TESTIMONY OF THE NATURAL RESOURCES DEFENSE COUNCIL

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Concerning the Climate and Community Impacts of Pennsylvania's Hydrogen Hubs and Hydrogen Deployment

Before the House Environmental Resources & Energy Committee

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Chairman Vitali, Chairman Causer, and honorable members of the House Environmental Resources & Energy Committee: thank you for the opportunity to testify. My name is Rachel Fakhry, and I am the Policy Director for Emerging Technologies at the Natural Resources Defense Council (NRDC), a member-based non-profit environmental organization with more than 90,000 members and activists in Pennsylvania. NRDC works in the U.S. and internationally to protect natural resources, public health, and the environment, and we are committed to tackling the climate crisis by driving greenhouse gas emissions down to net-zero by no later than mid-century.

I have led NRDC's hydrogen advocacy for several years and testified on hydrogen policy before the Subcommittee on Energy of the U.S. House of Representatives' Committee on Science, Space and Technology in 2022, as well as before the Pennsylvania House Democratic Policy Committee in 2021.[1] NRDC supports the deployment of truly zero-carbon, renewable hydrogen to replace fossil fuels in the hardest-to-electrify sectors of the economy, in a manner that maximizes heath and economic benefits for communities.

Executive Summary

The U.S. and global clean hydrogen industry is nascent and pathways toward successful deployment remain nebulous. As a winner of two hydrogen hub (H2Hub) awards-- the Mid-Atlantic Hydrogen Hub (MACH2) and Appalachian Hub (ARCH2)-- Pennsylvania occupies a unique position to serve as a nation-leading incubator of a successful clean hydrogen industry that delivers significant climate, public health, and economic benefits.

In fact, the H2Hubs are where the rubber hits the road: these are formative opportunities to get the technology right from the start. The development of the U.S. and Pennsylvania hydrogen landscape will involve new infrastructure, new workforces, and new industries. The resulting market will have a significant impact on the state's energy landscape and the communities where it is built. With this impact in mind and considering the suite of climate and health risks that poorly managed hydrogen carries, it is imperative that Pennsylvania's policymakers approach hydrogen deployment and policies with well-informed caution to maximize climate, health and economic benefits and minimize harmful consequences. Furthermore, planning and designing this new industry cannot be done without robust public engagement.

While some features of the H2Hubs have been made public, critical details that will determine their climate, public health and economic bona fides are still being worked out. Hub participants are expected to finalize detailed plans over the next 12-18 months. Therefore, policymakers have a major role to play in steering the H2Hubs in a direction that maximizes health and economic benefits to Pennsylvanians and bolsters the state's transition to a clean economy.

The stakes cannot be higher at this critical juncture. Pennsylvania either does hydrogen well, harvests its best climate, health and economic potential and sets the industry up for success. Or the state fails to implement the necessary guardrails and effectively engage the public, such that the two state H2Hubs

[1] Written Testimony to the Subcommittee on Energy, House Committee on Science, Space and Technology, U.S. House of Representatives, H2Success: Research and Development to Advance a Clean Hydrogen Future, February 2022, https://democrats-science.house.gov/imo/media/doc/Ms.%20Fakhry%20Testimony.pdf ; TESTIMONY OF THE NATURAL RESOURCES DEFENSE COUNCIL Concerning the Merits and Limitations of Hydrogen Technology as a Decarbonization Tool, July 2021, https://www.nrdc.org/sites/default/files/media-uploads/hydrogen_testimony_hdpc_hearing_nrdc_0.pdf

increase the state's GHG emissions, lead to Pennsylvanians bearing the brunt of a more costly transition to a clean economy and amplify mistrust in hydrogen as a boondoggle that failed to meet on its promise.

Pennsylvania is robustly positioned to do this right, including by adopting key approaches enacted by Colorado and Illinois in their recently passed hydrogen policies. My recommendations for a success-oriented hydrogen deployment framework apply both to the administration of the state's H2Hubs as well as state hydrogen policy more broadly, and they build on Rep. Vitali's previously introduced HB1215, in favor of which NRDC has previously testified before the House Environmental Resources & Energy Committee.

My testimony is structured as follows:

1- I begin by briefly reiterating the benefits and risks of hydrogen development, and the need for robust safeguards and well-designed policies to navigate it;
2- I then offer the following recommendations to Pennsylvania policymakers to maximize societal and climate benefits and minimize harmful consequences of hydrogen development:
    a. Adopt rigorous climate and public health standards for all hydrogen production, including the three pillars of 1) additionality; 2) deliverability; and 3) hourly matching for electrolytic hydrogen and minimal methane leakage with robust measurement reporting and verification for hydrogen produced from fossil fuels, otherwise known as "blue" hydrogen;
    b. Target hydrogen deployment in hard-to-electrify applications and minimize deployment in applications that have more cost-effective solutions—like direct electrification.
    c. Espouse a high degree of transparency and engage in proactive and robust public and community engagement in the context of the H2Hubs development to build trust and ensure that hydrogen deployment actually benefits communities.

