Science and Technology

Addressing big challenges

Climate Resilience

Space & Hypersonics

Neurotechnology

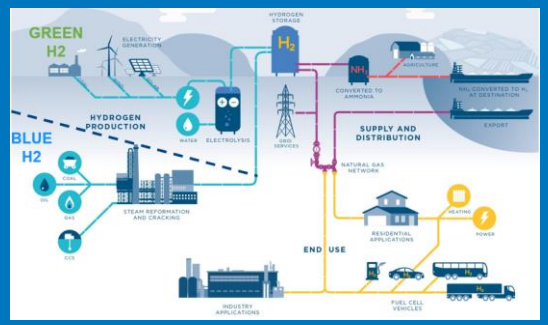


PFAS

Research Infrastructure

Microelectronics Trust & Assurance

CCS Deployment



H_2 and DAC Deployment

Enhanced Geothermal

REE / CM

Plastics Upcycling/Recycling

Re-energizing Appalachia

Economically • Socially • Environmentally

ARCH2 APPALACHIAN REGIONAL CLEAN HYDROGEN HUB

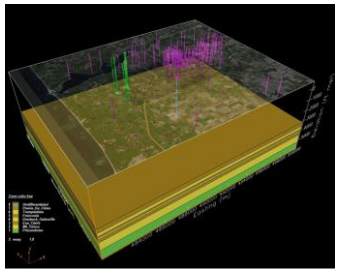
Battelle CCUS includes government, industry, & international projects on CO_2 storage over 25 years

MRCSP/MRCI Large-Scale Public-Private Partnership

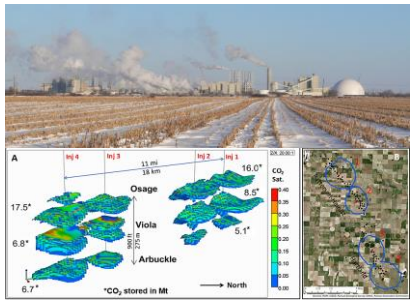
MRCSP
MIDWEST REGIONAL CARBON SEQUESTRATION PARTNERSHIP

MRCI
Midwest Regional Carbon Initiative

Commercial Carbon Storage Development



CarbonSAFE Scaling Up



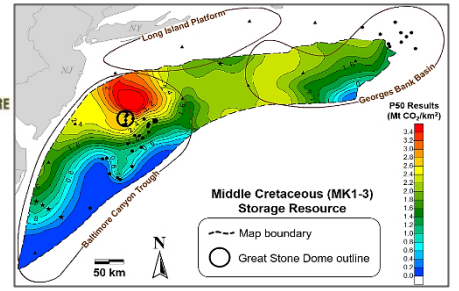
Nebraska & Kansas, Ohio, Michigan

International CCUS Development

AEP Mountaineer Pilot and FutureGen

Offshore Carbon Storage

MID-ATLANTIC U.S. OFFSHORE CARBON STORAGE RESOURCE ASSESSMENT PROJECT



Re-energizing Appalachia
Economically • Socially • Environmentally

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APPALACHIAN REGIONAL CLEAN HYDROGEN HUB

And Then There Were 7

- **Appalachian Hydrogen Hub (Appalachian Regional Clean Hydrogen Hub (ARCH2)**; West Virginia, Ohio, Pennsylvania)
- **California Hydrogen Hub (Alliance for Renewable Clean Hydrogen Energy Systems (ARCHES); California)** — The California Hydrogen Hub will produce hydrogen exclusively from renewable energy and biomass. It will provide a blueprint for decarbonizing public transportation, heavy-duty trucking, and port operations

- **Gulf Coast Hydrogen Hub (HyVelocity H2Hub; Texas)** — The Gulf Coast Hydrogen Hub plans for large-scale hydrogen production using both natural gas with carbon capture and renewables-powered electrolysis, leveraging the Gulf Coast region's abundant renewable energy and natural gas supply to drive down the cost of hydrogen

- **Heartland Hydrogen Hub (Minnesota, North Dakota, South Dakota)** — The Heartland Hydrogen Hub will leverage the region's abundant energy resources to help decarbonize the agricultural sector's production of fertilizer,

- **Mid-Atlantic Hydrogen Hub (Mid-Atlantic Clean Hydrogen Hub (MACH2);** Pennsylvania, Delaware, New Jersey) —It plans to develop renewable hydrogen production facilities from renewable and nuclear electricity using both established and innovative electrolyzer technologies

- **Midwest Hydrogen Hub (Midwest Alliance for Clean Hydrogen (MachH2); Illinois, Indiana, Michigan)** —The Midwest Hydrogen Hub will enable decarbonization through strategic hydrogen uses including steel and glass production, power generation, refining, heavy-duty transportation, and sustainable aviation fuel.

