November 14, 2022

VIA EMAIL: Cleanh2standard@ee.doe.gov

To: Hydrogen & Fuel Cells Technologies Office

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Re: RFI - Clean Hydrogen Production Standard Draft Guidance

In addition to helping the United States decarbonize, the guidance document tells us that, "Hydrogen plays a critical role in a comprehensive energy portfolio for the United States, and the use of hydrogen resources promotes energy security and resilience as well as provides economic value and environmental benefits for diverse applications across multiple sectors in the economy."

The guidance document also cites the Infrastructure Investment and Jobs Act of 2021, also known as the Bipartisan Infrastructure Law (BIL), which requires that the developed standard,

- "support clean hydrogen production from each source described in section 16154(e)(2) of this title" (e.g., including but not limited to fossil fuels with carbon capture, utilization, and sequestration (CCUS); hydrogen-carrier fuels (including ethanol and methanol); renewable energy resources, including biomass; nuclear energy);
- define the term "clean hydrogen" as provided in section 16166(b)(1)(B) to mean hydrogen produced with a carbon intensity equal to or less than 2 kilograms of carbon 1 BIL Section 40311 (Findings; purpose.) 2 42 U.S.C. 16166(a). 2 dioxide-equivalent produced at the site of production per kilogram of hydrogen produced; and"
- "take into consideration technological and economic feasibility."

In summary, DOE is charged with developing a standard with which it will assess and potentially fund proposed hydrogen projects on the basis of their ability to contribute to decarbonization and energy security and resilience, while being environmentally beneficial and technologically and economically feasible. We believe this task should be undertaken with advance recognition that the major competing hydrogen manufacturing technologies – blue hydrogen derived from fossil fuels, principally natural gas; green hydrogen derived from water by means of electrolysis powered by renewable resources; and pink hydrogen derived from water by means of electrolysis powered by nuclear – are not equal in their ability to contribute to these objectives and that that inequality should be taken into consideration as DOE determines which projects it will fund and at what levels.

Recognition and consideration of the relative abilities of the different hydrogen manufacturing technologies to achieve the desired goals will help DOE avoid squandering public funds on projects which either have little potential to compete effectively in the marketplace or which do a comparatively poor job of meeting carbon reduction and environmental goals and, because superior options are available, would detract from rather than contribute to meeting the standard if they were funded. We realize that making such judgments is not an exact science and, for that reason, DOE must cast a reasonably broad net. At the same time, DOE cannot be blind to factors that in some cases almost preordain the failure of projects

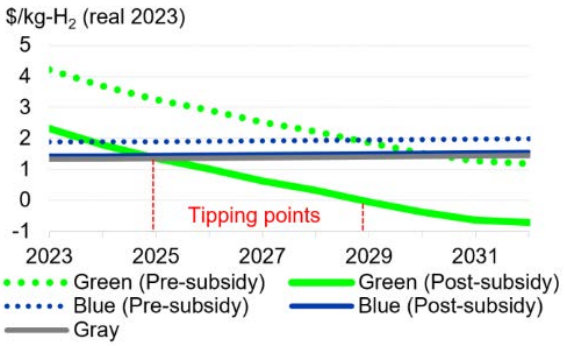
or assure that projects will add to environmental and economic burdens rather than mitigating or reducing them. In the following sections, we describe some of those factors.

Assessing economic value and technological and economic feasibility

Assessing economic and technological feasibility and value of proposals for manufacturing blue hydrogen from methane with the assistance of carbon capture and sequestration technology necessarily requires consideration of the competitiveness of such projects as compared to alternative methods of manufacturing clean hydrogen and a determination of whether such projects are likely to be cost-competitive both during the funding periods set out in the BIL and in the Inflation Reduction Act and beyond.

Multiple analyses suggest that few blue hydrogen projects are likely to be competitive either in the near term or the long term. Even before passage of the Inflation Reduction Act, BNEF[1], Goldman Sachs[2], and other analytic firms' analyses of the unsubsidized levelized cost of hydrogen found that green hydrogen will be lower in cost than blue hydrogen by the end of this decade. And the updated provisions of the 45V tax credit compound the green hydrogen advantage by offering a credit of up to $3/kg while setting criteria that make for a maximum credit of approximately $.75/kg for blue hydrogen[3][4].

