

Legislative Testimony
Hearing of the Pennsylvania House Environmental Resources and Energy Committee
Hydrogen Hubs and Climate Change
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Good day and thank you for allowing me to testify.

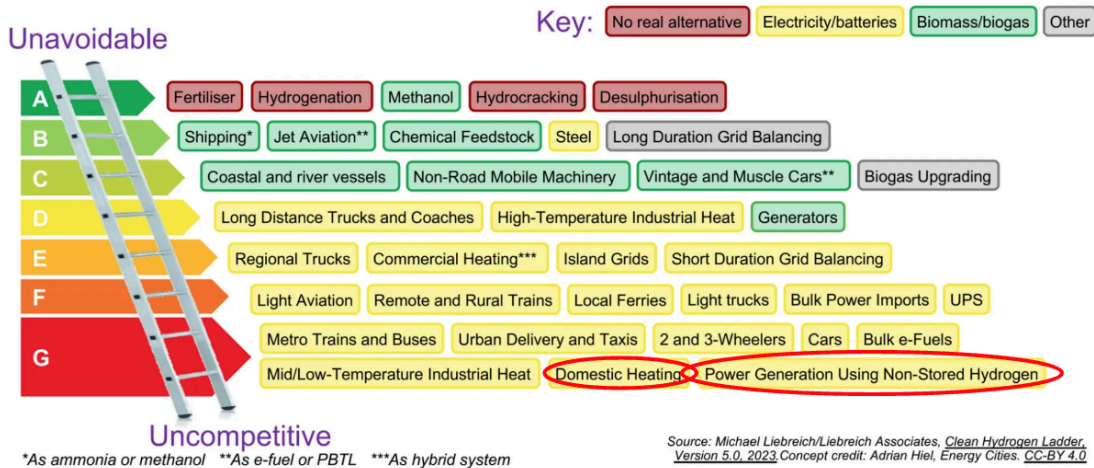
I’m Sean O’Leary, a researcher at the Ohio River Valley Institute¹, where we explore strategies to achieve equitable and sustainable prosperity in Pennsylvania, Ohio, West Virginia, and Kentucky. My work focuses on economic development and the impacts of the energy and petrochemical industries.

Lately we hear a great deal about hydrogen’s environmental and economic promise. But hydrogen deployment also carries risks, not just for health and safety, but economic risks, including higher prices, taxes, and utility bills along with little potential for job growth.

The question of whether hydrogen deployment will be economically helpful or harmful turns on the uses to which it is put. In some cases, such as steel and cement making, hydrogen is a viable decarbonization option as energy analyst Michael Liebreich’s hydrogen competitiveness ladder² illustrates.

Hydrogen Ladder 5.0

Liebreich Associates



Hydrogen Ladder Version 5.0 courtesy of Michael Liebreich under CC by 4.0 Deed

¹ <https://ohiorivervalleyinstitute.org/>

² <https://www.linkedin.com/pulse/hydrogen-ladder-version-50-michael-liebreich/>

But these applications don't require very much hydrogen. Uses that would require large amounts, such as power generation and domestic heating, are found at the bottom of the competitiveness ladder. That's because they lend themselves to more efficient decarbonization methods. Shoehorning hydrogen into these applications will drive up prices, taxes, and utility bills.

That's exactly what some ARCH2 hydrogen hub projects would do. And it's why the greatest risk policymakers face isn't that you'll do too little to support hydrogen, but that you'll do too much and force hydrogen into uneconomic uses.

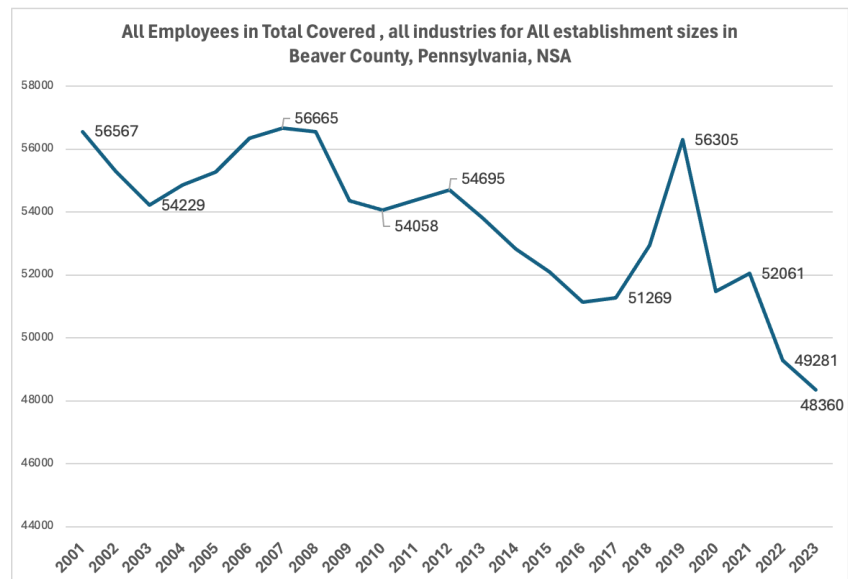
Even on its own terms, ARCH2 isn't a big deal environmentally or economically

It's important to understand that ARCH2's environmental and economic contributions will be tiny. When the Department of Energy (DOE) announced the regional hubs³, it said ARCH2 would abate 9 million metric tons of CO2 annually and create 21,000 jobs.