- **Pacific Northwest Hydrogen Hub (PNW H2; Washington, Oregon, Montana)** — The Pacific Northwest Hydrogen Hub plans to leverage the region's abundant renewable resources to produce clean hydrogen exclusively via electrolysis. Its anticipated widescale use of electrolyzers will play a key role in driving down electrolyzer costs, making the technology more accessible to other producers, and reducing the cost of hydrogen production.

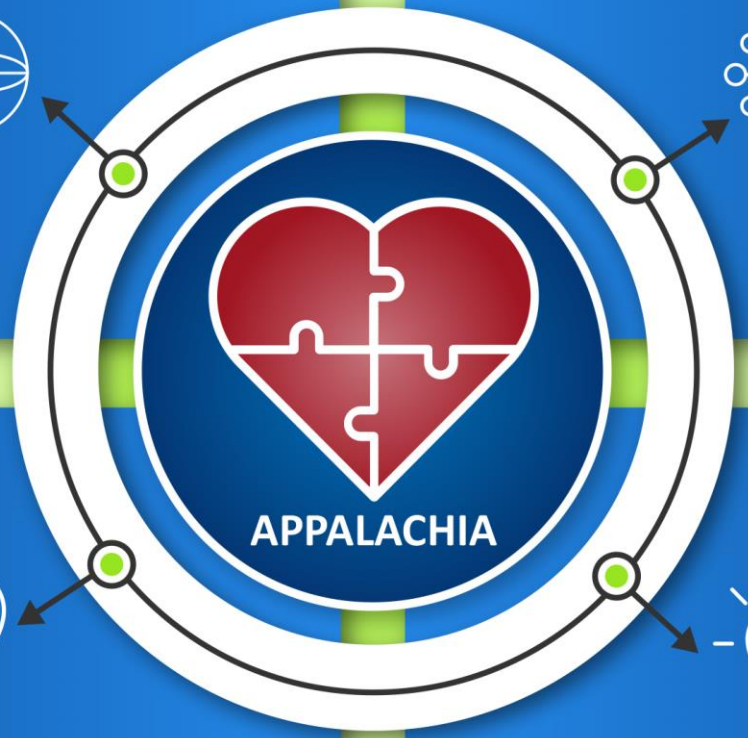
Why ARCH2

RESOURCES

- Largest natural gas-producing formation in the United States (EIA, 2022)
- Natural gas spot prices consistently discounted to Henry Hub
- Renewable electricity sources for H_2 production
- Subsurface CO_2 and H_2 storage

COMMUNITIES

- Long history of energy production vital to US economic growth
- Disadvantaged by energy transition from coal
- Designated ENERGY COMMUNITY by IWG



LOCATION

- Close to major demand centers in all directions key for interhub connectivity
- Includes eight of the top 25 priority communities as designated by the Interagency Working Group (IWG) on Coal and Power Plant Communities and Economic Revitalization

Project Development Partners

- Decades of expertise in the region
- Strong financial commitment to ARCH2
- Leadership in ESG and Climate initiatives