Effect of production tax credits on US levelized cost of hydrogen



Source: BloombergNEF. Note: This modeling uses project level assumptions available in BloombergNEF's H2Val model. Green H_2 calculation assumes production tax credit

These figures will vary somewhat regionally, but they set a high bar for proposed blue hydrogen products to clear before they can be considered economically feasible. Economic feasibility is an important criterion to meet lest we experience another episode like past DOE grants for coal carbon capture and sequestration projects, which involved $684 million of funding for eight coal CCS projects of which, according to the Government Accountability Office[5], only one remained in operation beyond the grant period before it was closed because it, like all the others, were economically infeasible.

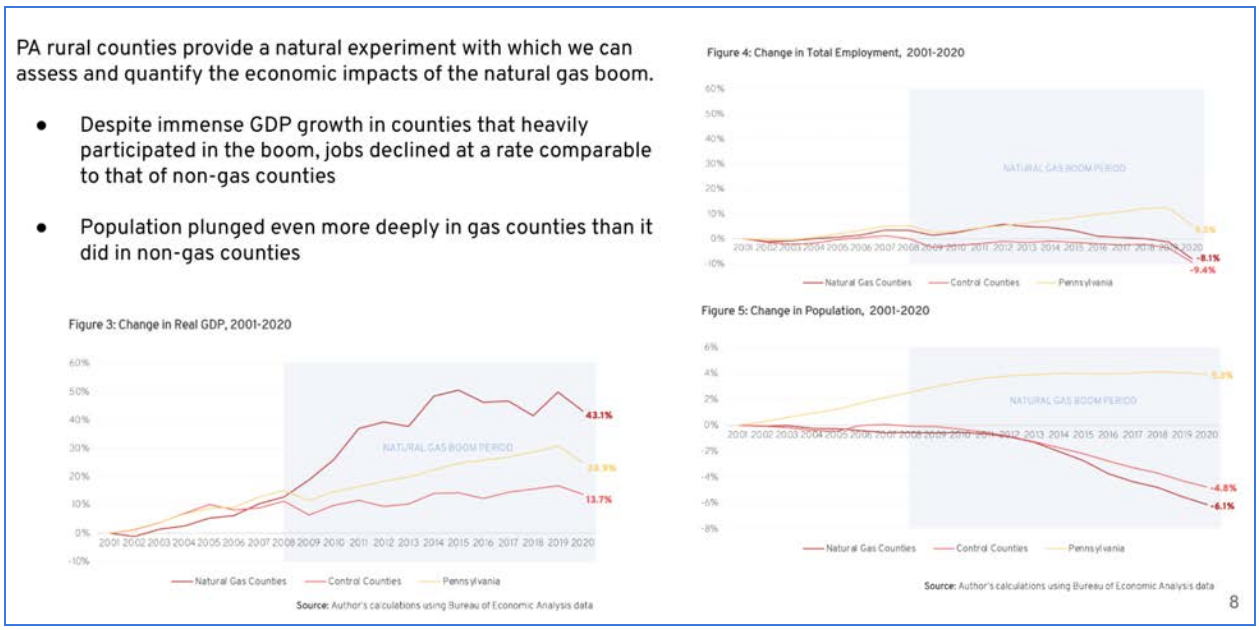
Assessments of economic value also need to take into account the fact that increases in production of hydrogen from methane will necessarily result in increases in natural gas production. For Appalachia and for projects based in our region, that is a drawback, not a benefit.

