



Hydrogen Hubs, Explained:

A Journalist Workshop Hosted by the
Ohio River Valley Institute & Partners

MONDAY, SEPT. 11, 9 AM - 5:30 PM

RENAISSANCE PITTSBURGH HOTEL

Contents:

(Click to jump)

- [Workshop Slideshows & Recordings](#)
 - [*Downstream Delusions: The Limits & Economic Cost of an Appalachian Hydrogen & Carbon Capture Hub*](#)
 - [*Hydrogen Hubs: What We Know*](#)
 - [*Debunking Myths about Carbon Capture and Blue Hydrogen Being “Clean”*](#)
 - [*Carbon Capture Injection and Storage – Law and Policy*](#)
 - [*Panel Discussion: Health and Environmental Justice Risks of Hydrogen & Carbon Capture Buildout*](#)
- [Additional Resources](#)
 - [*Hydrogen Hub Proposals: The State of Play*](#)
 - [*Clean Hydrogen*](#)
 - [*Decarbonization, Permitting, and Environmental Justice*](#)
 - [*Cost & Economic Impacts*](#)
 - [*Alternative Economic Development Opportunities*](#)
 - [*Miscellaneous Industry & Government Documents*](#)

Workshop Slideshows & Recordings

Downstream Delusions: The Limits and Economic Cost of an Appalachian Hydrogen & Carbon Capture Hub

- Sean O’Leary (Ohio River Valley Institute)
 - [Slideshow](#)
 - [Recording](#)
 - [Contact Sean](#)

Hydrogen Hubs: What We Know & Challenges With Federal Implementation

- Tom Torres (Ohio River Valley Institute)
 - [Slideshow](#)
 - [Recording](#)
 - [Contact Tom](#)

Debunking Myths about Carbon Capture and Blue Hydrogen Being “Clean”

- David Schlissel (Institute for Energy Economics and Financial Analysis)
 - [Slideshow](#)
 - [Recording](#)
 - [Contact David](#)

Carbon Capture Injection and Storage – Law and Policy

- James Yskamp (Earthjustice)
 - [Slideshow](#)
 - [Recording](#)
 - [Contact James](#)

Panel Discussion: Health and Environmental Justice Risks of Hydrogen & Carbon Capture Buildout

- Morgan King (West Virginia Rivers)
 - [Slideshow – Blue Hydrogen: Impacts on Public Health, Water, and Climate](#)
 - [Recording](#)
 - [Contact Morgan](#)
- Tom Schuster (Sierra Club)
 - [Recording](#)
 - [Contact Tom](#)
- LaTricea Adams (Black Millennials for Flint, WHEJAC)
 - [Slideshow – Gaps in Community Engagement](#)
 - [Recording](#)
 - [Contact LaTricea](#)
- Sarah Martik
 - [Recording](#)
 - [Contact Sarah](#)

Additional Resources

Hydrogen Hub Proposals: The State of Play

- [Appalachia Hydrogen Facts](#) | ORVI, Jun. 2023
 - A public-facing repository of information on carbon capture and hydrogen hubs—what they entail, where they come from, and how they stand to impact the region’s public health, environment, and economy.
- [Hydrogen Hubs: Get to Know the Encouraged Applicants](#) | RFF, Feb. 2023
 - RFF analysts discuss the profiles of encouraged applicants for federal Regional Clean Hydrogen Hubs funding, including feedstocks, end uses, and partners.
- [Regional Clean Hydrogen Hub Funding Opportunity Announcement](#) | US Dept. of Energy, Sep. 2022
 - This document outlines the parameters of the Regional Clean Hydrogen Hub program, including program goals, application requirements, and other information for applicants.
- [Community Benefits Plan Guidance](#) | US Dept. of Energy, Oct. 2022
 - This supplement to the FOA is intended to support applicants in developing the community benefits plans required in the application for hydrogen hub funding.
- [H2Hubs Applicant Informational Webinar](#) | US Dept. of Energy, Jan. 2023
 - This webinar was hosted by the Office of Clean Energy Demonstrations and was intended to provide information to prospective applicants regarding the Regional Clean Hydrogen Hubs program, the funding application, and the community benefits plan.
- [Regional Clean Hydrogen Hubs Notifications](#) | US Dept. of Energy, Apr. 2023
 - In December 2022, the US Department of Energy’s Office of Clean Energy Demonstrations gave encouragement or discouragement notifications to Concept Papers submitted for the Regional Clean Hydrogen Hubs program. This page outlines the assessment process and includes Frequently Asked Questions about the program structure.