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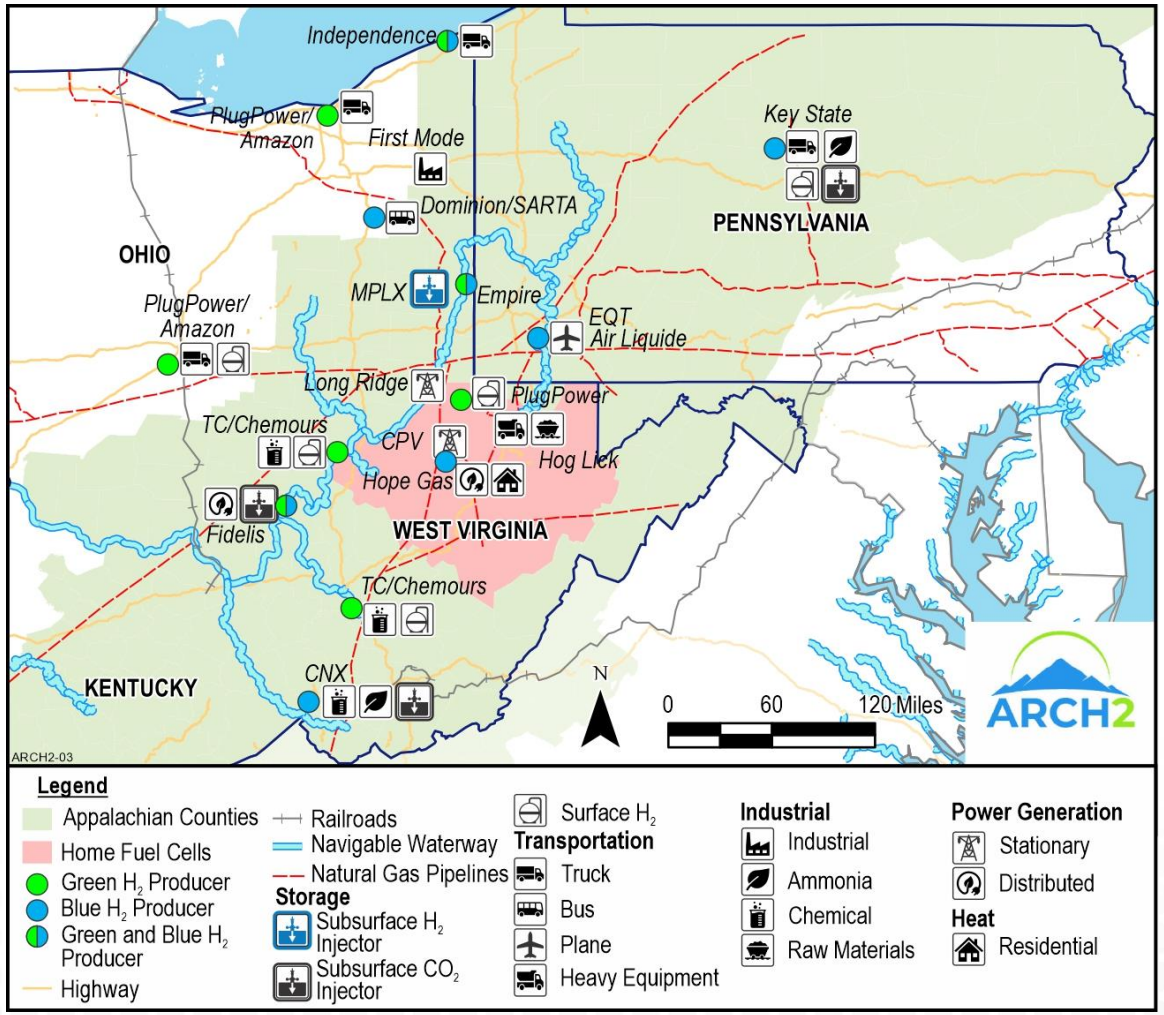
ARCH2 Overview



Note: Proposed project locations based on preliminary siting are subject to change during the detailed planning phase (phase 1).

Re-energizing Appalachia
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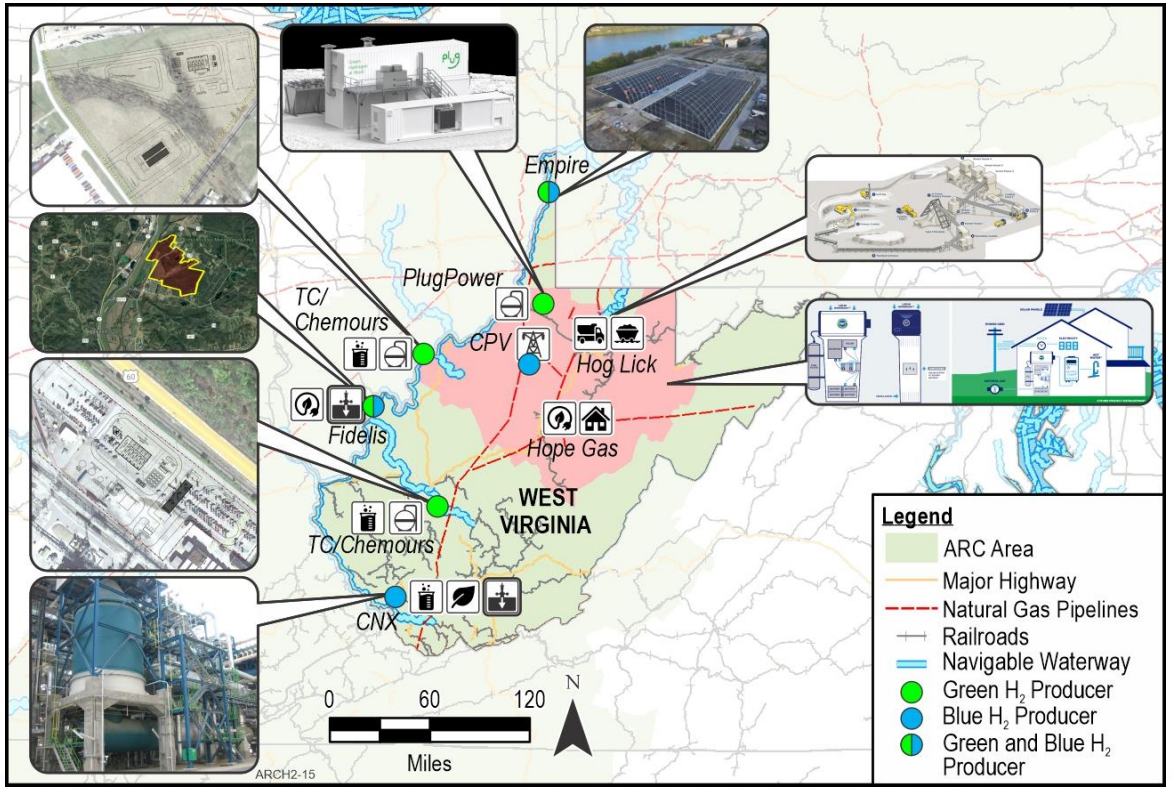
ARCH2 APPALACHIAN REGIONAL CLEAN HYDROGEN HUB