In February 2021, the Ohio River Valley Institute released an analysis of growth in economic output, jobs, income, and population[6] during the region's natural gas production boom that began in 2008. The

[1] https://about.bnef.com/blog/green-hydrogen-to-outcompete-blue-everywhere-by-2030/
[2]https://www.goldmansachs.com/insights/pages/gs-research/carbonomics-the-clean-hydrogen-revolution/carbonomics-the-clean-hydrogen-revolution.pdf
[3]https://www.hydrogeninsight.com/production/involvement-in-blue-hydrogen-will-negatively-impact-companies-long-term-credit-ratings-moody-s/2-1-1335960
[4]https://www.rechargenews.com/energy-transition/opinion-why-market-dynamics-will-reduce-the-average-price-of-green-hydrogen-to-1-50-kg-by-2030/2-1-1292801
[5] https://www.gao.gov/assets/gao-22-105111.pdf
[6] https://ohiorivervalleyinstitute.org/wp-content/uploads/2021/02/Frackalachia-Report-update-2_12_01.pdf

analysis found that the 22 Ohio, Pennsylvania, and West Virginia counties that produced 90% of all Appalachian natural gas during the boom experienced almost no job growth and suffered an absolute loss in population. In all, the region's shares of American jobs, income, and population all declined. That was despite the fact that the economic output of those counties as measured by Gross Domestic Product (GDP) skyrocketed, demonstrating that the reasons for the failure of the boom to contribute to local economic prosperity are structural in nature.

These results were confirmed a year later in a second analysis of the Appalachian natural gas boom's economic impacts[7] on rural counties in Pennsylvania that are heavy producers. In order to determine whether the economic failures described above were attributable to the natural gas industry or to other factors in local economies, this analysis compared the experiences of those counties with those of rural counties in Pennsylvania that did not participate heavily in the boom. Prior to the boom, both the natural gas counties and the control counties had been on very similar economic trajectories with respect to economic output, jobs, and population. As noted before, the onset of the boom caused immense growth in economic output in the gas counties. The non-gas counties experienced no such spike. However, with respect to jobs and population, the two groups were almost indistinguishable with both experiencing 8-9% declines in jobs and 5-6% losses of population.



In summary, expanded blue hydrogen manufacturing in Appalachia will impose net costs, not benefits, while also tethering our economy to a technology that is likely to be uneconomic and uncompetitive in national and global markets. For those reasons, to the degree that issues of technological and economic feasibility matter in the selection process, funding proposals for projects to manufacture blue hydrogen or that would result in an expansion of natural gas production in Appalachia should be penalized in DOE scoring on the grounds of doubtful economic viability and adverse economic and environmental impacts.

[7] https://ohiorivervalleyinstitute.org/wp-content/uploads/2022/08/Misplaced-Faith-FINAL-1-1-3.pdf

Assessing lifecycle greenhouse gas reductions

The draft guidance points out that, "The CHPS is not a regulatory standard, and DOE may not necessarily require future funded activities to achieve the standard. However, hydrogen hubs funded in support of the BIL will be required to 'demonstrably aid achievement' of the CHPS by mitigating emissions across the supply chain to the greatest extent possible (e.g., by employing high rates of carbon capture, using low-carbon electricity, or mitigating upstream methane emissions)."

This phrasing grants DOE wide discretion in deciding which projects to fund, still the words, "demonstrably aid achievement" have important implications. First, they require actual demonstration – not conjecture, not presumption – that a proposed activity aids achievement of the standard. For proposed projects, that entails development of a rationale for how the project aids achievement of the standard and quantitative criteria with which to measure its success in doing so. And, in the case of blue hydrogen, because its production confers little or no net economic benefit and because there are alternative methods of production that are likely to be less costly and which result in greater emission reductions, enforcement of those criteria should be vigorous. When equally or more effective alternative solutions for meeting the CHPS are available, the public interest is not served by continuing to support projects that fail to meet performance standards.

Given that compliance with performance standards entails additional costs for funding recipients, it's essential that measurement and validation be done by regulatory bodies or their agents who are accountable to the public. We already see gas companies trying to evade existing standards[8]

At the same time, numerous reports[9] [10] [11] [12] have found that the EPA assumed leak rate of 1.4% for methane seriously understates the amount actually being emitted. The authors of one study[13] summarized the situation this way.

