

Hydrogen Hubs – A New Frontier in Energy

DEP CAC Hydrogen Session

JANUARY 9, 2024



U.S. Dept of Energy is making a commitment to kickstart a H2 economy



Investment in Clean Hydrogen

- National H2 strategy --\$8 Billion
- Funded seven hubs –different sources
 - Blue, green, pink, others
- Generate faster market liftoff
- Use of proven H2 technologies
- Expand CCUS deployment



Preserving our environment

- Driven by climate-based metrics
- Focused on hard to abate industry
- Reduce historic environmental burdens regionally
- Export opportunities–wider impacts



Public/Private Partnership

- Expand H2 production/utilization
- Establish H2 regional H2 corridors leading to a national H2 network through connective infrastructure
- Collaborative across various aligned partners including gov't
- With 50%+ private cost-share



Building a foundation for a vibrant and sustainable energy paradigm for U.S.

- Moonshot approach striving to bring cost of H2 to \$1/Kg in 1 decade (1-1-1)
- While creating strong community benefit
- And offering commercially viable energy transition to manufacturing and others

Decarbonization Network of Appalachia (DNA)

Core Mission: Investing in North Central Appalachia and enhancing the future of communities, environment, and economy through a regional “hydrogen hub”



A Hydrogen hub will **bring low-carbon energy to Appalachia, strengthen existing industries**, while leading in next-generation clean technology deployment

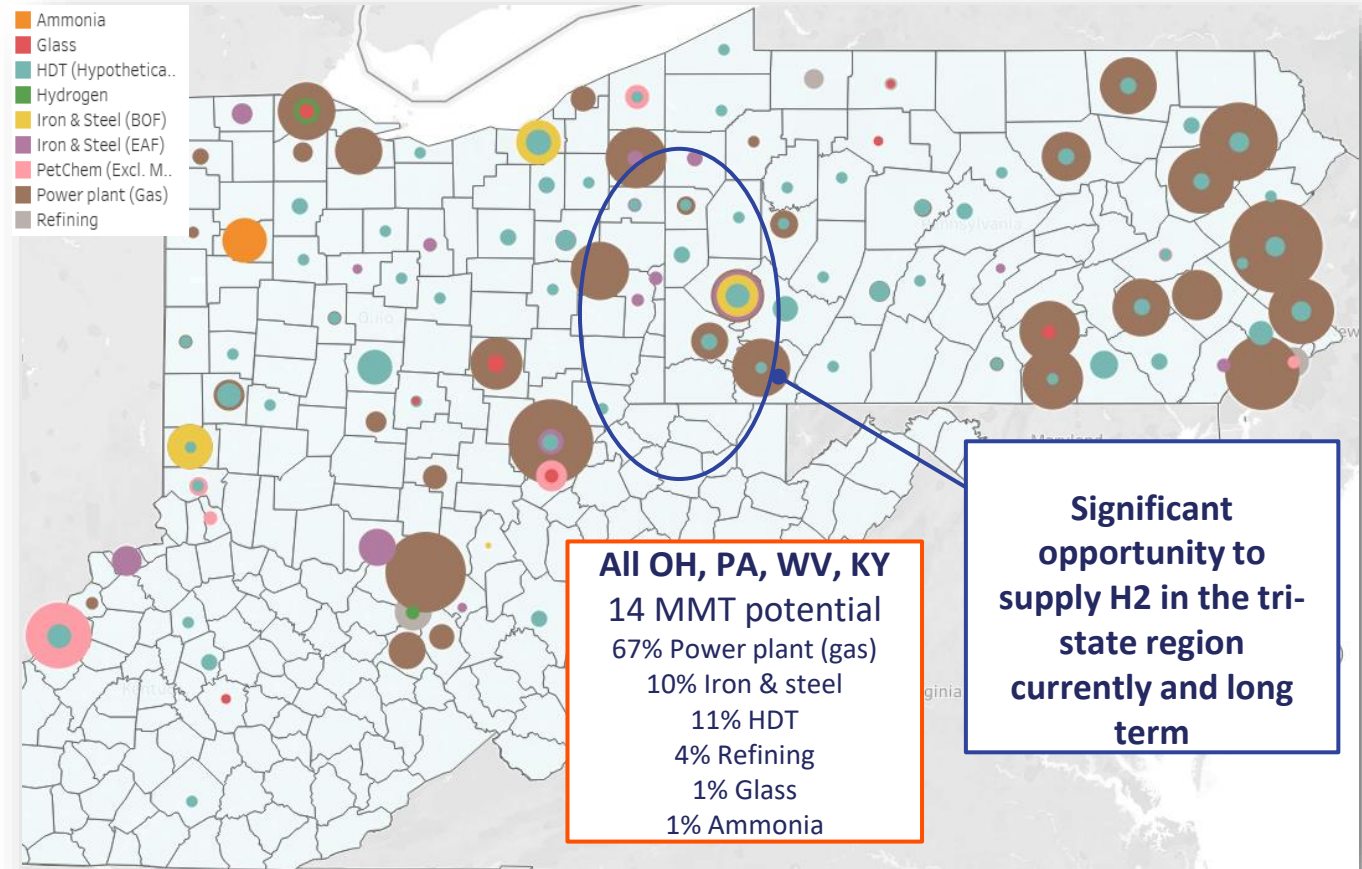
Designed to build a broad tri-state coalition from the public and private sectors to support this project with significant investment from all participating partner entities