9 million tons sounds like a lot, but it doesn't even offset the emissions of one coal-fired power plant. It's less than 2% of Pennsylvania, Ohio, and West Virginia's emissions.

ARCH2's jobs impact is even smaller. DOE says that, of the 21,000 jobs, 18,000 will be temporary construction jobs. We recently saw what that means in Beaver County, where construction of the Shell petrochemical complex caused a brief jobs spike, followed by a plunge to a decades-long low⁴ in jobs.

Meanwhile, the 3,000 permanent jobs will be divvied up between three states. The few that land in Pennsylvania will amount to less than three-one hundredths of a percent of the commonwealth's 5.8 million jobs.



These aren't results for which you should squander taxpayer dollars, although that's what some ARCH2 projects would have you do.

³ <https://www.energy.gov/oced/regional-clean-hydrogen-hubs-selections-award-negotiations>

⁴ Quarterly Census of Employment & Wages. <https://www.bls.gov/cew/home.htm>

ARCH2's economically absurd projects

EQT Corporation is collaborating with West Virginia distributor, Hope Gas⁵, to power households with hydrogen. Not only does the hydrogen ladder classify this application as uncompetitive, an Oxford University meta-review⁶ of fifty-four studies reported that all of them found hydrogen to be more costly and less efficient than electrification. For that reason and for reasons of safety, Britain canceled its residential hydrogen program⁷.

Meanwhile, ARCH2 business development partner⁸, Long Ridge, has an ongoing project to generate electricity by blending hydrogen with natural gas⁹, another application at the bottom of the competitiveness ladder. The cost of hydrogen blending is so unreasonable that analysts and government agencies have stopped considering its feasibility. Last year, Lazard's Levelized Cost of Energy analysis¹⁰ found that a 20% hydrogen blend would nearly double the cost of producing electricity. This year, Lazard didn't bother to include blue hydrogen blending in its analysis¹¹. And recently, the Environmental Protection Agency dropped hydrogen blending as a Best System of Emission Reduction (BSER)¹².

Nonetheless, one of the organizations guiding ARCH2, TRC¹³, promotes hydrogen power generation. A slide from a recent industry presentation titled "ARCH2 Growth and Expansion"¹⁴ calls power generation's hydrogen offtake potential "significant" and includes a map of the region's gas plants.

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<https://wvmetronews.com/2023/10/31/hope-gas-describes-its-vision-of-bringing-hydrogen-hub-benefits-to-peoples-homes/>

⁶ <https://www.sciencedirect.com/science/article/pii/S2949790623000101>

⁷

<https://www.theguardian.com/environment/article/2024/may/09/third-pilot-of-household-hydrogen-heating-shelved-by-uk-government>

⁸ <https://www.arch2hub.com/community-support/>

⁹ <https://www.longridgeenergy.com/about>

¹⁰ <https://www.lazard.com/research-insights/2023-levelized-cost-of-energyplus/>

¹¹ <https://www.lazard.com/media/gjyffoqd/lazards-lcoepus-june-2024.pdf>

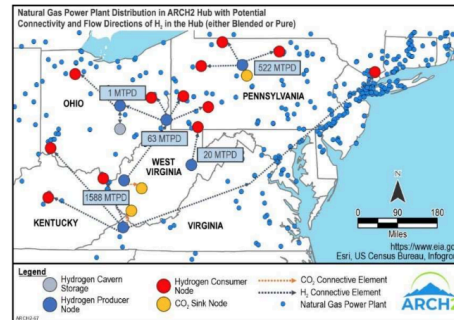
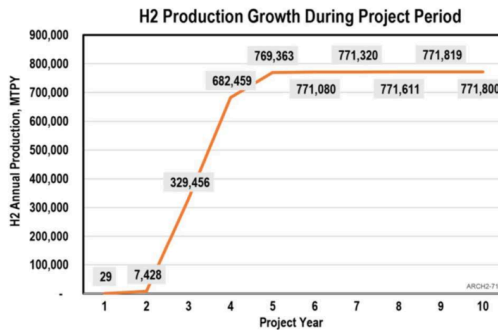
¹²

<https://www.hydrogeninsight.com/policy/too-expensive-us-regulators-drop-hydrogen-co-firing-from-power-plant-decarbonisation-plan/2-1-1633418>

¹³ <https://www.arch2hub.com/pmos/>

¹⁴ <https://mecseminars.com/sites/default/files/2024-02/Workshop%20GG.pdf>

ARCH2 Growth and Expansion



AT TIME OF INTERVIEWS

- ARCH2 advances a national clean H₂ network by use of scalable and replicable technology approaches for H₂ 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.
- H₂ offtake potential in NG combined cycle power plants is significant
- Mobility projects part of regional and national networks of refueling systems
- Total revenues from H₂ and product sales alone can exceed \$2B annually.