"In the United States, official estimates from the US Environmental Protection Agency (EPA) indicate nearly one-third (30%) of anthropogenic CH4 emissions arise from oil and natural gas (O&G) operations. However, a large body of measurement-based studies have consistently found higher O&G CH4 emissions than is estimated in EPA inventories. Alvarez et al. synthesized research on US O&G CH4 emissions in 2015 and found 13 teragrams (1 Tg = 1 million metric tons), 60% higher than the Greenhouse Gas Inventory (GHGI) estimates for 2015 as estimated in 2017; in Reporting Year 2021, EPA lowered estimated 2015 emissions making the difference 70%. Much of this discrepancy has been attributed to the O&G production sector, where measurement-based estimates are ~2× higher than the GHGI, with recent research suggesting substantial underestimation in the GHGI attributed to fugitive emissions from well site equipment and unintentional emissions from liquids storage tanks."

This is all a problem because DOE data show that a leak rate of greater than 2% makes it unlikely and maybe impossible for blue hydrogen to meet the "clean hydrogen" life cycle emission standard of 4 kgCO2e/kg_H2.

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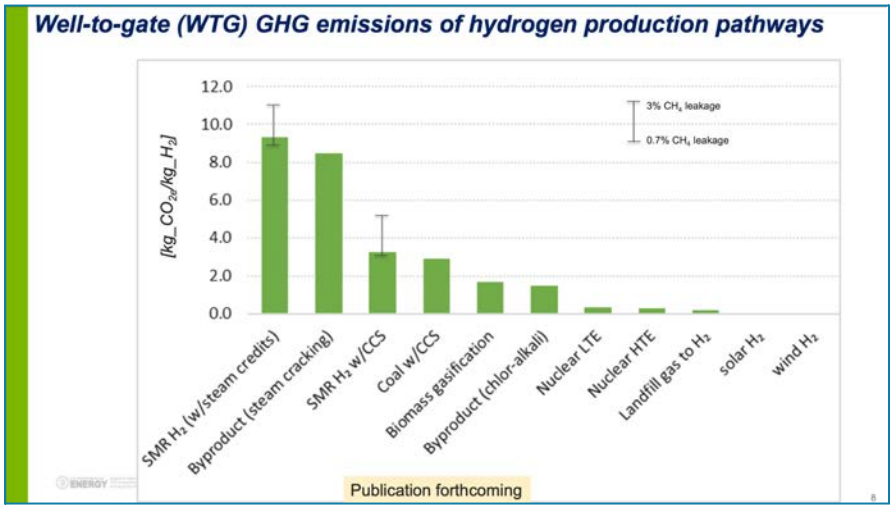
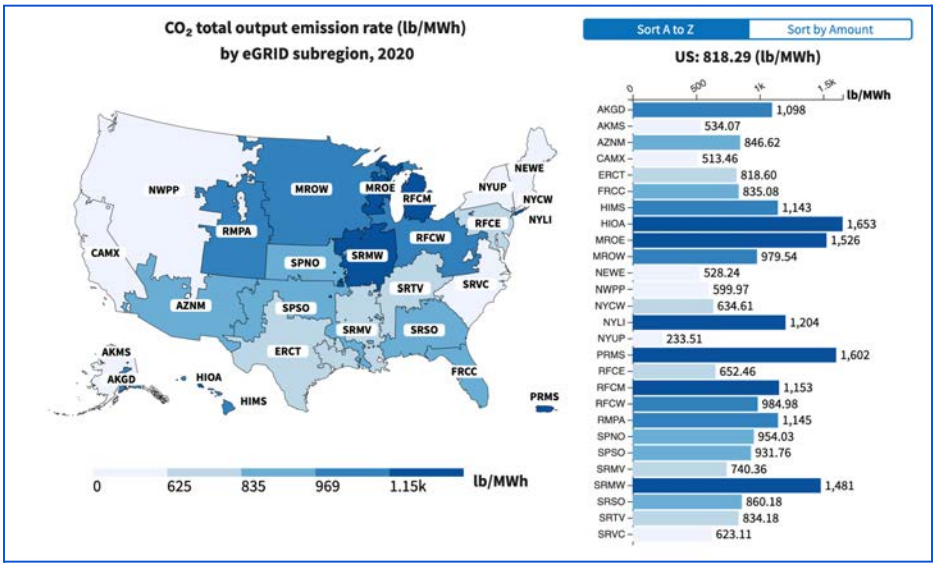
[8]https://finance.yahoo.com/news/methane-loophole-shows-risk-gaming-100032010.html
[9]https://earth.stanford.edu/news/methane-leaks-are-far-worse-estimates-least-new-mexico-theres-hope#gs.x9znt3
[10] https://www.science.org/doi/10.1126/science.aar7204
[11]https://science.house.gov/imo/media/doc/science_committee_majority_staff_report_seeing_ch4_clearly.pdf
[12] https://agupubs.onlinelibrary.wiley.com/doi/10.1029/2020JD034194
[13] https://www.nature.com/articles/s41467-022-29709-3