1- <u>Hydrogen offers a potential solution to the hardest-to-decarbonize sectors of the economy. But absent guardrails, it may stall climate progress and increase the clean energy transition costs for Pennsylvanians.</u>

Clean hydrogen has the potential to substitute for fossil fuels in the most challenging sectors of the economy, including aviation, maritime shipping, and steelmaking. Those applications require either a chemical feedstock to drive a chemical reaction – as in steelmaking – or dense forms of energy to propel heavy equipment like vessels, aircrafts, and large trucks across long distances. Electrification– the solution to decarbonize much of the economy – may face technical hurdles in those applications because it may either require an entirely new process to forgo chemical reactions which require a molecule – as in steelmaking-- or may require very large batteries to propel heavy equipment across long distances, creating potential weight and payload issues for freight trucks, aircrafts, and shipping vessels. In contrast, hydrogen —or a hydrogen-derived product, such as ammonia— offers many of the attributes that those challenging applications demand: it has high energy density by mass– nearly three times that of diesel or gasoline – and can act as a chemical feedstock in heavy industry applications. Hydrogen has thus emerged as a compelling potential tool for decarbonization and a complement to established climate solutions like electrification, efficiency, and renewable energy.

But hydrogen production and use are inefficient; weak climate standards governing its production and untargeted deployment outside of narrow applications with limited clean energy alternatives will most likely stall climate progress and increase electricity costs for Pennsylvanians. Hydrogen production—

both electrolytic hydrogen and "blue" hydrogen-- is energy-intensive. Absent rigorous guardrails (which I describe in the following section), hydrogen production could drive substantial increases in carbon emissions and health-harming pollution. Poorly regulated blue hydrogen production is very GHG-intensive and would deliver scant emissions reductions relative to status quo hydrogen, while poorly regulated electrolytic hydrogen may drive millions of tons of emissions increases on the electricity grid.

Furthermore, hydrogen is an energy intensive solution relative to alternatives like direct electrification, where those alternatives exist and are reliable. The production, transport, storage, and use of hydrogen typically involve a series of energy conversions that incur high efficiency losses. For instance, between 20 and 50% of energy is lost in the production of hydrogen. Additionally, hydrogen equipment and appliances, such as fuel cell cars and boilers, are generally much less efficient than electric alternatives. These losses make hydrogen a relatively costly option for many applications that can be feasibly served by more efficient solutions like direct electrification. Buildings and passenger cars generally constitute two particularly poor widespread applications for hydrogen, with a strong evidence base supporting this reality. For example, hydrogen boilers could require 5 to 6 times more electricity to heat a home with hydrogen than to do so with an efficient heat pump.[2]

Burning hydrogen in turbines to generate electricity is also an inefficient use of hydrogen. Using electricity to produce hydrogen, and then burning that hydrogen for electricity is evidently streaked with inefficiencies. This pathway is no more than about 20 to 45% efficient, which is as inefficient as gas peakers which are only utilized during the highest demand hours. Similarly, any hydrogen use in the power sector must be limited to narrow applications, such as the long-duration storage of power, to avoid increasing power prices for Pennsylvanians and the state's carbon emissions.

Accordingly, there is now strong consensus around the ranking of hydrogen end-uses based on efficiency and cost-effectiveness relative to other solutions (Figure 1).

[2] International Energy Agency, "Global Hydrogen Review 2021," (page 87), 2021, https://iea.blob.core.windows.net/assets/e57fd1ee-aac7-494d-a351-f2a4024909b4/GlobalHydrogenReview2021.pdf ; Recharge News, "Why using clean hydrogen for heating will be too difficult, expensive and inefficient: report, " February 2021, https://www.rechargenews.com/markets/why-using-clean-hydrogen-for-heating-will-be-toodifficult-expensive-and-inefficient-report/2-1-960777 ; Jan Rosenow, "Heating homes with hydrogen: Are we being sold a pup?," 2021, https://www.raponline.org/blog/heating-homes-with-hydrogen-are-we-being-sold-a-pup/