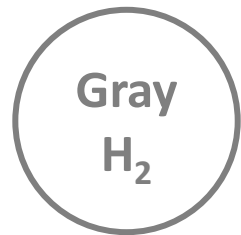
From state governments, to labor unions, to local community groups, **a H₂ hub is designed to bring together members of the North Central Appalachian community** with a stake in the region's future –significant number of entities expressing strong support

Deep Dive | Potential to alleviate historical health and environmental burdens

- Counties surrounding the DNA H2Hub account for **27% of all emissions** in OH, PA, & WV
- **Above average PM2.5 scores** are caused by combustion of coal, natural gas, gasoline, and diesel - 14 counties (~2.3M people) in proximity of the H2Hub exceed national averages
- The tri-state area has 14 counties that experience a far higher **risk of cancer** than the national average - likely driven in part by their proximity to heavily polluting industries
- **Diversifying the geographies and industries (e.g., steel)** of offtake partners will drive benefit for an even greater portion of Appalachia



Blue hydrogen, from natural gas with carbon capture, creates low-carbon H₂ well-suited to Appalachia's resources, with minimal disruption to industries



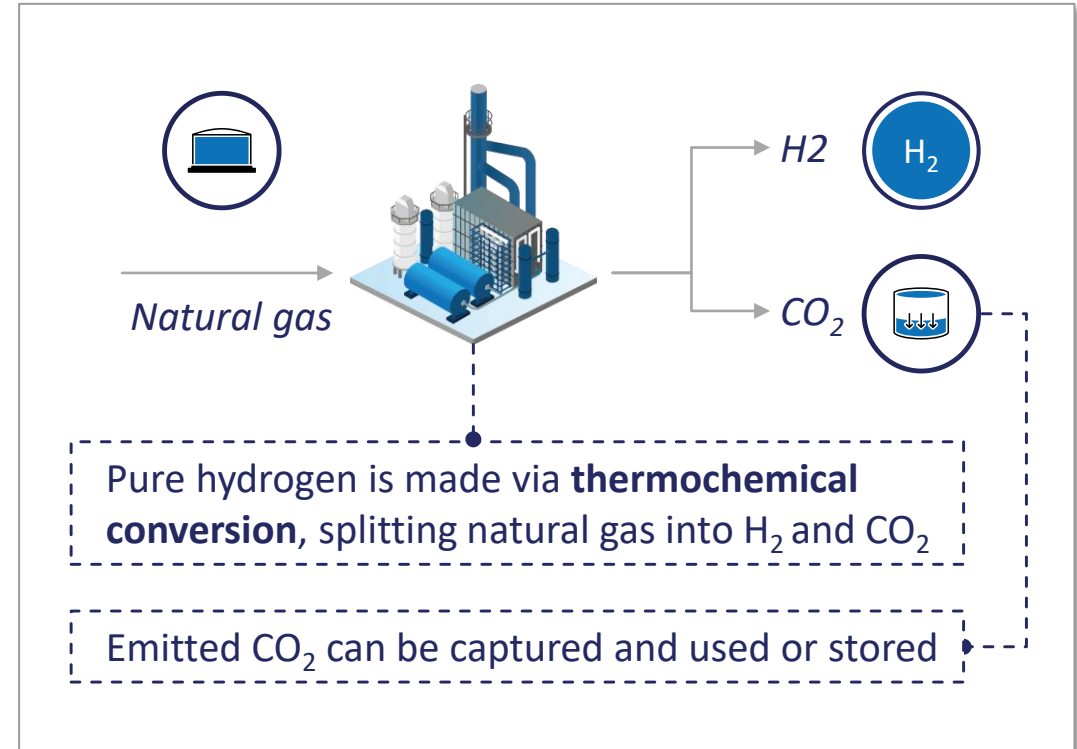
Almost all current H₂—produced from fossil fuels, releasing carbon dioxide emissions into the atmosphere



