Appalachian Regional Clean Hydrogen Hub (ARCH2)

ARCH2 Mission: Use the nation's lowest-cost NG as primary feedstock to enable and sustain a regional H_2 economy across multiple end-use sectors in the Appalachian region while ensuring the economic benefits are shared fairly and equitably among local communities.

ARCH2 Vision: A clean, economically viable and socially equitable H_2 ecosystem, spanning multiple production, storage, delivery, and diverse end-use applications within the Appalachian region, that serves as a model for a national clean H_2 network.

Agenda

- Background on Hydrogen (Basics, Opportunities)
- Energy Transition and the Federal Landscape
- Department of Energy's Vision for Hydrogen
- Appalachian Regional Clean Hydrogen Hub (ARCH2)

Hydrogen Basics

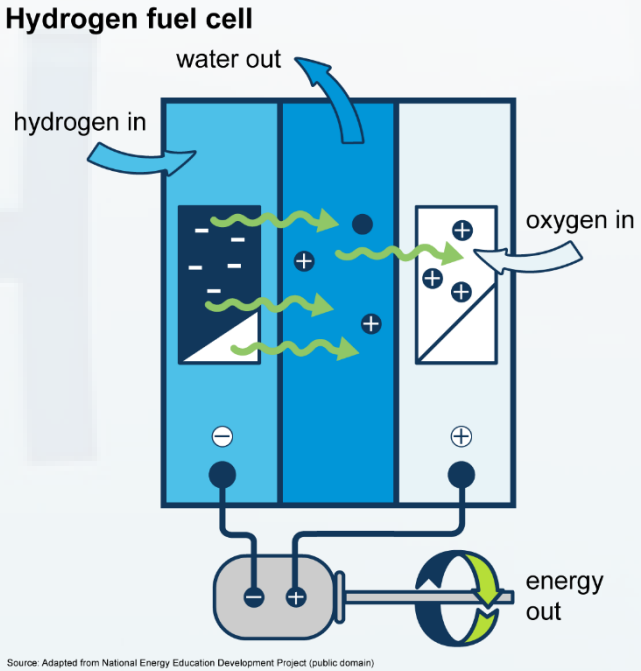
ARCH2
APPALACHIAN REGIONAL CLEAN HYDROGEN HUB

Hydrogen Basics

- Clear, colorless gas
- Atomic weight of 1
- Most abundant element in the universe
- Exists in diatomic form of H_2 with molecular weight of 2
- Combusts to yield H_2O

$$2\ H_2 + O_2 \longrightarrow 2\ H_2O$$

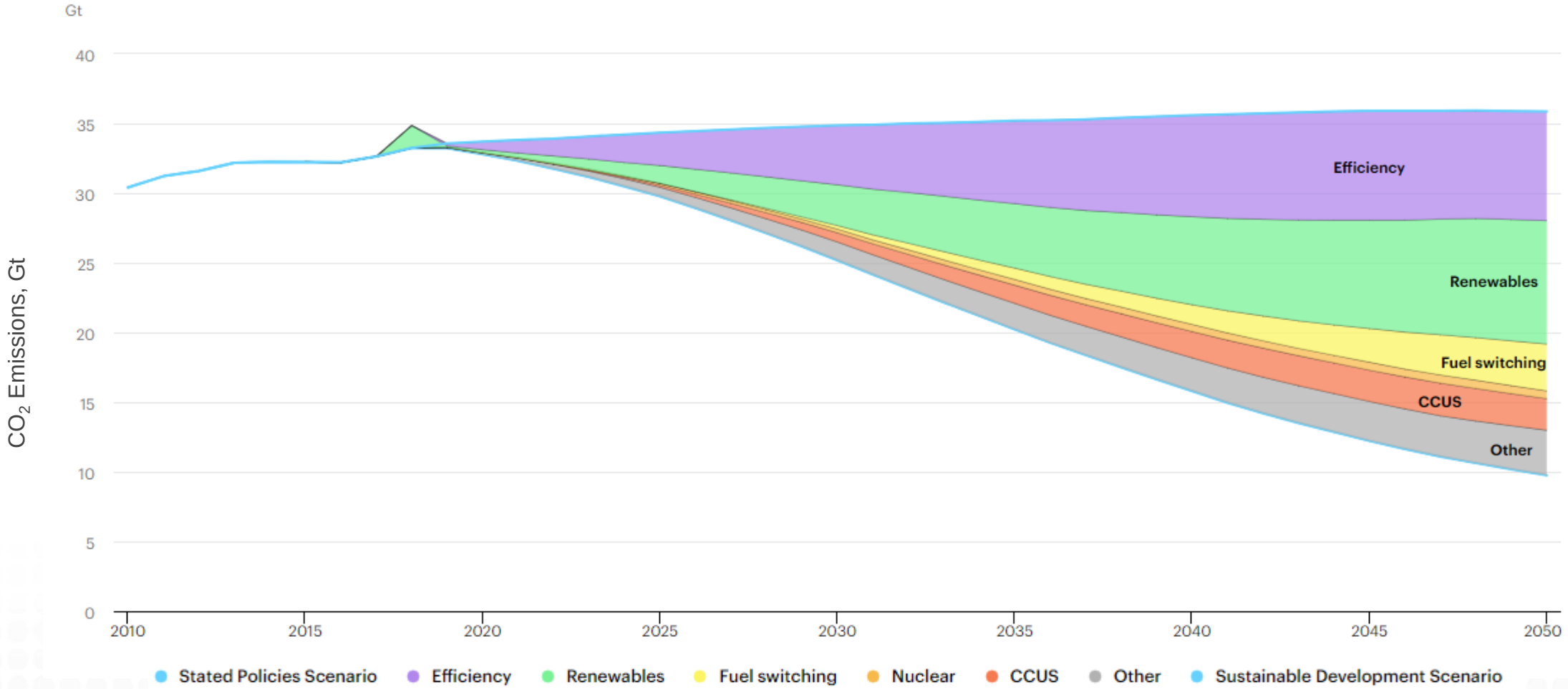
- Versatile, flexible energy carrier
  - Fuel cells convert H_2 into electricity
  - Up to 15% H_2 can be blended with natural gas
  - Used as input in Industrial processes (steel, ammonia)
- But not all hydrogen production methods have the same carbon footprint