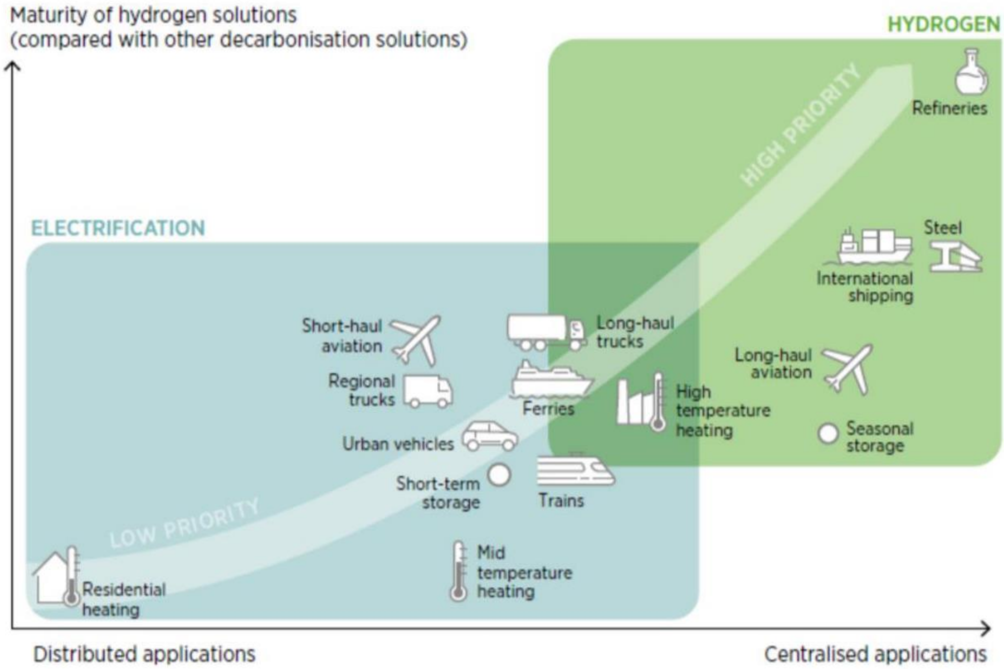

Figure 1: Clean hydrogen policy priorities, International Renewable Energy Agency[3]

1- **Pennsylvania must adopt rigorous climate and public health standards for all hydrogen production.**

Absent strong production standards and effective guardrails, Pennsylvania's H2Hubs will *increase* carbon emissions and health-harming pollution while compromising compliance with the Commonwealth's climate goals in Executive Order 2019-01 and undermining Governor Shapiro's repeated commitment to take "real action to address climate change."

a. **Electrolytic hydrogen production must adhere to the three pillars of additionality, deliverability, and hourly matching to prevent a suite of harmful consequences for Pennsylvanians and the hydrogen industry.**

Pennsylvania is set to invest in electrolytic hydrogen production as part of MACH2 shared with Delaware and New Jersey. Electrolytic hydrogen avoids many of the climate and public risks inherent to fossil-derived (or "blue" hydrogen), but still carries a range of risks that require rigorous standards.

b. **The three pillars of new clean supply, hourly matching, and deliverability are necessary to prevent emissions increases, public health harms, and a U-TURN for Pennsylvania's climate progress.**

Electrolytic hydrogen production is power hungry, as it involves the breaking of chemical bonds between hydrogen and oxygen in water. Therefore, even if a modest share of electricity feeding an electrolyzer is

[3] International Renewable Energy Agency, "Geopolitics of the Energy Transformation The Hydrogen Factor," 2022, https://www.irena.org/publications/2022/Jan/Geopolitics-of-the-Energy-Transformation-Hydrogen

derived from fossil fuels, hydrogen production would result in significant emissions increases. In fact, electrolytic hydrogen powered by Pennsylvania's average electricity grid— where unabated fossil fuels still account for about two thirds of total generation—would more than 50% more carbon intensive than today's incumbent and highly emitting gas-derived hydrogen (or "grey" hydrogen). In other words, it would be 1.6 times worse than status quo (Figure 2).

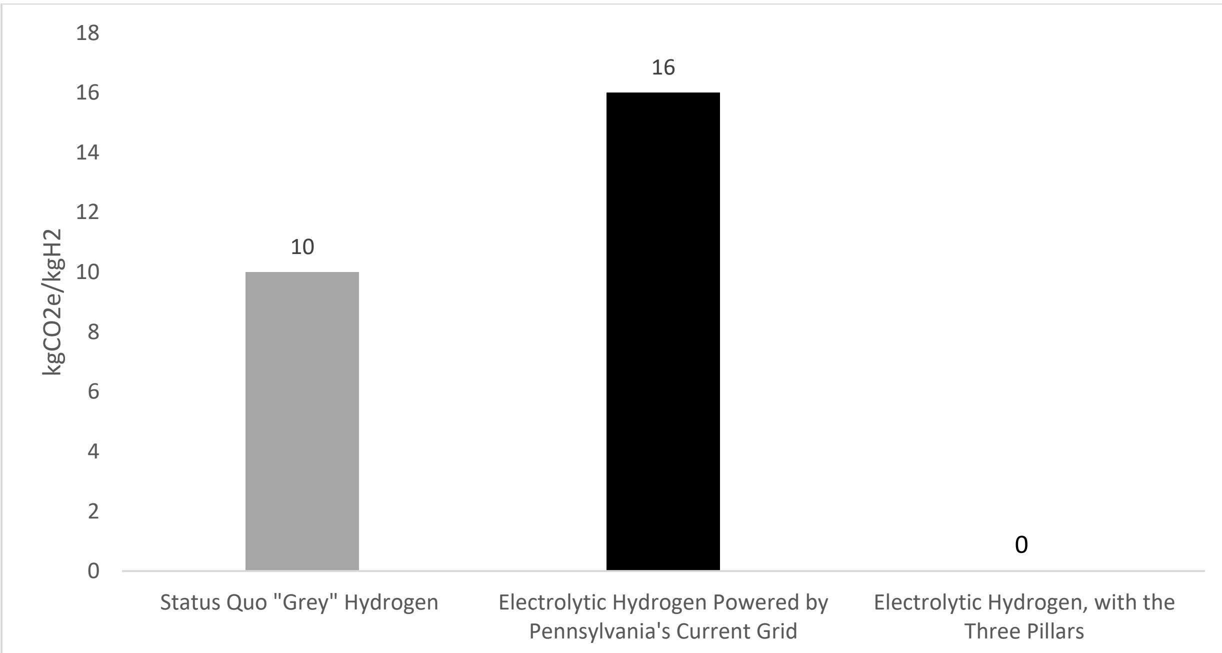

Figure 2: Carbon intensity of "grey" hydrogen vs. electrolytic hydrogen with and without guardrails.