Another element that should be accurately accounted for in calculating emissions is the electric grid that powers the process. The draft guidance refers to “the U.S. average grid mix” of resources. However, in many regions of the country, local grids are significantly more emissions intensive than the national average. For instance, the grid in the RFCW subregion, which includes western Pennsylvania, Ohio, West Virginia, and Indiana, as well as parts of other states, is 20% more carbon-intensive than the national average. And the RFCM subregion, which includes most of Michigan, is 40% more carbon-intensive.



To not account for regional variations in emissions intensity would reward states including Ohio[14] [15] that adopt policies for the specific purpose of perpetuating fossil fuel use or discouraging renewable energy development despite the fact that doing so results in increased emissions.

[14]https://www.vox.com/energy-and-environment/2019/7/27/8910804/ohio-gop-nuclear-coal-plants-renewables-efficiency-hb6

[15]https://ohiocapitaljournal.com/2022/08/23/nine-ohio-counties-ban-wind-solar-projects-under-new-state-law/

For the same reason, responsibility for variations in upstream emissions should be placed on project developers. While they may have limited ability to control the resource mix of the utilities that serve them, giving them responsibility for upstream emissions will send an essential price and risk signal that will encourage developers to locate proposed facilities in regions where they have access to reliably low-emission grids that do not impose a risk of non-compliance.

Assessing environmental benefits

As when assessing the economic impacts of proposed projects, the proper reference point when assessing the environmental impacts is not the current situation, but rather alternative prospective solutions which may achieve greater reductions in GHG emissions and local pollutants at less cost. While blue hydrogen may reduce GHG emissions relative to gray hydrogen, it increases emissions relative to green hydrogen, which as has been previously pointed out, is essentially free of GHG emissions and is likely to be as inexpensive or less expensive than blue hydrogen by the end of the decade. And, unlike blue hydrogen, green hydrogen's cost-effectiveness will not vary because of fluctuations in global commodity markets and will not be permanently dependent on government subsidies.