Why Hydrogen Now?

- Zero carbon fuel source
- Scalable fuel source
- Multiple applications across sectors
  - Transportation (goods and people movement)
  - Power generation
  - Energy storage
  - Natural gas blending
  - Marine propulsion
  - Aviation
  - Steelmaking and other industrial applications
- Instrumental to advance deep decarbonization by mid-century

Sustainable Development Scenario, 2010-2050



Source: IEA, CO2 emissions reductions by measure in the Sustainable Development Scenario relative to the Stated Policies Scenario, 2010-2050, IEA, Paris https://www.iea.org/data-and-statistics/charts/co2-emissions-reductions-by-measure-in-the-sustainable-development-scenario-relative-to-the-stated-policies-scenario-2010-2050

Federal Landscape

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 $8 Billion in funding for clean hydrogen hub demonstration projects

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
    - takes into consideration technological and economic feasibility
- **IRA:**
  - Allowed DOE to establish Hydrogen Hub Program
  - Adds new tax credits for hydrogen production (45V)

OCED
Office of Clean Energy Demonstrations

45V Tax Credits Help Advance BIL and IRA Objectives

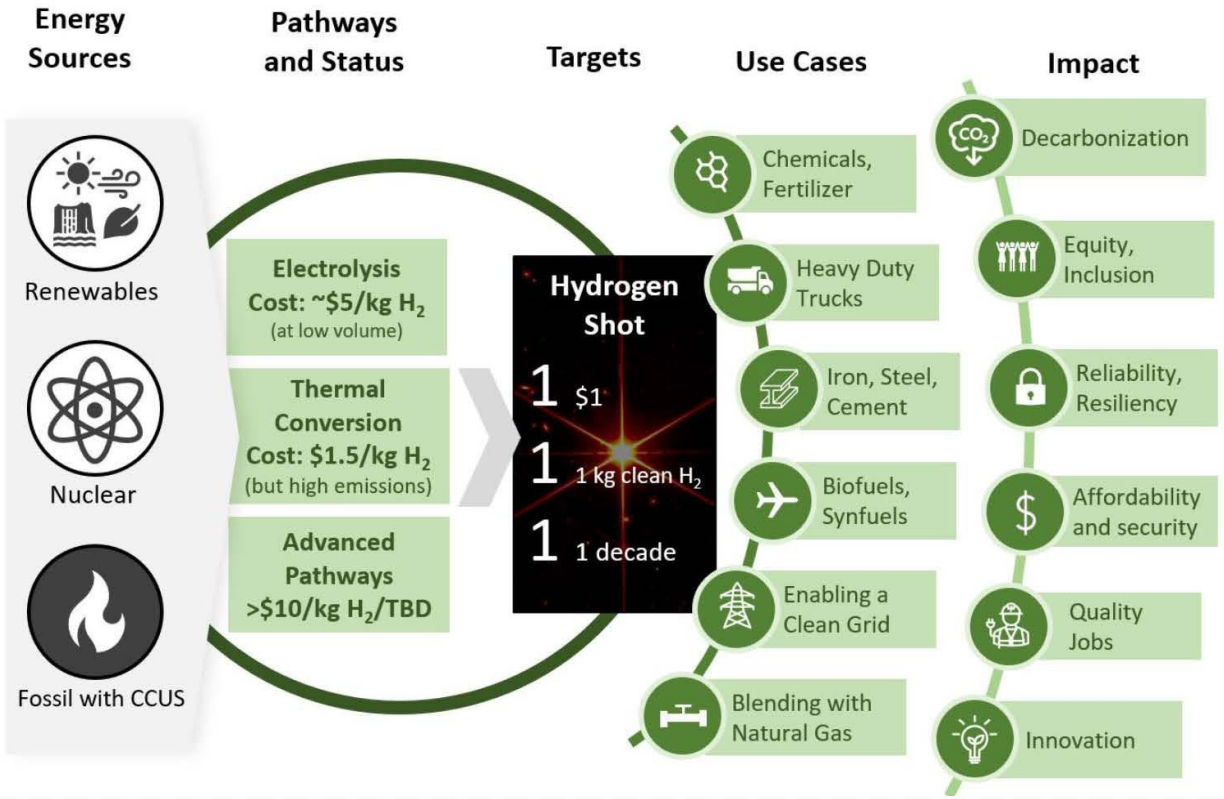
Lifecycle Emissions (kg CO_2e/kg Clean H_2)	Gross Tax Credit Amount	Full Credit Amount (5x Multiplier)
Less than 0.45	$0.60	$3.00
0.45 to 1.5	$0.20	$1.00
1.5 to 2.5	$0.15	$0.75
2.5 to 4.0	$0.12	$0.60