Clean Hydrogen

- [How green is blue hydrogen?](#) | Robert Howarth and Mark Jacobson, Aug. 2021
 - A peer-reviewed study of blue hydrogen’s lifecycle greenhouse gas emissions accounting for emissions of both carbon dioxide and unburned fugitive methane. The analysis finds that the greenhouse gas footprint of blue hydrogen is more than 20% greater than burning natural gas or coal for heat and some 60% greater than burning diesel oil for heat. Blue hydrogen’s total

carbon dioxide equivalent emissions are 9%-12% lower than gray hydrogen's, though fugitive methane emissions for blue hydrogen are higher than for gray hydrogen because of an increased use of natural gas to power the carbon capture.

- [Fact-checking PA Politicians' Blue Hydrogen Hype in the Wake of House Bill 1059](#) | ORVI, Nov. 2022
 - This blog breaks down Pennsylvania's billion dollar blue hydrogen subsidy and fact checks claims regarding blue hydrogen's economic viability, impacts, and role in decarbonization.
- [System Design to Enable True Green Hydrogen](#) | ORVI, Apr. 2023
 - This brief sidebar from ORVI's *Green Steel in the Ohio River Valley* report outlines the conditions needed to ensure that green hydrogen maximizes its climate reduction potential, including additionality, regionality, and time-matching – the three pillars of green hydrogen.
- [Clean Hydrogen Production Standard](#) | U.S. Dept. of Energy, Jun. 2023
 - This guidance document establishes a target of 4.0 kgCO₂e/kgH₂ for life cycle greenhouse emissions associated with hydrogen production. The Clean Hydrogen Production Standard is an essential element of the Regional Clean Hydrogen Hub program.
- [Feedback to the Proposed Clean Hydrogen Production Standard](#) | ORVI, Nov. 2022
 - This comment outlines recommendations for developing the standard, including region-specific considerations for the DOE regarding the carbon intensity of the grid in the Ohio River Valley, the need to weigh decisions based on alternatives to blue hydrogen production, and how best to calculate lifecycle emissions reductions.
- [Request for Comments on 45V Hydrogen Production Tax Credit](#) | Internal Revenue Service, Nov. 2022
 - This document requests feedback from the public to support the development of guidance for implementing the 45V hydrogen production tax credit, including defining clean hydrogen and reporting requirements.

Decarbonization, Permitting, and Environmental Justice

- [Carbon capture's methane problem](#) | IEEFA, Aug. 2022
 - Enchant Energy's San Juan Generating Station in New Mexico is a case study of the real-world carbon mitigation potential of carbon capture technology on coal-fired power plants. Including the substantial “upstream” methane emissions from the coal mine that supplies fuel to the station, IEEFA analysis finds that the project's effective carbon capture rate would be no more than 72%, not the 90% that Enchant claims. The problem of associated methane emissions is endemic to all coal and natural gas plants with proposed carbon capture retrofits, as well as the blue hydrogen hubs seeking state & federal subsidies.

- [Industry is Misleading the Public on Carbon Capture, Internal Documents Show](#) | ORVI, Oct. 2022
 - Fossil fuel companies are misleading the public about carbon capture technology, according to [internal documents](#) unearthed as part of the US House Committee on Oversight and Reform investigation into fossil fuel company misinformation. Private conversations between top employees of major oil and gas corporations reveal that the industry is pushing carbon capture as a climate solution, despite private acknowledgement that the technology is meant primarily to prolong and expand oil and gas drilling.

- [PA Health and Environment Study](#) | University of Pittsburgh, Pennsylvania Department of Health, Aug. 2023
 - Children who lived closer to natural gas wells in Pennsylvania fracking counties were more likely to develop lymphoma, a relatively rare form of cancer, and nearby residents of all ages had an increased chance of severe asthma reactions, according to this series of major health studies first [announced](#) by former Pennsylvania Gov. Tom Wolf in 2019. The studies were prompted by years of community advocacy in rural Southwestern Pennsylvania, where shale gas companies have drilled more than 3,500 wells since 2008 and dozens of children and young adults have been diagnosed with Ewing sarcoma and other forms of cancer.