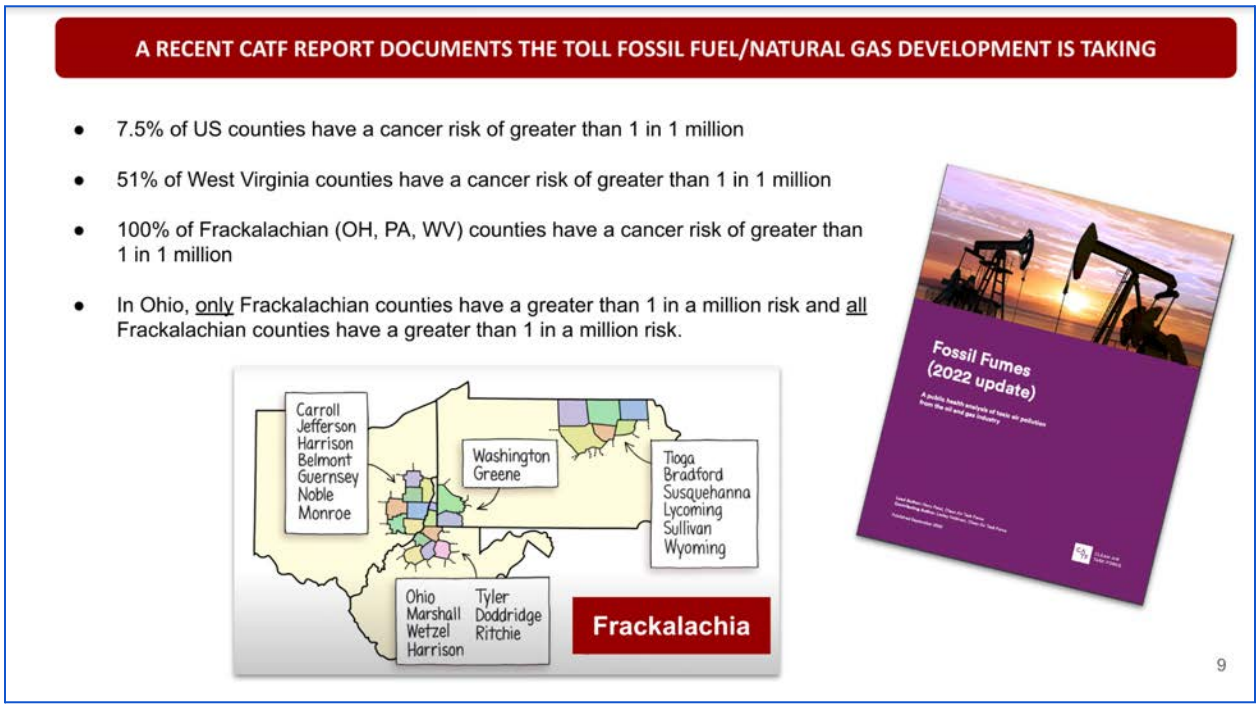
Environmental assessments of proposed projects should also take into consideration life cycle water pollutants and criteria air pollutants. Again, the point of reference when assessing local pollutants should not be existing circumstances, but rather alternative projects or technologies that could produce equal or better outcomes at less cost. Already, residents in regions such as the Ohio River Valley in Appalachia and the Gulf Coast suffer from elevated health risks and premature mortality because of the prevalence of industries that extract, process, and consume fossil fuels.

A 2019 study[16], which appeared in Nature Sustainability, by researchers at Carnegie Mellon University, Princeton University, and Stanford University, found that the combined impacts of climate pollution and criteria pollutants would require an estimated tax of $2 per thousand cubic feet (mcf) on the production of natural gas to compensate for their effects. That figure should be added to the cost of blue hydrogen when assessing costs and economic feasibility as compared to green hydrogen.

The use of renewable energy credits (RECs) and offsets should be forbidden

As described above, the greater Ohio Valley and other regions of the country whose oil and natural gas resources make them likely candidates for designation as blue hydrogen hubs are already among those that are most heavily afflicted by job loss, population loss, and elevated risks of disease and death associated with toxic emissions. The severity of the problem is illustrated in a recent Clean Air Task Force report[17], which documents the increased risk of cancer in Appalachian counties where natural gas production is most heavily concentrated.

[16] https://www.cmu.edu/tepper/news/stories/2019/december/nicholas-muller-research-shale-gas.html
[17] https://cdn.catf.us/wp-content/uploads/2016/06/14175846/fossil-fumes-report-2022.pdf