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This is disturbing both because hydrogen power generation is uneconomic and because ARCH2 says this in its FAQs¹⁵:

Will power that is produced by ARCH2's proposed projects feed into the public power grid managed by electric power utilities? If so, will this result in an increase in consumer energy costs?

At the present time, none of ARCH2's proposed projects are planning to produce hydrogen to feed the public power grid, therefore, there will be no impact on consumer energy costs.

This statement is disingenuous and, in light of TRC's promotional efforts, intentionally misleading.

Costs and implications if hydrogen is forced into large and uneconomic applications

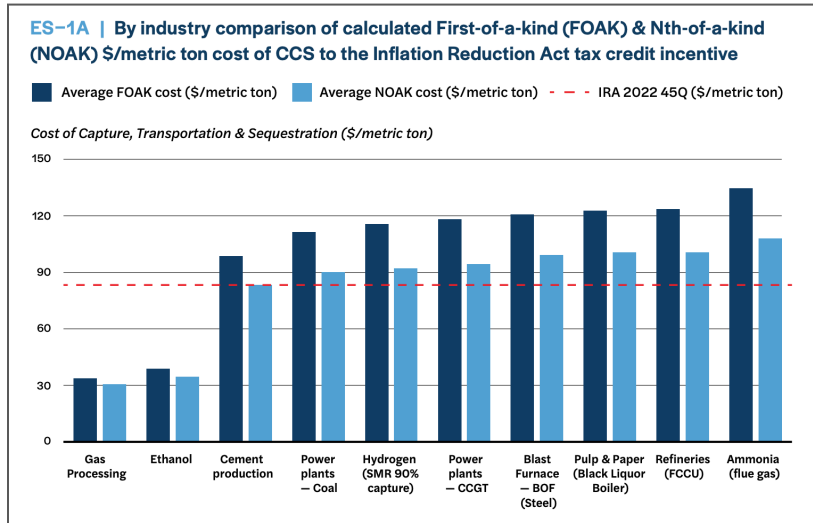
I already mentioned the near doubling of the cost for electricity produced by blending hydrogen and natural gas. In the short term, some of the cost might be offset by federal tax credits. However, the tax credits also pose risks.

¹⁵ <https://mecseminars.com/sites/default/files/2024-02/Workshop%20GG.pdf>

The DOE has earmarked \$925 million for ARCH2. But the 45V and 45Q tax credits will cost taxpayers some \$9 billion if ARCH2 projects come to fruition.

And last year the Energy Futures Initiative¹⁶ found that the 45Q subsidy is still insufficient to spur adoption. The EFI analysis probably understates the problem since it was done before the recent bout with inflation and the run-up in interest rates.

Moreover, the 45V and 45Q subsidies expire after ten and twelve years respectively at which time the recovery of added costs due to hydrogen will fall entirely on customers.



That's not all. Blue hydrogen manufacturing requires CCS for which the region has no existing infrastructure. Hydrogen production alone won't be sufficient to support the networks of pipelines required to transport hydrogen and captured carbon.

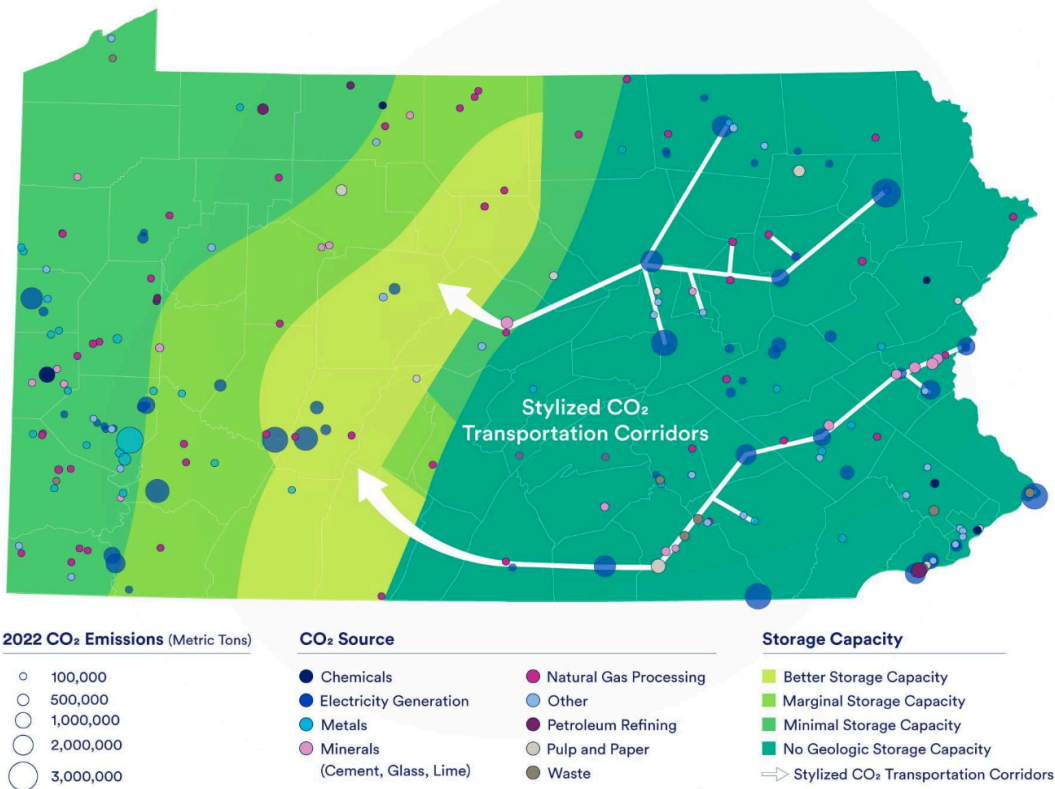
So, just as hydrogen may be force-fed into uneconomic applications, the same might happen with CCS. One ARCH2 affiliated organization, the Clean Air Task Force¹⁷, is explicitly targeting the power sector in which CCS is as costly as hydrogen.