December 22, 2023 - Draft guidance published by Treasury

April 2024 – Public comment period closed

Department of Energy's Vision for Hydrogen

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 Fully Integrate Production, Transportation, Storage and Offtake

Seven Regional Clean Hydrogen Hubs

- Production
- Storage
- Transportation
- Use (Offtake)

ARCH2

ARCH2 Overview

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

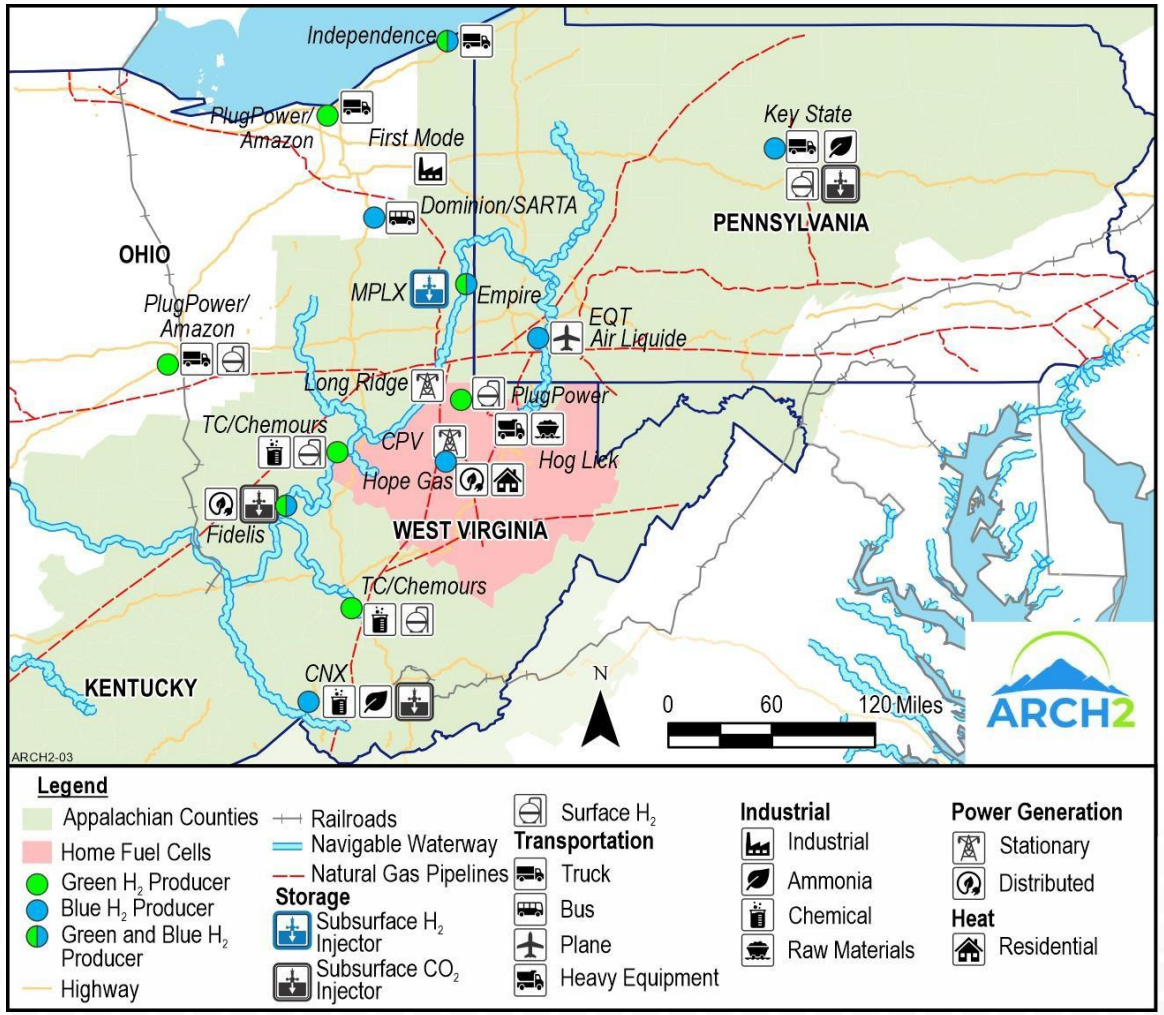
LOCATION

- 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