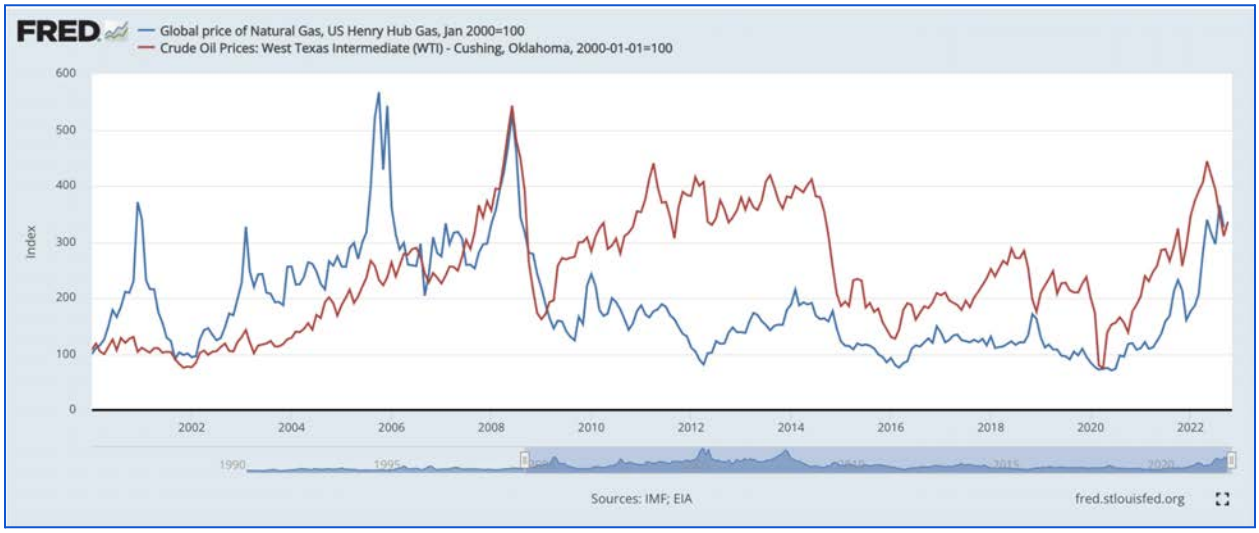
Because the greater Ohio River Valley, made up of eastern Ohio, western Pennsylvania, and West Virginia, is not at present a hydrogen producing region, any introduction of blue hydrogen production will result in increased emissions of greenhouse gasses and criteria pollutants from both the manufacturing process and from upstream processes associated with natural gas extraction, processing, and transportation. That increase would be compounded by allowing blue hydrogen manufacturers to use RECs or offsets, either partially or entirely, to meet the clean hydrogen standard.

DOE should not be in the business of increasing climate and air pollution emanating from our region or making the greater Ohio River Valley and Appalachia more of a “sacrifice zone” than it already is. To that end, DOE should not allow RECs and offsets to be used to meet the clean hydrogen standard. And, if DOE ultimately does allow that practice, as part of its evaluation of proposed projects, DOE should quantitatively assess and make public the degree to which projects will increase climate and criteria pollutants and the corresponding increase in pollutants that will be inflicted on local communities.

Assessing energy security and resilience

The best way to achieve energy resilience and assure that we have sufficient supplies of any fuel is to require as little of it as possible. Hydrogen produced from natural gas and other fossil fuels competes with the energy system for its feedstock. Because that feedstock is traded on global commodity markets, it is subject to price fluctuations caused by weather, geopolitical conflicts, and the actions of state-controlled oil and gas companies in non-democratic, authoritarian countries. We are currently paying a steep financial price for that vulnerability as a war in Europe and the Organization of Petroleum Exporting Countries cartel combine to restrict supplies and drive up costs.

It’s not as though that price and supply volatility can be depended upon to recede once current conflicts are resolved because, as the history of oil and gas in this century shows, price volatility is endemic.



Nor can America's vulnerability to price volatility be reduced by increased domestic production. Because American suppliers participate in global commodity markets, the prices they charge both abroad and in the United States are heavily influenced by global events. The only way to reduce Americans' vulnerability to these risks is to reduce our reliance on fossil fuel resources. However, increasing production of hydrogen from natural gas does exactly the opposite. It increases demand for natural gas and, therefore, our susceptibility to the same forces that are driving up prices for gasoline, heating oil, and electricity.