¹⁶

https://energyfuturesinitiative.org/wp-content/uploads/sites/2/2023/02/20230212-CCS-Final_Full-copy.pdf

¹⁷ <https://www.catf.us/resource/new-look-carbon-capture-storage-opportunities-pennsylvania/>

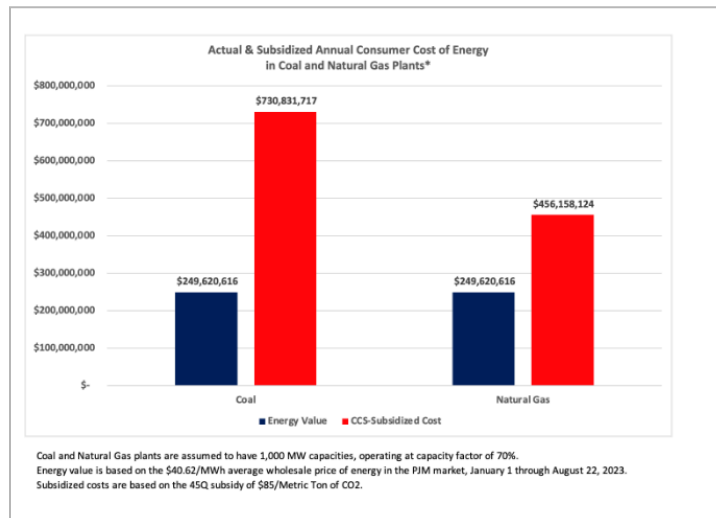
Figure ES-1: Stylized Relationship between CO₂ Sources and Potential Storage Capacity for the Combined Lockport and Knox Formations



CCS nearly doubles the cost of gas power and triples the cost of coal power.

Nevertheless, the industry proposes using eminent domain to construct thousands of miles of pipelines while asking the legislature to assume long term liability risks.

Finally, the impetus to force blue hydrogen and CCS into applications for which they are uncompetitive comes from the mistaken belief that natural gas development is economically beneficial.



In fact, despite explosive growth, the gas industry has failed to deliver jobs and prosperity¹⁸. The counties in Pennsylvania where the industry is most prevalent lead the commonwealth in job and population loss¹⁹. And they're doing worse now than they were before the gas boom began.

Conclusion

In light of hydrogen's costs, the threat of natural gas expansion, and ARCH2 disingenuousness, I ask you to ensure that public support is not given to projects in which hydrogen and CCS are uneconomic. And, for applications in which hydrogen is appropriate, I encourage you to support the use of green hydrogen, which is cleaner and less expensive than blue hydrogen when all the costs are taken into account.

I've submitted an addendum, which expands on these and other issues and that I hope you'll read. Please feel free to contact me with questions.

Thank you.

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¹⁸

<https://ohiorivervalleyinstitute.org/frackalachia-update-peak-natural-gas-and-the-economic-implications-for-appalachia/>

¹⁹ <https://ohiorivervalleyinstitute.org/?s=misplaced+faith>

EXTENDED REMARKS: THREE COLLATERAL CONCERNS

1. The ARCH2 Hydrogen Hub May Fail to Manifest

Despite \$925 million in DOE seed funding and potentially larger subsidies from Inflation Reduction Act tax credits and other incentives, many ARCH2 projects and the larger “hydrogen economy” enterprise as a whole may fail to be realized. It’s a phenomenon that we recently watched play out in our region in the case of another highly touted industrial build-out: the Appalachian petrochemical cluster.