Produced from natural gas with emissions capture technology for **low-carbon H₂**

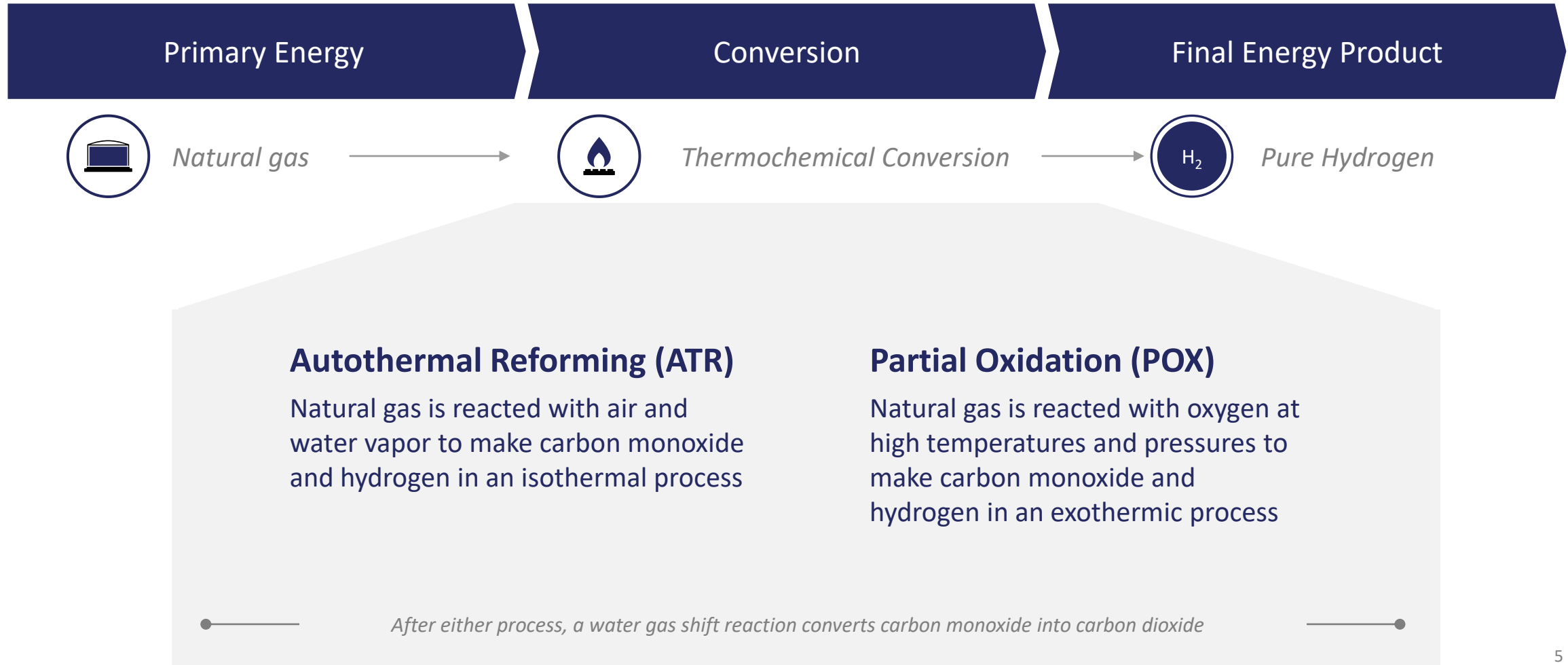


Made using electricity from renewable energy sources at significantly higher cost than blue H₂