Absent strong guardrails, electrolytic hydrogen production in MACH2 will increase Pennsylvania's carbon emissions and compromise the state's efforts to decarbonize its grid and economy. It will also increase electricity prices for Pennsylvanians.

It is imperative that all electrolytic hydrogen producers be very mindful of the source, location, and time of their electricity consumption to prevent those harmful consequences. Pennsylvania policymakers must require that all electrolytic hydrogen projects adhere to the three pillars of 1) new clean supply (aka additionality); 2) deliverability and 3) hourly matching. NRDC and a large contingent of industry, consumer groups, environmental groups, and environmental justice groups are actively pressing for those in the context of the IRA clean hydrogen tax credits.[4] Colorado has recently enacted the three pillars in HB23-1281.[5]

- New clean supply requires that hydrogen projects be powered by new clean energy that is not currently on the grid and powering homes, businesses, and industries. Otherwise, hydrogen production will divert existing clean energy from the grid and drive an increase in unabated fossil fuel electricity to plug the gap, with substantial emissions increases.
- Deliverability requires that the hydrogen project and new clean energy project be located within reasonable proximity. This ensures that the clean energy is reaching the grid where the hydrogen project is located. Otherwise, if the clean energy is blocked by a grid bottleneck, fossil fueled electricity close to the hydrogen project will ramp up to meet the demand, driving emissions increases.
- Hourly matching requires that the hydrogen project only operate during hours where the clean energy is generating. Otherwise, a hydrogen project could claim that they are powered by solar energy, while in fact operating during evening hours where fossil electricity is abound, driving emissions increases. The hydrogen producer could make this sleight of hand claim by procuring ineffective solar renewable energy credits (RECs), that only demonstrate solar powering on paper.

There is now abounding and extremely robust evidence that the three pillars are the only system that will prevent such negative climate and public health consequences, and that all three are necessary.[6]

Electrolytic hydrogen production that drives increases in unabated fossil fueled generation on the grid will also drive increases in health-harming pollution. Given the risks, a large contingent of environmental justice and local groups are now expressly calling for the three pillars to govern all electrolytic hydrogen production.[7]

[4] Re: Implementation of the IRA 45V clean hydrogen tax credits as it relates to guidelines for emissions accounting of grid-connected electrolyzers, February 2023, https://www.nrdc.org/sites/default/files/2023-03/joint-letter-45v-implementation-20230223.pdf ; Group Urges Hourly Matching Implementation for Hydrogen Credit, July 2023, https://www.taxnotes.com/research/federal/other-documents/irs-tax-correspondence/group-urges-hourly-matching-implementation-for-hydrogen-credit/7h1c6; Hourly matching industry letter, June 2023, https://s3.documentcloud.org/documents/23854072/hourly-matching-industry-letter-final.pdf, Consumer advocates letter, October 2023, https://www.citizen.org/wp-content/uploads/Consumer-Advocates-45V-Letter.pdf

[5] Advance The Use Of Clean Hydrogen, 2023, https://leg.colorado.gov/bills/hb23-1281

[6] Electric Power Research Institute (EPRI), Impacts of IRA's 45V Clean Hydrogen Production Tax Credit, November 2023, https://www.epri.com/research/products/000000003002028407 ; Princeton ZERO Lab, Minimizing emissions from grid-based hydrogen production in the United States, 2023, https://iopscience.iop.org/article/10.1088/1748-9326/acacb5 ; MIT Modeling Initiative, Producing hydrogen from electricity, April 2023, https://energy.mit.edu/wp-content/uploads/2023/04/MITEI-WP-2023-02.pdf ; Energy Innovation, Smart Design Of 45V Hydrogen Production Tax Credit Will Reduce Emissions And Grow The Industry, April 2023, https://energyinnovation.org/publication/smart-design-of-45v-hydrogen-production-tax-credit-will-reduce-emissions-and-grow-the-industry/ ; Evolved Energy Research, 45V Tax Credit: Three-Pillars Impact Analysis, June 2023, https://www.evolved.energy/post/45v-three-pillars-impact-analysis ; Rhodium Group, Scaling Green Hydrogen in a post-IRA World, March 2023, https://rhg.com/research/scaling-clean-hydrogen-ira/

[7] Consumer advocates letter, October 2023, https://www.citizen.org/wp-content/uploads/Consumer-Advocates-45V-Letter.pdf

c. The three pillars are necessary to prevent electricity price increases for Pennsylvania homes, businesses, and industries.

Furthermore, the three pillars are necessary to prevent increases in electricity prices for Pennsylvanians. If power-guzzling electrolyzers are allowed to locate on the grid with minimal constraints—i.e., without the three pillars—electricity prices will increase. This harmful outcome is well documented both in the context of the powerful precedent of cryptomining, as well as energy system modeling valuating the impact of electrolytic hydrogen deployment in the context of the IRA clean hydrogen tax credits.[8]

Like hydrogen production, cryptomining is power hungry and has led to substantial electricity price increases and grid reliability challenges in New York and Texas. Modeling by Princeton ZERO Lab has similarly found that failure to implement the three pillars in the context of the IRA clean hydrogen tax credits would lead to an 8% increase in wholesale electricity prices in California, and a 10% increase in Colorado.[9] These price increases would effectively shift hundreds of millions of dollars a year in electricity costs away from hydrogen producers and onto homes and businesses. Similar price impacts would be expected to occur in Pennsylvania if hydrogen production is unmanaged.