According to an American Chemistry Council economic impact study²⁰, the cluster was to have at its core a fleet of five world-class ethane crackers, which were expected to spin off a downstream manufacturing boom. The Department of Energy hailed this as the start of an “Appalachian Energy & Petrochemical Renaissance”²¹.

Like the hydrogen hub, the petrochemical cluster was promoted by groups such as Shale Crescent USA²² and supported by promises of billions of dollars in state and federal aid. Pennsylvania extended \$1.6 billion in assistance to Shell in return for locating its cracker in Beaver County. In all, the ACC study said the cluster would result in over 100,000 jobs.

Now, seven years after the ACC study was released, the dream is effectively moribund. No more cracker plants are being considered and, of the economic impact study’s nine major projects, the Shell cracker is the only one that was built. and it is struggling. The Shell cracker also failed to trigger any identifiable build-out in downstream manufacturing or job growth.

The principal reasons for the petrochemical cluster’s failure - insufficient demand and an inability to attract private capital - are issues that also haunt hydrogen hub projects. As generous as the federal subsidies sound, over 90% of the capital required for hydrogen hub projects will have to come from the private sector. And the doubts are legion.

The International Energy Agency recently reduced its forecast for clean hydrogen production, explaining, “The main uncertainties are whether there is sufficient demand and offtake which, in part, is due to the higher cost compared to hydrogen produced from unabated fossil fuels or with the use of fossil fuels in applications where renewable hydrogen could replace them.”²³

²⁰

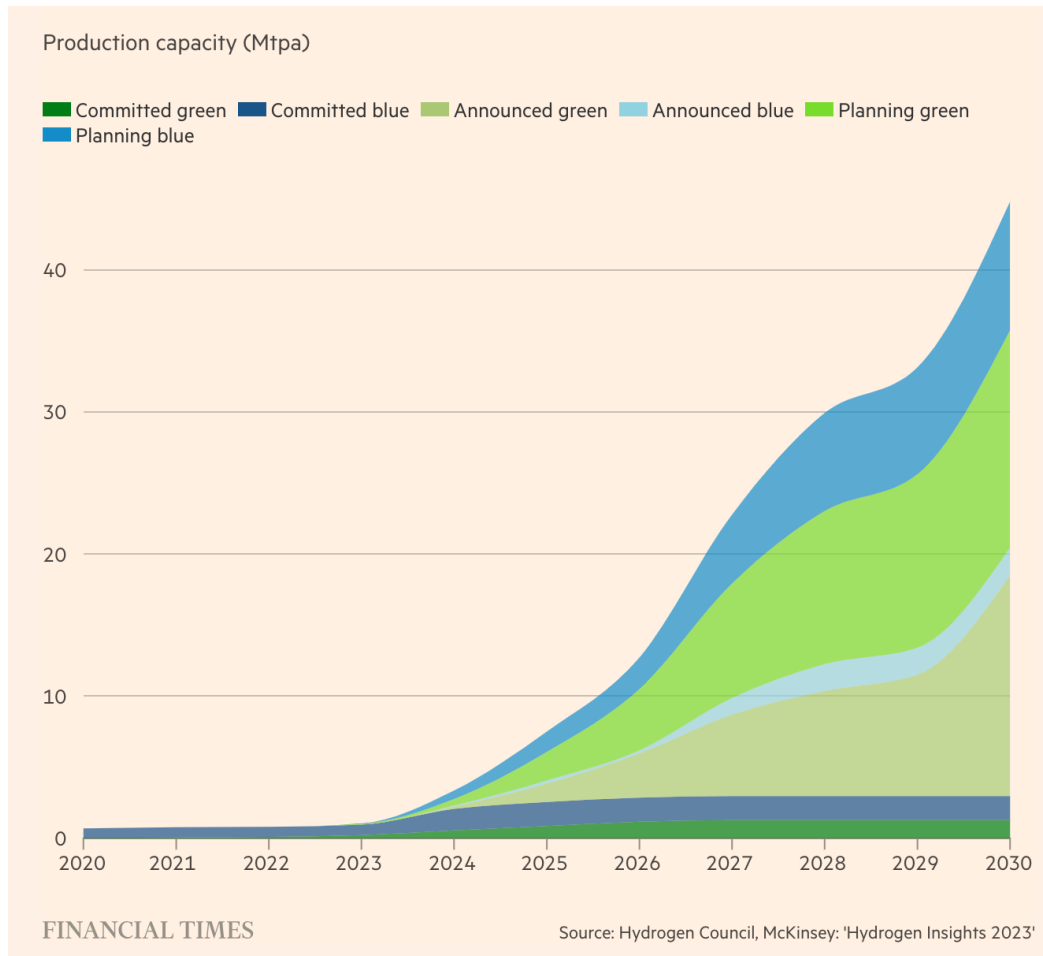
<https://www.americanchemistry.com/chemistry-in-america/news-trends/press-release/2017/new-report-shows-potential-for-major-appalachian-petrochemical-industry>

²¹ <https://www.energy.gov/articles/appalachian-energy-and-petrochemical-renaissance>

²² <https://shalecrescentusa.com/>

²³ <https://www.reuters.com/business/energy/iea-lowers-renewables-forecast-clean-hydrogen-2024-02-01/>

A recent Financial Times story²⁴ also highlighted that shortcoming and added that just a sliver of the hydrogen projects that have been announced have actually acquired commitments for financing.