ARCH2 Project Summaries

- **CNX/ TransGas:** Low-CI ammonia production
- **TC Energy/ Chemours**: Electrolysis-based H2 production in two chemical facilities
- **Fidelis / Mountaineer GigaSystem**: NG + biomass to produce Low CI H2 for datacenters, other off-takers.
- **HLA:** H2 off-taker: H2 use as fuel for off-site aggregate delivery trucks and on-site haul trucks/equipment.
- **Hope Gas/ WATT Fuel Cell Corp / EQT**: Produce clean H2 from NG for blending in Hope local distribution system and residential fuel cells.
- **Empire Diversified Energy**: Anaerobically digested food waste based H2 production for industrial and transportation fuel.
- **Plug Power/ Amazon:** Green H2 production facility in northern WV.



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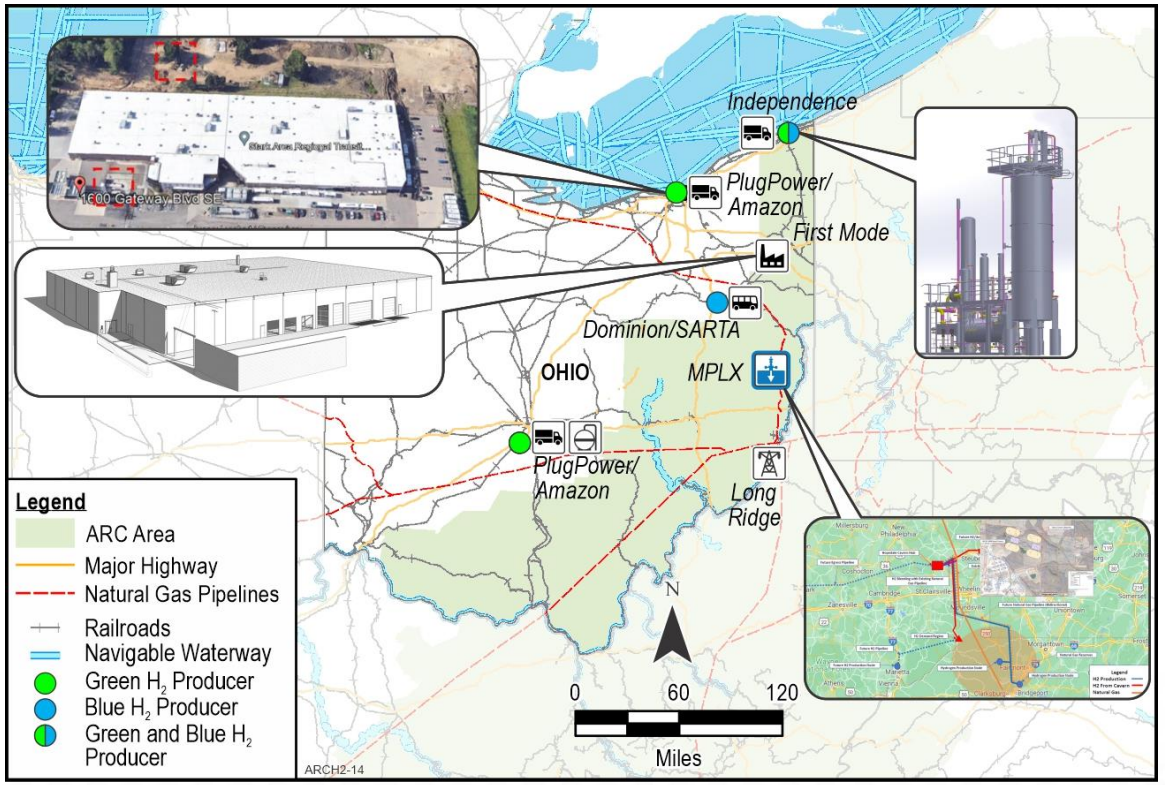
ARCH2 Project Summaries