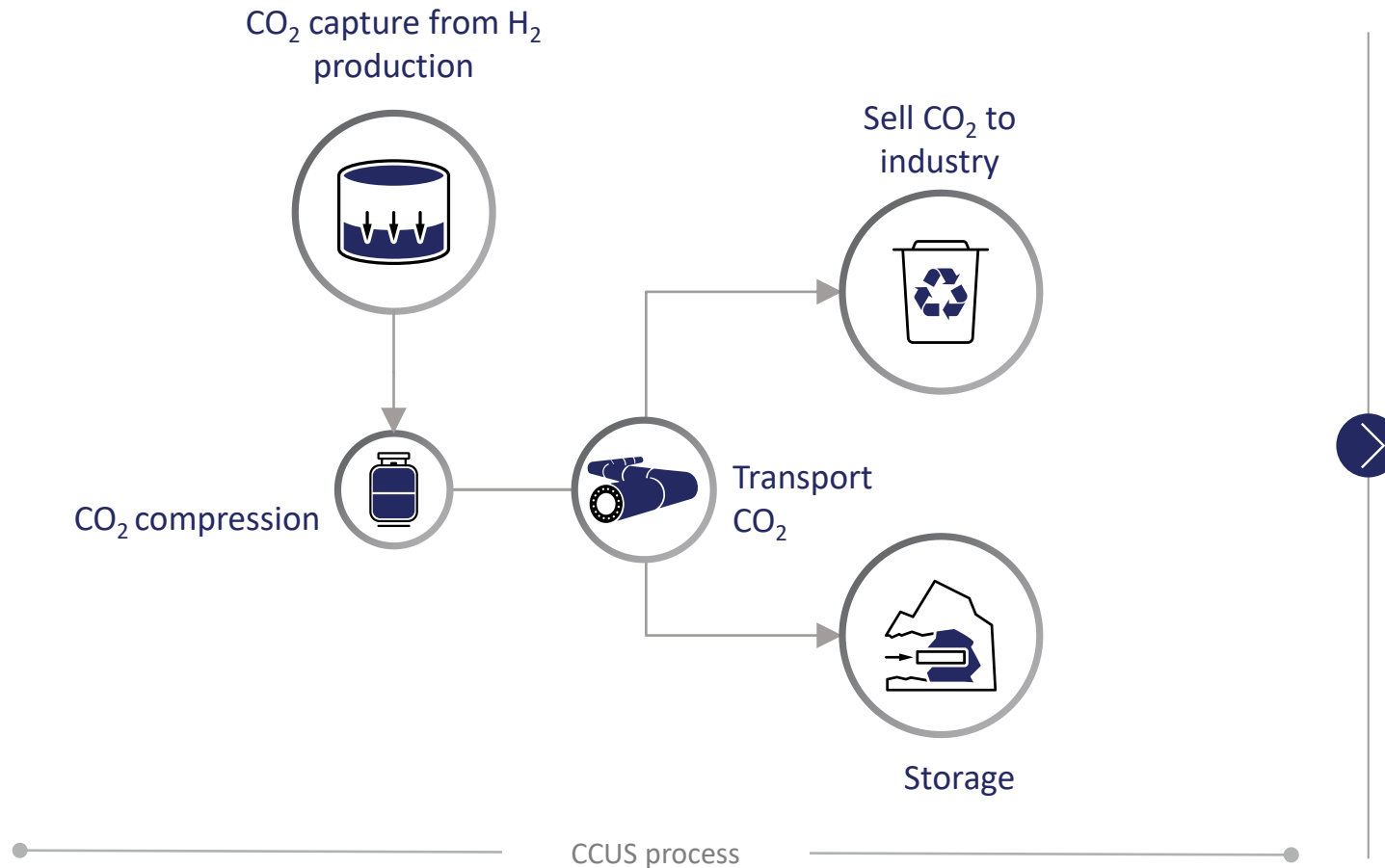


Blue hydrogen is well suited to Appalachia, capitalizing on the region's abundant natural resources, depth of industrial consumers, and existing workforce experienced in energy production

Cutting edge technologies H2Hubs can leverage include two methods of conversion that will safely and efficiently produce H2 from Appalachia's abundant natural gas resources



To help ensure hydrogen is clean, Carbon Capture, Utilization, & Storage tech will capture emissions from H₂ production before they reach the atmosphere



With blue hydrogen, H₂ production is combined with Carbon Capture, Utilization, & Storage (CCUS) to capture emitted CO₂ and store or sell it as an industrial input

This makes blue hydrogen a much cleaner fuel source than gray hydrogen that can generate low-carbon energy when used as a fuel source in energy production

Blue hydrogen is a lower carbon energy source and can bring next generation energy to existing and emerging industries in North Central Appalachia

Hydrogen can be a scalable, efficient, low-carbon source of energy...