Whether the hydrogen hub will prosper where the Appalachian petrochemical cluster collapsed remains to be seen.

2. Growing Public Anger at ARCH2 and DOE's Failure to Share Information

Since it announced seven regional hydrogen hubs in November of last year, the Department of Energy has convened an introductory webinar about the ARCH2 hub and two listening sessions. The overwhelming majority of public comments elicited at these meetings have expressed concern or outright opposition to the hub or to individual projects. The Charleston Gazette-Mail observed that, "...nearly all the speakers during Wednesday evening's roughly 100-minute long event viewed ARCH2 as a major environmental and economic liability that risks

²⁴ <https://www.ft.com/content/14a60649-172a-45c1-99a9-039f481430e7>

locking the region into fossil fuel infrastructure while relying on technology unproven at commercial scale.”²⁵

The failure of ARCH2 and DOE to respond to these concerns resulted in fifty-four organizations, most of which are based in Pennsylvania writing a letter to the Department of Energy²⁶ in which they asked DOE to:

- Disclose information relevant to ARCH2, including site locations and operational details for proposed projects, plans for carbon storage and transportation infrastructure, documentation regarding the department’s assessment of the track records of developers associated with ARCH2, and more.
- Work with community and environmental justice stakeholders to design an engagement structure that gives communities real decision-making during negotiations, planning, construction, and operation.
- Suspend negotiations with ARCH2 until these conditions can be met.

The fifty-four signatory organizations include:

- 350 Pittsburgh
- Alliance for Appalachia
- Appalachian Voices
- Beaver County Marcellus Awareness Community (BCMAC)
- Better Path Coalition
- Between the Waters
- Black Appalachian Coalition
- Breathe Project
- Buckeye Environmental Network
- Center for Coalfield Justice
- Center for International Environmental Law
- Citizens for a Healthy Jessup
- Clean Air Council
- The Climate Reality Project
- Concerned Health Professionals of Pennsylvania
- CREATE Lab, Carnegie Mellon University
- Delaware Riverkeeper Network
- Earthworks

²⁵

https://www.wvgazette.com/news/energy_and_environment/arch2-hydrogen-hub-blasted-over-environmental-transparency-concerns-at-doe-session/article_c25ca0a2-f162-53b7-98cb-5de57bbe3249.html

²⁶ <https://ohiorivervalleyinstitute.org/wp-content/uploads/2024/05/DOE-ARCH2-petition-1.pdf>

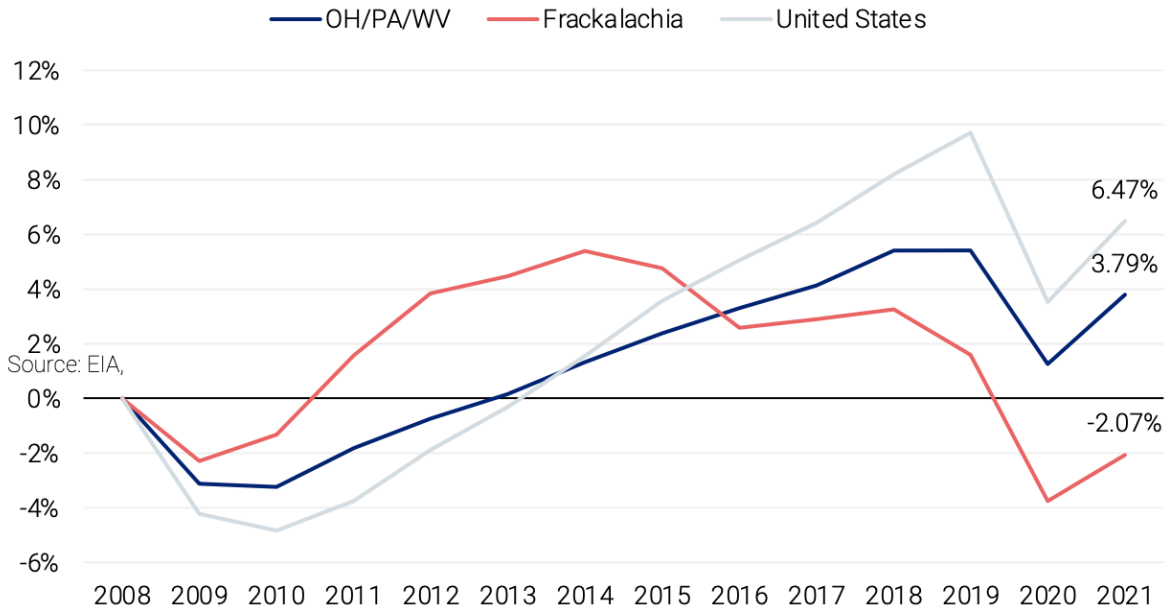
- Environmental Health Project
- Fair Shake Environmental Legal Services
- FracTracker Alliance
- Heartwood
- League of Women Voters of West Virginia
- Marcellus Outreach Butler
- Mid-Ohio Valley Climate Action
- Mon Valley Clean Air Coalition
- Mountain Lakes Preservation Alliance
- Mountain Watershed Association
- Move Past Plastic (MPP)
- NEPA Green Coalition
- No False Solutions PA
- North Braddock Residents for Our Future
- The Ohio River Valley Institute
- Ohio Valley Allies
- PCUSA
- PennEnvironment
- PennFuture
- People Over Petro Coalition
- Physicians for Social Responsibility Pennsylvania
- Pittsburghers Against Single Use Plastics (PASUP)
- Putting Down Roots
- Rail Pollution Protection Pittsburgh (RP3)
- Responsible Decarbonization Alliance (RDA)
- Rise Up WV
- River Valley Organizing
- Science and Environmental Health Network
- Three Rivers Waterkeeper
- Vote Solar
- Watchdogs of Beaver County
- Watchdogs of Southeastern Pennsylvania (WaSEPA)
- Water Is Life Church
- West Virginia Chapter of Sierra Club
- West Virginia Environmental Council
- West Virginia Highlands Conservancy
- West Virginia Rivers Coalition