Those risks have driven a large contingent of consumer advocate spanning the U.S. – including Pennsylvania Utility Law Project and the Pennsylvania Public Interest Research Group—to express deep concerns about the negative consumer price impacts and urge the Biden administration to require the three pillars for all electrolytic hydrogen projects.[10] Those groups expect the same from state policymakers, especially where hydrogen deployment is imminent as in Pennsylvania.

d. Pennsylvania's articulated plans to power hydrogen production with existing nuclear energy inherently carries climate, health, and consumer price risks. It should – and can-- be carefully managed.

The hydrogen produced in MACH2 will be largely via electrolysis powered by both renewable energy and nuclear energy, with about 20% of the total hydrogen produced powered by existing nuclear energy. This should give us great pause. Nuclear energy accounts for more than 30% of Pennsylvania's net generation and provides the overwhelming majority of the state's carbon-free power. Therefore, diverting nuclear energy from the grid for hydrogen production will result in a grim U-TURN for the state's progress on climate and equity as it will likely drive increased fossil fueled electricity to fill the gap, exacerbating health harms and increasing electricity prices for Pennsylvanians.

Producing the total amount of hydrogen planned to be produced in MACH2 by 2034– which is modest compared to the volume of hydrogen that could be deployed in Pennsylvania by then—by diverting nuclear energy from the Pennsylvania grid would drive more than 2 million tonnes of emissions increases on the state's grid – the equivalent of adding roughly half a million passenger cars for a year. This would also entirely nullify the claimed climate benefits of MACH2, projected to be 1 million tonnes of avoided carbon from hydrogen replacing fossil fuels in various applications.

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[8] Energy Innovation, Consumer Cost Impacts Of 45V Rules, November 2023, https://energyinnovation.org/publication/consumer-cost-impacts-of-45v-rules/

[9] Princeton ZERO Lab, Research Addendum Consumer Price Impacts, November 2023, https://zenodo.org/records/10041735

[10] Consumer advocates letter, October 2023, https://www.citizen.org/wp-content/uploads/Consumer-Advocates-45V-Letter.pdf

The state must therefore navigate this with great caution. To the extent that the state relies on nuclear energy to power hydrogen, policymakers must impose contours and protections to prevent harmful consumer, health, and climate implications. Those include:

- Requiring that nuclear plants uprate their capacity for hydrogen production;
- Requiring that nuclear plants demonstrate economic need that revenue from hydrogen production would help alleviate; or
- Requiring that for every hour that a nuclear plant diverts its power for hydrogen production, it supports the generation of new clean energy to nullify emissions and electricity price impacts.

Those three conditions mimic the impact of the new clean supply pillar and can therefore be considered in compliance with this pillar.

e. The three pillars will support robust industry and job growth.

The three pillars will support robust industry growth, which is why a large number of companies and industry groups are strongly in support of them. The pipeline of three-pillar compliant projects is growing rapidly, in the U.S. and worldwide. Furthermore, the overwhelming majority of studies – by electrolyzer manufacturers, hydrogen and renewable developers, academics and research groups the likes of the Electric Research Power Institute (EPRI)-- find three-pillar projects will be very cost-competitive from day one.[11]

The three pillars will also support job creation and economic opportunities for Pennsylvanians by incentivizing the deployment of new utility-scale clean energy development and turbocharging the creation of a new U.S. electrolyzer manufacturing base in which Pennsylvania could participate.

- New clean supply and hourly matching will drive more clean energy deployment to support hydrogen production. A substantial share of jobs linked to electrolytic hydrogen development comes from clean energy development. Failing to require new clean supply and/or allowing for annual matching would undermine the clean hydrogen sector's demand for new clean energy development, as hydrogen projects can simply tap into existing clean energy and/or rely on clean energy development that would have happened anyway.

- Not all electrolyzer technology is the same. The three pillars will require "smarter technology"-- advanced electrolyzer technologies with fast ramping capabilities to vary operations with the availability of clean energy. This is the frontier technology expected to draw significant interest as the global clean hydrogen market develops. The European Union is swiftly angling to become

[11] Princeton ZERO Lab, The Cost of Clean Hydrogen with Robust Emissions Standards: A Comparison Across Studies, April 2023, https://zenodo.org/records/7948769 ; Electric Power Research Institute (EPRI), Impacts of IRA's 45V Clean Hydrogen Production Tax Credit, November 2023, https://www.epri.com/research/products/000000003002028407 ; MIT Modeling Initiative, Producing hydrogen from electricity, April 2023, https://energy.mit.edu/wp-content/uploads/2023/04/MITEI-WP-2023-02.pdf ; Energy Innovation, Smart Design Of 45V Hydrogen Production Tax Credit Will Reduce Emissions And Grow The Industry, April 2023, https://energyinnovation.org/publication/smart-design-of-45v-hydrogen-production-tax-credit-will-reduce-emissions-and-grow-the-industry/ ; Evolved Energy Research, 45V Tax Credit: Three-Pillars Impact Analysis, June 2023, https://www.evolved.energy/post/45v-three-pillars-impact-analysis

