The Industry Agenda: Hydrogen

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Executive Summary

This Hydrogen Industry Agenda Report examines the influence agenda of the rapidly growing "clean" hydrogen industry, which is poised to receive tens of billions of dollars of funding and tax credits from the federal government over the next several years. The report outlines the executive branch departments, personnel, and policy fights that hydrogen industry stakeholders are most determined to influence, and points out the climate consequences of the lax standards that many industry players are lobbying for.

The report begins with an **introduction** explaining how hydrogen gas is produced and used, with varying greenhouse gas footprints and climate impacts. After exploring the many types and applications of hydrogen, we conclude that the only niche for hydrogen in true decarbonization would be for green hydrogen produced through electrolysis of water, powered by additional renewable energy sources, for use in fuel cells to generate electricity, or as a feedstock to decarbonize certain industrial processes. Every other pathway involves the continued combustion of fossil fuels and results in further greenhouse gas pollution. Further sections of this report outline additional risks of hydrogen infrastructure build-out including hazards from pipeline leaks, water depletion, and increased air pollution.

Section 2 explores how corporations are working to influence regulation of the hydrogen industry. This section outlines the **upstream, midstream, and downstream players** involved in the hydrogen economy, including chemical companies like Air Products Inc, pipeline operators like TC Energy, and fossil fuel companies like BP. This section also identifies the major **industry influence groups** working to influence executive agencies tasked with regulating hydrogen infrastructure, crafting hydrogen tax incentives, and distributing federal funding.

Section 3 outlines the policy issues that hydrogen industry players are working to influence, with particular attention to the **tens of billions of dollars** in "clean" hydrogen subsidies and tax credits available under the Biden administration's landmark pieces of legislation: the Infrastructure Investment and Jobs Act of 2021, and the Inflation Reduction Act of 2022. There are **several hot-button issues** involved in how executive branch agencies will implement these laws which industry groups are striving to influence. Chief among these are how strict federal standards will be for what constitutes clean hydrogen in terms of its lifecycle greenhouse gas emissions. Other issues include whether and how the administration will ensure accurate emissions accounting—with potential safeguards including time-matching, deliverability, and additionality—and how U.S. standards will align with EU standards, potentially propelling a race to the top or to the bottom in terms of how clean the global hydrogen economy really becomes.

Section 3 also delves into some of the **most harmful applications of hydrogen** being supported by the Biden administration, including extending the life of gas-fired power plants through blending hydrogen with methane, and propelling the build-out of risky and under-regulated hydrogen and carbon pipelines. This section also points out that hydrogen production consumes large amounts of water, while several companies are vying to build

hydrogen hubs with federal funding in severely water-stressed areas of the American southwest.

Section 4 identifies which executive branch departments and agencies hydrogen industry stakeholders are seeking to influence, and how these agencies are involved in regulating and supporting the hydrogen industry. As the administration doles out billions in funding for "clean" hydrogen build-out, crucial regulatory gaps remain, putting communities and ecosystems exposed to hydrogen infrastructure at risk. Relevant agencies include the Pipeline and Hazardous Materials Safety Administration (PHMSA), the Federal Energy Regulatory Commission (FERC), the Energy Department (DOE), the Environmental Protection Agency (EPA), the Occupational Safety and Health Administration (OSHA), and Treasury.

Section 5 identifies current personnel within these federal agencies who are advocates for hydrogen industry expansion. High-level personnel at several offices within the DOE have previously worked for companies with stakes in the hydrogen economy. Relevant DOE figures include Under Secretary for Infrastructure David Crane, whose career spans investment banking, the gas industry, and a term as CEO of a power generation developer investing in hydrogen production; and DOE Hydrogen and Fuel Cell Technologies Office Director Sunita Satyapal, who has spent her career researching and advocating for hydrogen technology, most recently as the co-Chair of the International Partnership for Hydrogen and Fuel Cells in the Economy. Other individuals within PHMSA and FERC leadership, including PHMSA's Associate Administrator for Pipeline Safety Alan K. Mayberry, are tied to the gas and pipeline industries. Rahm Emanuel, U.S. Ambassador to Japan, is also a high-profile figure advocating for the international expansion of the hydrogen economy.