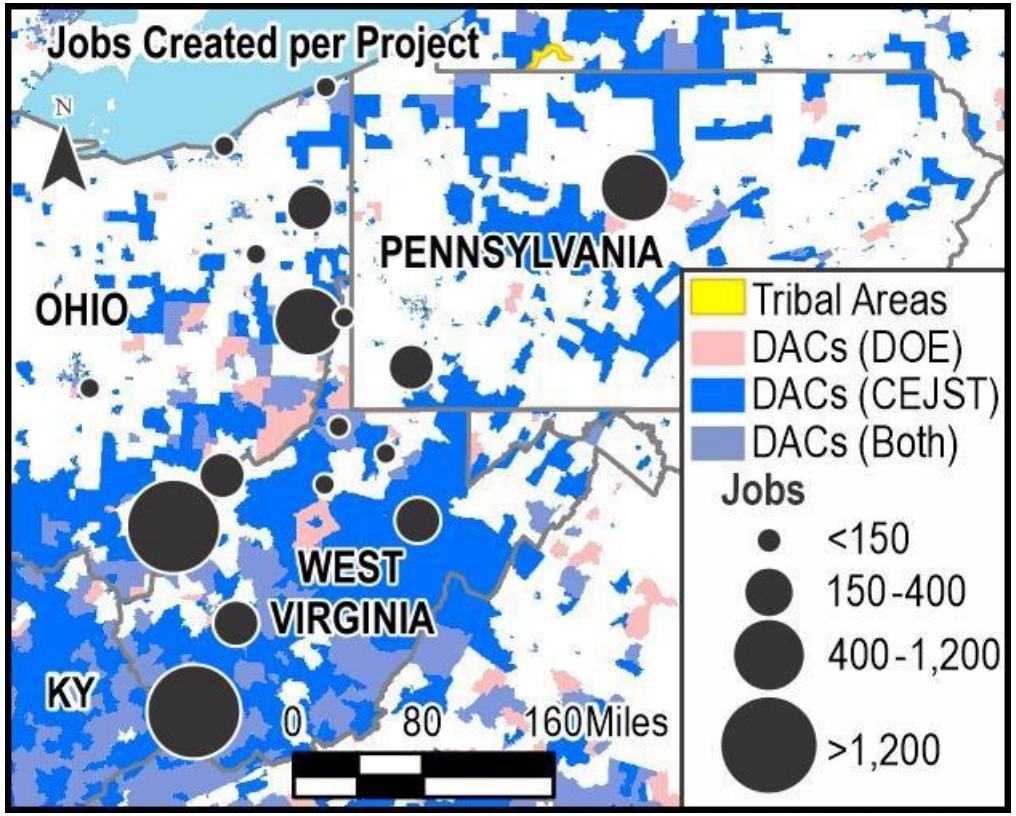
ARCH2 Overview



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

ARCH2 Jobs Impact

- ARCH2 will foster a just energy transition in a region disproportionately impacted by the loss of extractive industry jobs
  - Environmental benefits
  - Economic benefits
  - Jobs creation
  - Workforce development
- At its peak ARCH2 is expected to create more than 21,000 jobs
  - More than 18,000 in construction jobs
  - More than 3,000 permanent jobs.

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