a major advanced electrolyzer manufacturing base.[12] But weak standards such as annual matching will artificially advantage “low-tech” alkaline electrolyzer technology, which is inefficient, inflexible, and cheaper. This is because annually matched projects do not need to fluctuate their operations with the availability of clean electricity and can instead balance their operations by drawing power from the grid. Given that China has the greatest alkaline electrolyzer manufacturing capacity, weak standards in Pennsylvania and U.S. will incentivize cheap-but-outdated alkaline electrolyzers imported from China and kneecap the establishment of a U.S. electrolyzer manufacturing base, in which Pennsylvania could participate.

- **“Blue” hydrogen production must be subject to strict scrutiny and rules to minimize climate and public health harms.**

ARCH2 appears to be heavily reliant on hydrogen derived from natural gas and equipped with carbon capture and storage (CCS) – or “blue” hydrogen—with at least two facilities preliminarily planned in Pennsylvania (Figure 3). Blue hydrogen carries the same suite of climate and public health risks inherent to fossil fuels and should therefore be subject to strict scrutiny and rigorous climate and public health standards. Such standards would be different than the three pillars for electrolytic hydrogen.

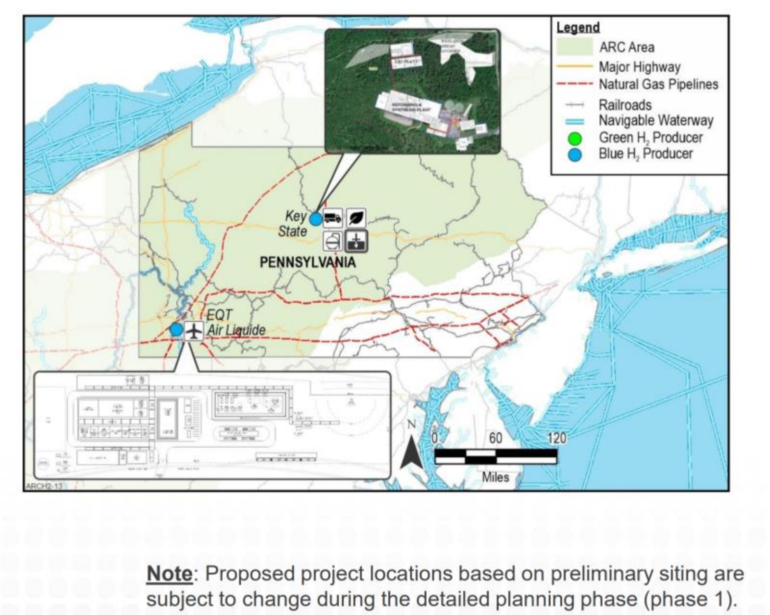

Figure 3: ARCH2 Project Summaries, as presented by the Department of Energy’s Office of Clean Energy Demonstrations.[13]

[12] Hydrogen: Commission supports industry commitment to boost by tenfold electrolyser manufacturing capacities in the EU¸ May 2022, https://ec.europa.eu/commission/presscorner/detail/en/ip_22_2829

[13] DOE Office of Clean Energy Demonstrations, Appalachian Regional H2Hub Community Briefing, Slide 28, https://www.energy.gov/sites/default/files/2023-10/H2Hubs_Appalachian_Community_Briefing.pdf

To minimize its negative climate impact, all blue hydrogen production must be held to strict carbon intensity standards. Otherwise, and when governed by weak standards concerning the level of carbon capture and upstream methane leakage, blue hydrogen would be very GHG-intensive and deliver scant emissions reductions compared with status quo "grey" hydrogen (Figure 4).