- [The Gassing of Satartia](#) | HuffPost, Aug. 2021
 - Journalist Dan Zegart depicts the February 2020 carbon pipeline rupture in Satartia, MS that hospitalized nearly fifty people and forced hundreds to evacuate their homes. Scaling carbon transportation infrastructure could place more communities at risk of similar disasters.

- [Carbon Dioxide Pipelines: Dangerous and Under-Regulated](#) | Pipeline Safety Trust, 2023
 - Accufacts Inc. prepared this report on behalf of Pipeline Safety Trust and identified significant gaps in regulations for pipeline transport of carbon dioxide. The report outlines critical health and environmental risks associated with this practice and includes recommendations for federal policymakers.

- [PHMSA Failure Investigation Report - Denbury Gulf Coast Pipelines, LLC](#) | US Department of Transportation, Pipeline and Hazardous Materials Safety Administration, Office of Pipeline Safety, May 2022
 - This report was issued by regulators alongside plans to revise carbon pipeline standards and provides key facts regarding the circumstances surrounding the 2020 pipeline failure in Satartia, Mississippi. The report identified necessary improvements to operator practices and emergency preparedness.

- [Class VI Permitting Report to Congress](#) | Environmental Protection Agency
 - This 2022 report to Congress outlines agency recommendations to improve Class VI permitting and includes a summary of stakeholder feedback.

- [Class VI Letter to Governors](#) | Environmental Protection Agency
 - This 2022 letter from EPA Administrator Michael Regan to state governors outlines the agency's priorities regarding the Class VI carbon injection well program, including the need for stronger

protections, environmental justice measures, and robust public participation.

- [Norway's Sleipner and Snøhvit CCS: Industry models or cautionary tales?](#) | Institute for Energy Economics and Financial Analysis
 - IEEFA researched two 'model' carbon sequestration projects in one of the most-studied geological fields in the world. Their findings reflect the dynamic and uncertain nature of long term geologic storage of carbon dioxide and highlight the regulatory oversight needed for these projects.
- [Liability transfer and unitization statute survey and background](#) | ORVI, Sep. 2023
 - This resource is a survey of statutes across the country pertaining to unitization of pore space and the transfer of long term liability for carbon dioxide geologic sequestration projects. Information is also provided regarding relevant legislative efforts in the Ohio River Valley.
- [The DOE and the Justice40 Initiative](#) | US Dept. of Energy, Jan. 2022
 - This page includes resources and information about the DOE's approach to Justice40, including eight policy priorities intended to guide DOE's implementation as identified by the Office of Economic Impact and Diversity.
- [Final Recommendations](#) | White House Environmental Justice Advisory Council May 2021
 - This report from the WHEJAC reflects their recommendations to the Council of Environmental Quality and to the Biden-Harris Administration regarding Justice40 and related efforts, including examples of projects which should and should not be thought of as benefiting communities.

Cost & Economic Impacts

- [2023 Levelized Cost of Energy+](#) | Lazard, Apr. 2023
 - Lazard's analysis pegs the cost of generating electricity with hydrogen at \$116/MWh, compared to \$62/MWh for unabated natural gas and \$20-\$40/MWh for renewables and natural gas-fired generation. Lazard's pricing scenario assumes hydrogen makes up just 20% of the fuel mix, with natural gas accounting for the rest. According to ORVI researcher Sean O'Leary's analysis, "in other words, replacing just 20% of the natural gas feedstock with hydrogen causes the price of electricity to jump by a frightening 87%. And worse, emissions are reduced by just 7%. This is why making electricity with hydrogen, even in a minor supporting role, is stupidly expensive."
- [Carbon Capture, Use, and Sequestration Would Decarbonize the Electric System...in the Worst Possible Way](#) | ORVI, Oct. 2021
 - A research brief on the economics of CCUS implementation in the national power system, including analysis of the 45Q tax credit and proposed expansions. With a price tag of \$100 billion/year, widespread adoption of CCUS in our electric system would spark outrage if its cost

showed up in our monthly bills or federal taxes.