At the same time, hydrogen can be produced from another resource, water, which is more abundant, less expensive, and which is not traded in global markets, making cost more stable and supply more reliable. If expansion of the hydrogen economy follows the dictates of economic efficiency and feasibility, the U.S. has a more than adequate supply of water to meet its hydrogen needs from now through 2050.

In summary, increased demand for blue hydrogen would increase both prices and volatility. And it would do so without any likely growth in jobs since the oil and gas industry is the economy's least labor-intensive major industry. Meanwhile, green hydrogen and the resources that support it are far better for the environment, they would produce greater emission reductions, and they are more labor-intensive than fossil fuels, meaning that they are more likely to deliver job growth and prosperity in local economies.

Recommendations

As the RFI states, ". . . the statute requires DOE to set a CHPS accounting for Congress's definition of "clean hydrogen" noted above, while also ensuring support for hydrogen production from diverse lowcarbon energy sources, and consideration of technological and economic feasibility." Elsewhere the RFI cites the importance of promoting energy security and resilience as well as providing "economic value and environmental benefits for diverse applications across multiple sectors in the economy."

These qualities – technological feasibility, economic feasibility, energy security and resilience, economic value, and environmental benefits – are criteria that should be rigorously applied to every application for funding. Technological feasibility requires that applicants be able to meet or directly contribute to the achievement of the quantitative standard set forth in the legislation. Applicants should be fully responsible for emissions resulting from both their operations and those of upstream suppliers who are freely chosen and, therefore, within the control of the applicants. Also, because of serious questions about the accuracy

of existing estimates of fugitive methane emissions and because of the oil and gas industry's well-documented history of trying to evade regulation, monitoring and measurement of emissions should be performed by a public entity or agent that is in no way beholden to the oil and gas industry.

The economic feasibility criterion should require applicants to demonstrate the possible and preferably probable competitive superiority of their proposed product in an unsubsidized environment over that of competing technologies. And, when assessing economic competitiveness DOE should take fully into account the externalized costs resulting from emissions of both greenhouse gasses and criteria pollutants that the proposed project will inflict as compared to those of competing technologies.

A fair application of the energy security and resilience criterion requires that DOE recognize and consider the threat that continued or increased dependence on fossil fuel resources does to the economy. New markets for natural gas detract from security and resilience by putting upward pressure on prices and increasing vulnerability to global commodity market fluctuations. These risks can and should be quantified and, to the degree that proposed projects increase them, applicants should be expected to demonstrate offsetting benefits that make the assumption of greater insecurity and vulnerability worthwhile.

In assessing the economic and environmental benefits of proposed projects, particularly those from Appalachia in which natural gas and/or coal may play a significant role, DOE should consider the unvarnished facts about the economic impact the shale gas boom has had on the region. As the data show, natural gas expansion has at best had no positive impact on job and population growth and is rapidly trending toward having negative impacts. Indeed as the natural gas boom matures, whatever small growth in jobs it initially provided diminish, which is why Pennsylvania's rural natural gas counties have experienced job losses every year for the last nine years despite continued industry expansion.

Because of the economic, environmental, and health toll that the introduction of blue hydrogen manufacturing would have on regions where hydrogen production has not previously been a major industry and because of the added pollution from upstream industries it would inflict on natural gas-producing regions such as the Ohio River Valley, which already suffer disproportionately from adverse health impacts, DOE should not allow manufacturers to meet the clean the hydrogen standard by means of renewable energy credits or offsets because doing so would only compound the economic and environmental injustices already being done.

We accept that the hydrogen economy must expand in order for the United States to minimizing climate change impacts. However, the latest and best research suggests that expanded need can be met at the least cost, with the fewest environmental impacts, and with the best economic outcomes by green hydrogen. We realize that is a proposition that the legislation requires DOE to test. However, that requirement shouldn't and doesn't mean that DOE must wear a blindfold with respect to facts when it creates criteria and evaluates regions for designation as hydrogen hubs and projects for funding.

We ask that DOE acknowledge these facts, incorporate them into its evaluations, and that these considerations be reflected in the number and the value of the awards that DOE eventually makes.

Thank you.
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