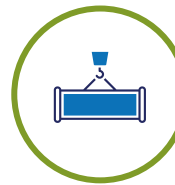
...with broad applications in the industries that make up the backbone of Appalachia



The **most abundant element in the universe**

Highly energy dense, containing **~3x as much energy as oil**

Low carbon footprint with some forms of production



Steel

Ready substitute for coal in blast furnaces & can be used for H₂-based DRI¹ to decarbonize steel production



Chemicals

Low-carbon alternative feedstock and fuel for chemical & polymer manufacturing

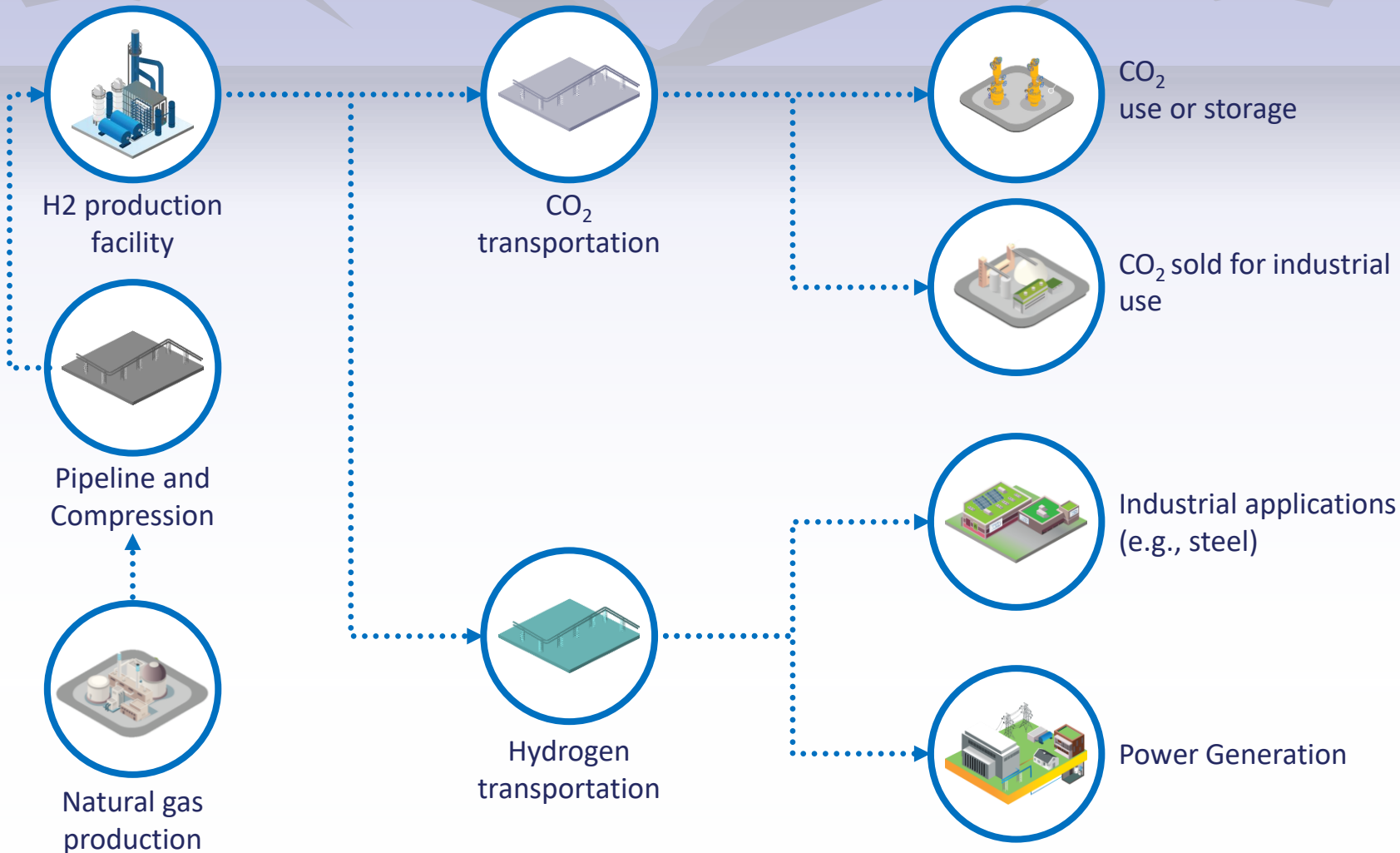


Power

Blended with natural gas, provides lower-carbon substitute for power generation

1. Direct Reduced Iron – an input for steel manufacturing traditionally created using fossil fuels

Hydrogen Hubs bring diverse supply chain pieces together, connecting energy production with applications & demand