- [CCS for power yet to stack up against alternatives](#) | IEEFA, Mar. 2023
 - The cost of carbon capture and storage (CCS) remains unclear as no known new power plants have been built with the technology installed and operating at commercial scale. Thermal power generation with CCS has a levelized cost of electricity of at least 1.5-2 times above current alternatives, such as renewable energy plus storage. In Australia, if CCS is applied with all costs borne by increasing electricity prices, annual volume weighted average wholesale prices could climb by 95% to 175%.
- [Energy Department should only spend public funds on hydrogen hub projects that are practicable](#) | IEEFA, Apr. 2023
 - The US Department of Energy must decide if proposed production methods and uses for H2Hub proposals are safe, protect the environment, and are economically competitive, IEEFA's Suzanne Mattei writes. A DOE failure to exercise its ability to determine which hydrogen production methods are practicable could result in a substantial waste of tax dollars.
- [Frackalachia Update: Peak Natural Gas and the Economic Implications for Appalachia](#) | ORVI, Aug. 2023
 - The largest gas-producing counties in Ohio, Pennsylvania, and West Virginia have underperformed the state and the nation since the dawn of the Appalachian fracking boom. In all, these "Frackalachian" counties lost 10,339 jobs and 47,652 residents from 2008 through 2021, data show. As Appalachian gas production begins to plateau, it looks increasingly unlikely that new natural gas development will deliver economic prosperity to the region.
- ['Hydrogen unlikely to play major role in road transport, even for heavy trucks': Fraunhofer](#) | Recharge, Feb. 2022
 - Hydrogen fuel-cell vehicles have lost their one-time advantages of range and fast-charging, and are likely to remain uncompetitive with battery EVs, according to [research](#) from an independent German research institute.
- [Regardless of what they say, green hydrogen will be cleaner, cheaper, and it's around the corner](#) | ORVI, May 2023
 - Subsidies aside, by 2030, renewable-powered green hydrogen is expected to become cheaper than gray or blue hydrogen as capital and operational costs continue to fall. Meanwhile, the price of natural gas—used to create methane, the feedstock for gray and blue hydrogen—remains volatile and unpredictable.
- [Stupid Ways to Make Electricity \(Hint: To do it really stupidly, you need hydrogen\)](#) | ORVI, Jun. 2023
 - Hydrogen is 2.5 to 4 times more expensive than natural gas as a power generating feedstock. In fact, for hydrogen to be cost-competitive with natural gas, its cost would have to be \$.40/kg, less than half the price DOE aims to achieve by 2030. Hydrogen is "stupidly expensive," O'Leary explains, which is why it will never economically serve as a 'base load' resource for generating

electricity, nor is it likely to be sensible or affordable as a ‘peaking’ resource or even as a means of balancing load in an increasingly renewables-based power system.