3. The Structural Inability of Natural Gas Development to Create Jobs & Prosperity

Much of the political support for the ARCH2 hydrogen hub is grounded in a belief that it will create new uses for natural gas and that increased gas production is economically beneficial for Pennsylvania. The data clearly show otherwise.

Since the dawn of the fracking boom, the twenty-two Ohio, Pennsylvania, and West Virginia counties that produce 90% of Appalachian natural gas, far from flourishing economically, have experienced record job and population losses.

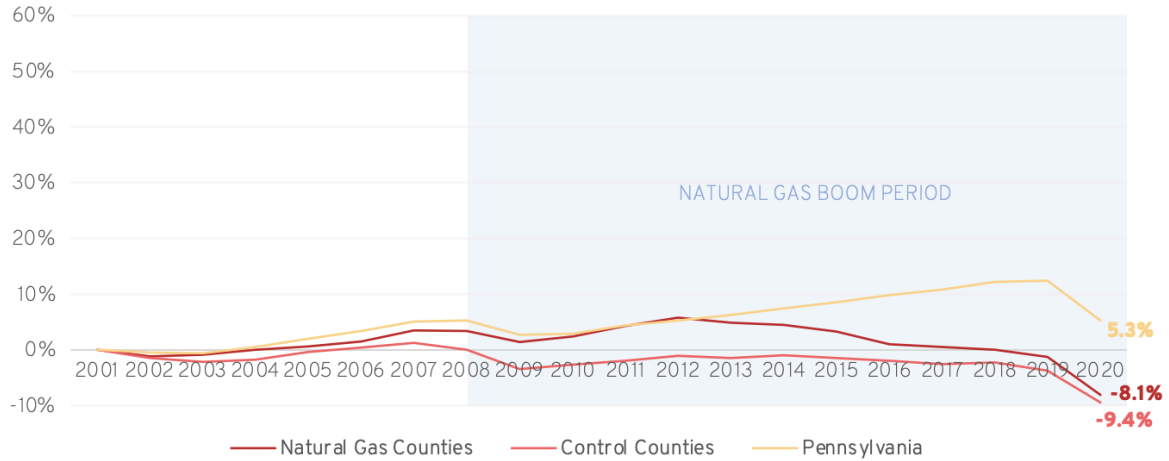
Figure 13: Cumulative Change in Total Employment, 2008-2021



Source: Bureau of Economic Analysis, CAEMP25N Total full-time and part-time employment by NAICS industry