A Hydrogen Hub will create growth opportunities for the wide set of industries that have a role to play in the hydrogen and carbon supply chains

A H2Hub will create a network of hydrogen producers, consumers, and local connective infrastructure to support production across the value chain



- Natural gas is the **most cost-effective and advanced method of hydrogen production**
- Appalachia has abundant reserves, making **natural gas an ideal energy source for a local H2Hub**

- The DOE is looking for deployment of **state-of-the-art hydrogen production technologies** that best fit the defined concept
- In selecting a winning Hub applicant, DOE considered **modularization, scale, feed gas, cost competitiveness**, as well as **lifecycle emissions**

- The goal is to grow to serve applications in transportation, steel manufacturing, chemicals, zero-carbon energy generation and storage, advanced manufacturing, and carbon management solutions across sectors

In the race to accelerate the low-carbon energy transition, H2 made from natural gas with carbon capture will be a critical tool in decarbonization



Lower-carbon source of energy and feedstock for local industries

- Compared to traditional hydrogen production, **facilities purpose-built with carbon capture** allow for **80%-90% emissions reduction**
- Blue hydrogen can help **curb carbon emissions in local industries**, while allowing current hydrogen users, like plastics manufacturers, to reduce their overall carbon footprint



Ready to immediately help cut emissions and clean the air

- Producible from available inputs, natural gas & carbon capture-based H2 **promotes a transition to lower carbon fuels**, in-line with the urgency demanded to address climate change
- A proven technology, **H2 & natural gas blends will leverage H2 to reduce carbon emissions** as hydrogen production is scaled up



Catalyst to kickstart green manufacturing leadership

- H2 made from natural gas is **commercially viable now**—leveraging existing infrastructure for **2-3x cheaper production** vs. hydrogen made with renewable energy
- **Captured carbon creates additional economic opportunity** in downstream industrial uses
- With a long-term goal of zero-emissions, **investment in current production builds infrastructure** to support a lower carbon future

H2Hub Community Benefits Plan (CBP)



The H2Hub investment has the potential to be a historic turning point for communities in North Central Appalachia who are among the most disadvantaged in the country. It represents an opportunity to harness the energy transition to drive socioeconomic benefits to the region and reverse decades of underinvestment.

Community & Labor Engagement	Investing in the American Workforce	Diversity, Equity, Inclusion, & Accessibility	Justice40
<p>H2Hubs co-create solutions with community and labor groups:</p> <ul style="list-style-type: none"> Engage significant numbers of community and environmental groups, labor, workforce and economic development boards, research and academia, and state & local government Multi-stakeholder engagements to address community concerns of economic and job opportunities, environmental impact, community disruption and safety, etc. Community investment to maximize benefits and address broader social challenges included addiction and mental health, housing access, daycare, etc. 	<p>A H2Hub will create and train a future-proof workforce in communities where employment to lags national averages:</p> <ul style="list-style-type: none"> Receive support from labor unions and will build union-supported frameworks for worker and project success A H2Hub will attract and retain workers seeking above-average pay, training for in-demand skillsets, and long-term advancement Workforce development investments will span training, recruitment, apprenticeship, support services, etc. 	<p>H2Hub Project Teams plan to materially expand equitable access to economic and job opportunities by:</p> <ul style="list-style-type: none"> Promoting equitable access to training and employment, especially for women, BIPOC and underrepresented groups Fostering diverse supply chains by increasing SMBs and MWBs in Hub ecosystem and supporting MWB enterprise creation Establishing a culture of equity and inclusion through training resources and equitable hiring practices 	<p>Several million residents in communities surrounding the northcentral H2Hub network are among the most vulnerable to energy transition-related job losses, most polluted counties in the country, with a significant number of people living in disadvantaged census tracts.</p> <p>Once the H2Hub is in operation, these communities stand to gain:</p> <ul style="list-style-type: none"> GDP near-term GDP growth Jobs created and preserved Well-to-grave CO₂e reductions PM_{2.5} reductions from power end-use

Clean energy advancement funds to catalyze research and advancements in clean energy technology

Resourcing commitments for community benefits and engagement team with appropriate skills and oversight

Rigorous **performance management** mechanisms and milestones will ensure tracking and progress against key community benefit KPIs