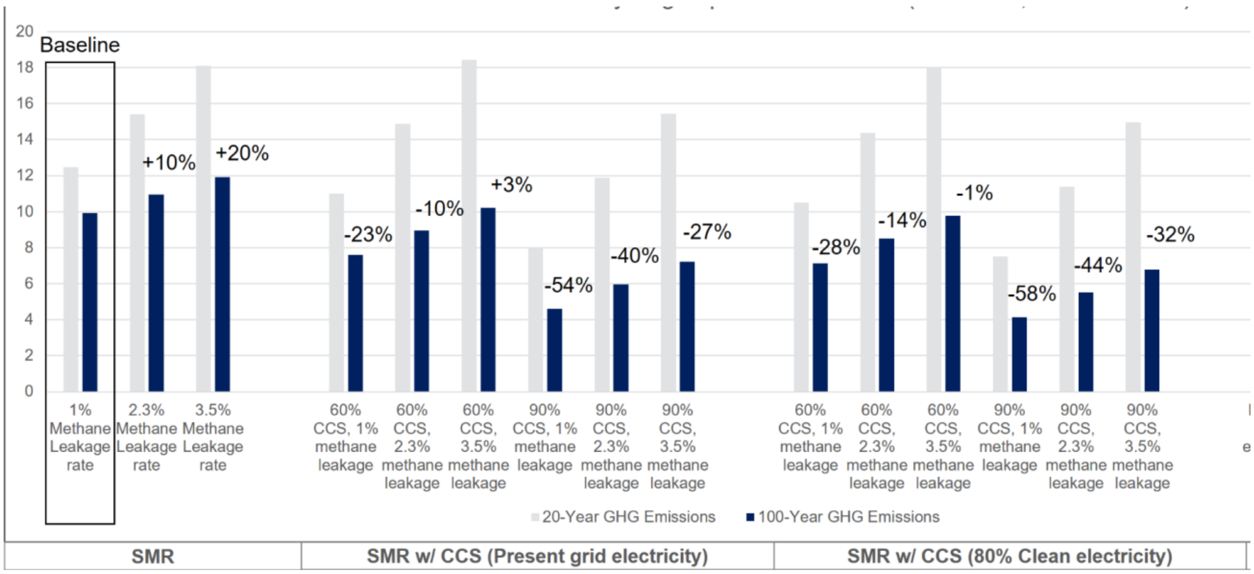

Figure 4: Carbon intensity of various blue hydrogen pathways compared with "grey" hydrogen (or steam methane reforming "SMR") based on a range of capture rates, upstream methane leakage and electricity sourcing for CCS operations. This is pulled from a forthcoming analysis by Environmental Resources Management Consulting, commissioned by NRDC.

In order to deliver meaningful emissions reductions compared with status quo "grey" hydrogen, all blue hydrogen production in the state must be governed by the following requirements:

- A limit on upstream methane leakage at no more than 1%. Upstream methane emissions account for a significant portion of the overall greenhouse gas intensity of blue hydrogen, and they have an even stronger climate warming effect in the near term. But methane leakage estimates have been shown to grossly underestimate what scientists have observed nationwide and in certain basins. Notably, Pennsylvania is the second-largest gas-producing state in the country, and independent analysis from the Environmental Defense Fund in 2020 found methane emissions from the state's oil and gas sources to be significantly higher than government inventories suggest.[14] It is therefore critical that blue hydrogen producers in Pennsylvania be required to demonstrate a <1% methane leakage rate via in-basin and/or operator-specific measurements in lieu of inaccurate on-paper averages.
- A requirement that projects' carbon capture rate be no less than 90%. Anything less would be severely misaligned with Pennsylvania's climate progress and goals and pose major concerns relating to the longevity of the investment in anticipation of tightening climate standards over

[14] Environmental Defense Fund, Explore Pennsylvania's oil and gas pollution, https://www.edf.org/energy/explore-pennsylvanias-oil-and-gas-pollution

time. The state should consider claw back mechanisms should projects fail to mee their intended capture rates.

Furthermore, considering the well-documented harmful health impacts of natural gas production and use, blue hydrogen producers must be required to adopt best-in-class pollution control measures and technologies. Producers must be held accountable to regularly publish pollution reports and establish safety protocols with local first responders in case of an emergency. Additionally, communities who will live in proximity to those projects must be fully informed of the potential harmful health impacts of gas production and use. Through early and frequent engagement (as I describe further below), developers must work with communities to identify their concerns and mitigate project impacts accordingly.

- **Pennsylvania must target hydrogen deployment to serve hard-to-electrify applications.**

It is imperative that Pennsylvania target hydrogen deployment in both H2Hubs – and hydrogen deployment more broadly-- in hard-to-electrify applications to minimize the costs of the clean energy transition to Pennsylvanians and avoid stalling progress on climate. **The H2Hubs have a higher chance of succeeding with such end-use prioritization, as they would be better aligned with DOE's own expressed priorities (as noted below) and hydrogen's long-term prospects.** H2Hubs that are heavy on uncompetitive hydrogen end-uses may not survive without federal subsidies, and their longevity is therefore questionable. Both Colorado and Illinois have adopted a targeted approach to supporting hydrogen deployment, offering tax credits exclusively to hydrogen use in hard-to-electrify applications with clear exclusion of "electrifiable" applications such as buildings heat and cars. Rep. Vitali's amendment to Act 108 of 2022 similarly limits tax credits to clean hydrogen deployment in existing "grey" hydrogen uses, chemical feedstocks, long duration energy storage, and any use that the Department of Environmental Protection determines is not feasible to electrify, such as steelmaking. It also explicitly rules out light- and medium- duty vehicles, and any use of hydrogen in gas distribution networks from qualifying for the tax credit. Those are critical safeguards against wasting public money on subsidizing inefficient and costly uses of hydrogen.

The DOE's national hydrogen roadmap and strategy also takes a clear stance on hydrogen end-uses, stressing the need to prioritize hydrogen deployment in hard-to-electrify sectors and minimize deployment in applications that can be more readily electrified.[15] The DOE appears to be operationalizing this guiding principle in its administration of the H2Hubs, as initial high-level descriptions of selected end-uses across H2Hubs seem to gravitate towards hard-to-electrify end-uses. That said, project details will snap into focus in the next 12-18 months.

Most of the information that we have about targeted end-uses in MACH2 and ARCH2 is housed in DOE's very high-level slide decks presented during the recently held OCED Community Briefings[16]. We therefore do not have sufficient information to exert judgement on the direction of the two hubs. Pennsylvania policymakers can have significant sway on the types of projects finalized over the next 12-18 months.