- **MPLX:** H_2 storage facility development with connective infrastructure to support ARCH2 producers, storage, and end-users
- **Dominion Energy Ohio**: H2 production with CO_2 capture to supply H_2 to regional transit (e.g., SARTA)
- **Plug Power/ Amazon:** One distribution center with H_2 fueling MHE; fueling station FCEV delivery trucks.
- **First Mode:** H_2 end-user: Manufacturing facility for retrofitting mining trucks with H_2 fuel cell power system.
- **Independence Hydrogen:** H2 production facility using industrial off-gas as feedstock in Ashtabula, Ohio to provide clean hydrogen for material handling equipment at distribution centers.



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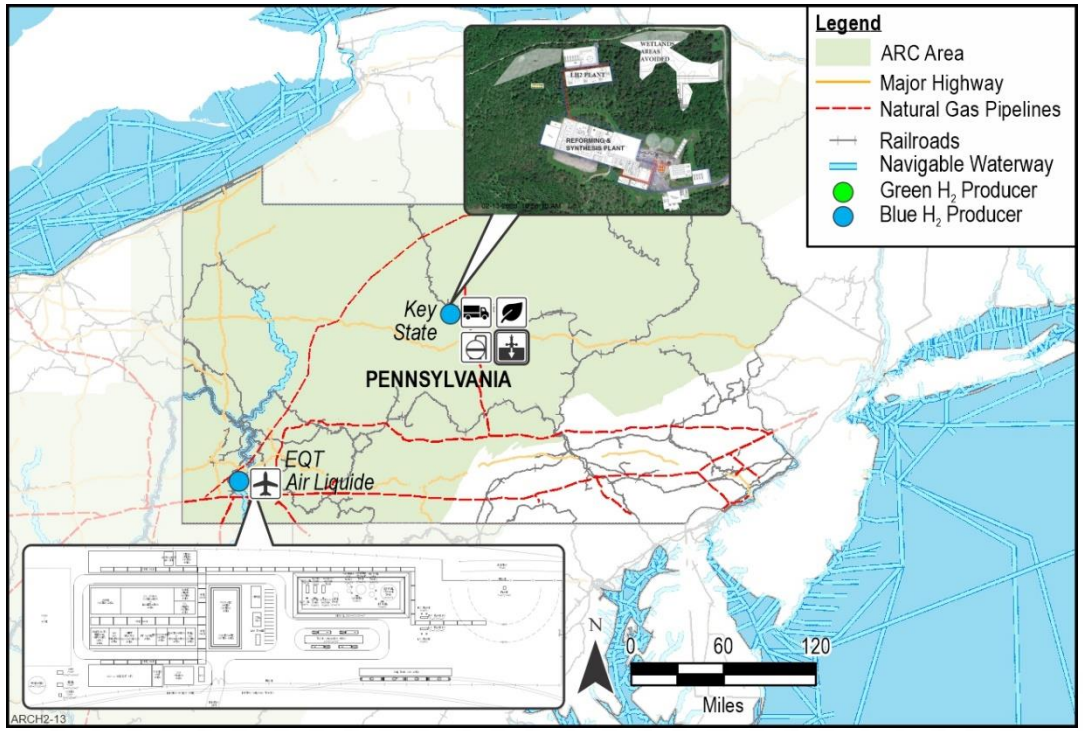
ARCH2 Project Summaries

- **EQT-GTL:** Low-carbon NG and renewable natural gas (RNG) (as required) to produce low-carbon aviation fuel.
- **Air Liquide -** Liquified H2 facility in southwest PA to serve as an offtake for EQT's excess hydrogen to be used in the mobility sector.
- **KeyState:** H_2 production plus other products (NH3, urea/diesel exhaust fluid (DEF))



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ARCH2 Regional Outreach

Labor / Trades / Workforce Development

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Business Development / Industry Organizations

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Community / Environment / Non-Profits

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Academia

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