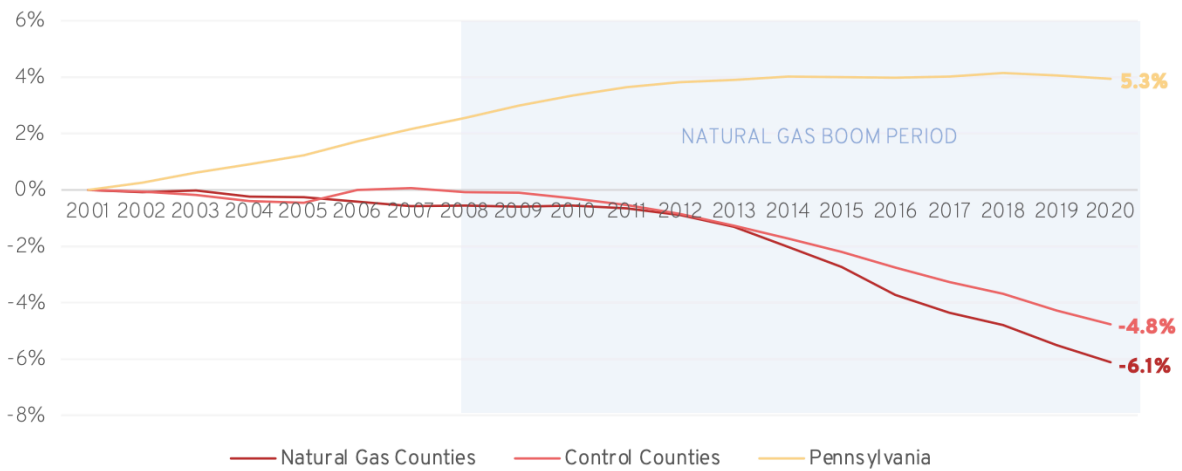
The situation is even worse in rural Pennsylvania counties, where the natural gas boom was strongly felt. Not only did these counties experience deeper job losses than non-rural counties, their job losses were nearly as great as those in rural counties that were not heavily impacted by the gas boom. And population loss was greater in the rural natural gas counties than it was in rural counties that weren't gas-impacted.

Figure 4: Change in Total Employment, 2001-2020



Source: Author's calculations using Bureau of Economic Analysis data

Figure 5: Change in Population, 2001-2020

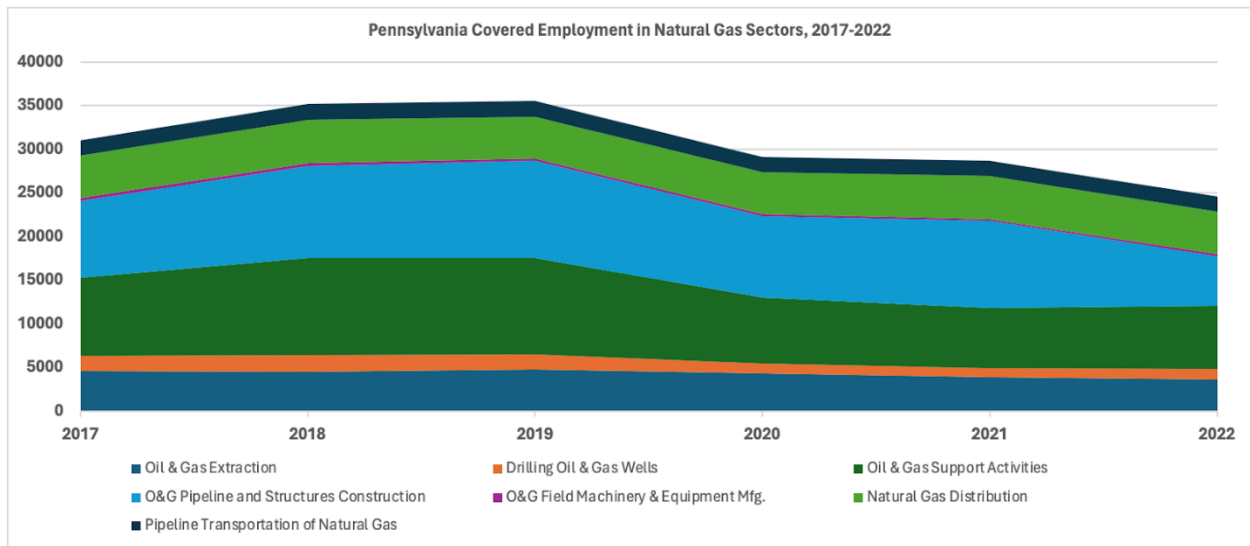


Source: Author's calculations using Bureau of Economic Analysis data

These trends, while disturbing, are not surprising. Most large-scale energy-related development is ineffective in bringing about increases in jobs and economic prosperity. And, as the charts comparing job and population change in rural gas and non-gas counties show, it's not because of failings in other parts of the economy. It's because the energy sector is one of the least labor-intensive sectors in the U.S. economy.

In 2021, ORVI published a report examining the structural issues in the natural gas and energy economy that produced the paradoxical outcome of vast increases in investment and output being accompanied by anemic and, because of negative impacts on quality of life, sometimes negative effects on jobs and population.

These problems are thrown into high relief by the fact that, even as the gas industry grows, its need for workers diminishes. The Quarterly Census of Employment and Wages, which documents jobs covered by the unemployment insurance system, shows that, of Pennsylvania's 5.8 million jobs, fewer than 25,000 of them are in the natural gas industry. And, between 2019 and 2022, the industry laid off over 10,000 workers or three out of every ten employees.



These losses took place despite the fact that gas production increased during that period. The bottom line is that natural gas development not only doesn't generate growth in jobs and prosperity, the industry's poor level of labor intensity, its dilatory effects on quality of life, and its boom/bust character make it structurally incapable of doing so.