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[15] U.S. Department of Energy, U.S. National Clean Hydrogen Strategy and Roadmap, 2023, https://www.hydrogen.energy.gov/library/roadmaps-vision/clean-hydrogen-strategy-roadmap

[16] H2Hubs Local Engagement Opportunities Office of Clean Energy Demonstrations, https://www.energy.gov/oced/h2hubs-local-engagement-opportunities

Eyeballing the project sketches presented by DOE, it appears that MACH2 targets hydrogen deployment in industrial facilities and transportation applications (including heavy duty trucking and transit). The Pennsylvania portion tracks those end-uses, in addition to potentially port operations at the DRS Terminal.

ARCH2 seems to focus on hydrogen deployment in the power sector, heavy duty trucks, and industrial processes. The Pennsylvania portion appears to track those end-uses, in addition to the production of aviation fuel.

While those sketches do not raise immediate concerns for Pennsylvania, we recommend exercising caution concerning using hydrogen to generate electricity, which appears to be the subject of focus in MACH2 and ARCH2 – and the hydrogen hubs more broadly. As I note in section 1) above, this is an inefficient use of hydrogen outside of narrow reliability and long duration storage applications, and its widespread use would increase power prices for Pennsylvanians and drive carbon emissions increases.

- **<u>Stepped up transparency and community engagement are imperative.</u>**

The development of the Pennsylvania and U.S. hydrogen landscape will involve new infrastructure, new workforces, and new industries. The resulting market will have a significant impact on the energy landscape and the communities where it is built. Climate alignment and equity are imperative for the success of H2Hubs and hydrogen deployment more broadly, and that means planning and designing the industry cannot be done without transparency and robust public engagement. Pennsylvania can help set the bar.

Some confidentiality is a part of business, but there is significant scope for H2Hub administrators to espouse a high degree of transparency and engage in proactive information sharing. This is paramount to build public trust in the H2Hubs. Similarly, robust community engagement improves projects, increasing buy-in and trust that can help turn opposition into support.

Hitherto, both MACH2 and ARCH2 administrators and participants have fallen short with respect to both transparency and engagement with frontline communities. This has resulted in the public and communities who will live in proximity with the Hub projects being entirely in the dark and has produced mistrust in the societal and climate benefits of the H2Hubs. Course correction is urgent, and Pennsylvania policymakers have an important role to play in mandating improved practices on the part of H2Hub administrators. The Department of Energy has expressly underscored that it will heavily weigh community engagement and buy-in in future Go/No Go decisions that will determine whether H2Hub projects proceed or not. Proactive and robust community engagement is therefore critical for the success of the Pennsylvania H2Hubs.

Going forward, to promote transparency and foster meaningful community engagement, we recommend the following, non-exhaustive approaches:

1. **Demonstrate beneficial stewardship of public funds:**

As Pennsylvania's H2Hubs projects progress, administrators should publish key components of selected H2Hubs applications, including specific locations of proposed projects, projected community-identified benefits for projects, projected local pollution impacts, emissions impacts, planned hydrogen transport and storage infrastructure, and relative volumes of hydrogen deployment in various end-uses (e.g., disclose the volume of hydrogen being used for heavy duty transportation vs. industrial processes).

Furthermore, under President Biden's Executive Order 14008, the Justice40 initiative mandates that at least 40% of the benefits of certain federal investments must flow to disadvantaged communities (DACs). H2Hubs fall under these investments, and administrators have a responsibility to disclose how the aforementioned components specifically relate to DACs within the project's designated territories. This information can be shared without undermining confidential business information.

2. **Foster meaningful public and community engagement:**

H2Hub administrators should engage in meaningful public engagement, especially during negotiations and phase 1 of the H2Hub rollout over the next 12-18 months.

Robust public engagement is paramount both in H2Hubs governance and decision-making: local community and environmental justice groups must be included in decision-making positions within the H2Hubs governance structure and financial resources for local community and environmental justice groups must be secured to enable such engagement. Additionally, H2Hubs administrators should be required to work with communities to ensure these projects will deliver concrete, community-identified benefits, including good union paying jobs, local air pollution reduction, and other benefits included in transparent Community Benefits Plans (CBPs). ARCH2 administrators have committed to create a Community Benefits Advisory Board to oversee implementation of the CBPs: the Board must include ample representation of community groups who will live in proximity to H2Hub projects.

3. **Embed transparency requirements across the life of the hubs:**

H2Hub administrators must maintain high levels of transparency and information sharing across the life of the hubs. This includes ensuring communities and advocates have access to project information across the lifetime of the projects. In particular, communities and advocates ought to be informed about all potential impacts, both negative and positive, regarding the hub development, and developers must pay critical attention to reporting how those impacts will specifically flow to disadvantaged communities. Transparent information sharing cannot be passive, rather, developers must engage in collaborative, two-way engagement with communities through every stage of information-sharing. This means that beyond simply informing communities, developers must gather input from them throughout the project development process to better understand community concerns and develop ways to address them. These concerns should be tracked and published, so that DOE and advocates may hold developers accountable to addressing them.

We look forward to working with you and other stakeholders on these issues. There is much we need to learn from each other and many important questions which need to be resolved. Thank you for your careful attention to this input and the opportunity to testify.