- [The Clean Hydrogen Ladder \(version 4.1\)](#) | Michael Liebreich, Aug. 2021
 - A ranking of the possible applications for clean hydrogen based on efficiency, cost, and market standing.
- [The Energy Department's hydrogen gamble: Putting the cart before the horse](#) | IEEFA, Feb. 2023
 - The US Department of Energy is “putting the cart before the horse” by advancing decisions on methane-based blue hydrogen hubs without knowing whether such hubs will be clean enough to qualify—reliably and over the long term—for Bipartisan Infrastructure Law funding, IEEFA analysts write. Even before considering upstream methane emissions and downstream carbon emissions, no carbon capture and sequestration system has achieved a consistent 95% annual average carbon capture rate on a commercial scale over the long-term.
- [The Ohio River Valley Hydrogen Hub: A Boondoggle in the Making](#) | ORVI, Mar. 2022
 - Constructing a blue hydrogen hub would raise costs for ratepayers and taxpayers, it would be largely uneconomic without substantial federal subsidies, it would saddle the nation with significant unabated emissions and the Ohio River Valley with continued local air and water pollution, and, even if it were built, it wouldn’t stimulate major job growth or prosperity, according to this analysis by Senior Researcher Sean O’Leary. And, it’s not the first time the industry has sold the region on grandiose visions that were ultimately left unfulfilled or went terribly wrong.
- [Top economists tell OH, PA, WV governors petrochemical boom is a non-starter](#) | ORVI, Jun. 2020
 - On June 15, 2020, a group of seven prominent economists and policy analysts from leading universities in Ohio, Pennsylvania, and West Virginia and a former Pennsylvania Secretary of Environmental Protection wrote [a public letter](#) to the governors of the three states warning them that economic development strategies based on a massive buildout of the region’s petrochemical industry are infeasible. The letter recommends that the governors and other policymakers explore more viable and sustainable strategies.
- [What A Pennsylvania Hydrogen and Carbon Capture Hub Would Cost](#) | ORVI, Jun. 2022
 - A full-scale hydrogen and carbon capture hub would add \$1,000 to \$3,000 or more per year to Western Pennsylvanians’ taxes, utility bills, or a combination of both, research shows.
- [The Section 45Q Tax Credit for Carbon Sequestration](#) | Congressional Research Service, Aug. 2023
 - This fact sheet, originally issued in March 2020 but updated in 2023, outlines the legislative and regulatory background for the 45Q tax credit and provides cost projects pertaining to its use.
- [Investigation into misuse of 45Q tax credit](#) | Treasury Inspector General for Tax Administration
 - This report details an investigation initiated by Sen. Bob Menendez (D-NJ), a senior member of the Senate Finance Committee, which found that fossil fuel companies improperly claimed nearly \$1 billion through the 45Q carbon sequestration tax credit. Following enforcement action

from the IRS, approximately \$531 million of those credits were revoked, totaling 59% of the credits claimed between 2010 and 2019. The 45Q tax credit was later increased through the Inflation Reduction Act.

Alternative Economic Development Opportunities

- [The Centralia Model for Economic Transition in Distressed Communities](#) | ORVI, Jul. 2021
 - A real-life model of successful economic and clean energy transition in a chronically distressed coal town that faced the closures of a coal mine and a power plant, the town's largest employers. Centralia established a \$55 million transition fund for investments in clean energy, energy efficiency, and education that spurred local job growth, drove complementary investment, provided utility bill savings, increased disposable incomes, and improved quality of life. Despite the closing of the mine and impending retirement of the power plant, Centralia's transition formula, which can be replicated in similarly challenged places, led to economic and job growth that was twice that of the nation's in the first four years of grant funding.
- [Green Steel in the Ohio River Valley: The Timing is Right for the Rebirth of a Clean, Green Steel Industry](#) | ORVI, Apr. 2023
 - A transition from traditional coal-based steelmaking to fossil fuel-free steelmaking powered by green hydrogen could grow total jobs supported by steelmaking in the region by up to 43% by 2031, forestalling projected job losses. Transitioning to fossil fuel-free steelmaking would also cut Pennsylvania's industrial sector emissions by 4 million metric tons of CO₂e per year, improving quality of life and saving \$380 million in health, community, and environmental costs.
- [A Clean Energy Pathway for Southwestern Pennsylvania](#) | Strategen/ORVI, Dec. 2022
 - A renewables-based pathway centering energy efficiency & clean energy imports from the PJM market is more cost-effective than continued reliance on fossil fuels in the 10-county region surrounding Pittsburgh, this analysis finds. A strategy focused on natural gas and carbon capture will be 13% more costly than the clean energy pathway, which avoids expensive investments in CCS technologies to reduce emissions, while limiting the region's exposure to fuel price volatility and mitigating the risk of stranded fossil fuel assets. The clean energy pathway also results in a 97% reduction in CO₂ emissions from the power sector by 2050.
- [APPALACHIAN POWER COMPANY and WHEELING POWER COMPANY Application for the issuance of a Certificate of Public Convenience and Necessity for internal modifications at coal fired generating plants necessary to comply with federal environmental regulations, direct testimony by Sean O'Leary](#) | ORVI, May 2021
 - Sean O'Leary's testimony on the Mitchell coal-fired power plant, in which he argues for the plant's retirement aided by an economic transition plan like the [Centralia Model for Economic Transition in Distressed Communities](#).

Miscellaneous Industry & Government Documents

- [Ohio River Valley Hydrogen and CCS Hub Market Formation](#) | AFL-CIO, Sep. 2021
 - Summary of a workshop convened by the Labor Energy Partnership (LEP), an initiative of the Energy Futures Initiative (EFI) and the American Federation of Labor and Congress of Industrial Organizations (AFL-CIO), to promote hydrogen and carbon capture and storage development in the Ohio River Valley. Attendees included Senators Joe Manchin and Sherrod Brown, former Energy Secretary Ernest Moniz, White House National Climate Advisor, Gina McCarthy, and AFL-CIO secretary-treasurer, Elizabeth Shuler.
- [The Pathway to Carbon Management Commercial Liftoff](#) | US Dept. of Energy, Apr. 2023
 - An overview of the US Department of Energy's plan to develop carbon capture, use, and sequestration. The revamped 45Q tax credit for carbon storage and utilization, as well as approximately \$12 billion in funding from recent climate and infrastructure legislation, pave the way for "commercial liftoff," according to DOE.
- [The Pathway to Clean Hydrogen Commercial Liftoff](#) | US Dept. of Energy, Mar. 2023
 - An overview of the US Department of Energy's plan to develop regional hydrogen hubs. In the near-term (2023-2026), \$8 billion in DOE funding for Regional Clean Hydrogen Hubs will "advance new networks of shared hydrogen infrastructure," the department claims.
- [The Potential Economic Benefits of an Appalachian Petrochemical Industry](#) | American Chemistry Council, May 2017
 - An outline of the petrochemical 'renaissance' envisioned for the Ohio River Valley region, complete with five world-class ethane crackers, two hydrogenation plants, and an Appalachian Storage Hub connected by 500 miles of pipelines. Today, only one of these projects—the Shell ethane cracker in Pennsylvania—has even crossed the starting line. Hydrogen hub plans could be the next industry-led "failed vision."
- [Turning CCS projects in heavy industry & power into blue chip financial investments](#) | Energy Futures Initiative, Feb. 2023
 - An analysis of the remaining financial challenges for bringing carbon capture technology to full deployment stage after enactment of the Inflation Reduction Act. Even the enhanced 45Q subsidy remains insufficient to spur carbon capture adoption in many industries, including power generation. EFI claims that kickstarting at-scale CCS investment will require addressing two fundamental challenges: application heterogeneity, or the deployment of CO₂ capture technologies in new industrial and commercial settings, and value chain complexity, or managing the "four links" that connect a CO₂ capturing industrial facility to permanent geologic storage (capture, transport, deep underground injection, and ongoing monitoring).
- [Western Pennsylvania Hub, An Atlas of Carbon Capture and Hydrogen Hubs for United States Decarbonization](#) | Great Plains Institute, Feb. 2022

- Industry-associated think tank Great Plains Institute's roadmap of hydrogen hub buildout, with an inset analysis of Western Pennsylvania. According to this analysis, in Appalachian Ohio, Pennsylvania, and West Virginia, the gas and coal power generating sector is responsible for 90% of 45Q-eligible emissions. Everything else amounts to niche applications.
- [White House Council on Environmental Quality Report to Congress on Carbon Capture, Utilization, and Sequestration](#) | WHCEQ, Jun. 2021
 - WHCEQ's report to Congress on the status of carbon capture use and sequestration in the US economy and steps that can be taken to accelerate its development. The report encourages states to take actions that will raise utility bills and increase taxes to fund subsidies, expanding the field of battle into state legislatures and regulatory bodies such as public service commissions.
- [Carbon Capture and Storage: Actions Needed to Improve DOE Management of Demonstration Projects](#) | Government Accountability Office, Dec. 2021
 - The GAO found that the DOE's actions increased risks for taxpayer funds and the success of previous carbon capture demonstration projects. The report also outlines a number of external challenges impacting these projects, challenges that also apply to blue hydrogen projects.
- [Appalachian Hydrogen Infrastructure Analysis](#) | National Energy Technology Laboratory, Mar. 2022
 - This report outlines NETL's vision for a hydrogen economy in Appalachia and surveys existing resources, barriers, and regulations pertaining to the advancement of hydrogen infrastructure in the region.