Section 6 outlines the kinds of work experience that should raise questions about nominees to federal agency leadership positions and their sympathies with the hydrogen industry, and **Section 7** suggests questions that nominees should be required to answer before being appointed to positions in which they will have the power to regulate the hydrogen industry.

While hydrogen is widely touted by industry as a "clean energy source for the future," it is neither an energy source (see "**What is Hydrogen?**") nor necessarily clean. As this report explains, hydrogen's reputation as a renewable energy "source" is misleading: hydrogen is only as emissions-free as the way in which it is produced, and the process in which it is put to use. Today, most hydrogen production and utilization results in significant quantities of greenhouse gas pollution.

The significant overlap between the hydrogen industry and the fossil fuel industry—involving not only many of the same corporations, but also shared lobbying groups and greenwashing tactics—is particularly troubling given how much money the Biden administration is pouring into hydrogen as a cornerstone of its climate strategy. As long as a role for fossil fuels is preserved in the hydrogen economy, hydrogen will not be "clean," and its narrow potential role in true system-wide decarbonization will be overshadowed by the profit-seeking excesses of major industry players seeking federal funds without federal safeguards.

RDP's Industry Agenda series explores how different industries seek to influence executive personnel and policy decisions.

Introduction

What is Hydrogen?

Hydrogen is the lightest and most abundant element in the universe, but hydrogen gas doesn't exist freely in nature; it is always found in combination with other elements. Energy inputs are necessary to get hydrogen into a usable form, making it, rather than an energy source, an energy carrier: a substance that can store and transfer energy that was technologically produced from another source. (Batteries are also energy carriers.)

It takes more energy to produce hydrogen in a usable form than hydrogen provides as an energy source. But hydrogen has specific properties that make it useful in some niche applications. One is that hydrogen has the highest energy content per unit of weight of any element, though it has the lowest energy content by unit of volume. Being lightweight to store makes hydrogen theoretically appealing for aviation, but as the Hindenburg demonstrated, it's highly explosive, and proves challenging to store. In the context of a decarbonized energy grid, hydrogen fuel cells are talked about as a long-term storage option, similar to batteries, to kick in when renewables are offline.

Hydrogen can also be useful in decarbonizing certain industrial processes ranging from iron refining to polymer production, which already use major quantities of hydrogen as inputs. Today, the vast majority of hydrogen gas is produced via fossil fuels for various industrial uses like ammonia production, petroleum refining, methanol production, and steel production. While policy attention has historically been focused on hydrogen in transportation, global demand for hydrogen has long been dominated by the refining and ammonia production sectors.

Hydrogen's reputation as a renewable energy "source" is misleading: hydrogen is only as emissions-free as the way in which it is produced, and the process in which it is put to use. Today, most hydrogen production and utilization results in significant quantities of greenhouse gas pollution. Additionally, hydrogen has over 32 times the global warming potential of carbon dioxide over a 20-year period, so any hydrogen leaks erode the greenhouse gas reductions of switching from fossil fuels to hydrogen.

How is Hydrogen Produced?

Hydrogen production is often distinguished through a color-coded system, but typical color associations don't really apply. ("Blue" hydrogen, for instance, has nothing to do with water.) The four main types of hydrogen production are coded gray, brown/black, blue, and green.

Gray Hydrogen makes up approximately 76 percent of hydrogen produced globally and 95 percent of hydrogen produced in the United States. Gray hydrogen is typically produced through steam-methane reforming, in which methane gas is reacted with superheated steam (water heated to temperatures of over 1,500 degrees F) to produce hydrogen gas and carbon monoxide. Subsequently the carbon monoxide is reacted again with water to form additional hydrogen gas, as well as carbon dioxide. The hydrogen gas is utilized, and the carbon dioxide is released into the atmosphere. This is an energy-intensive and polluting process which, in relying on natural gas, yields greenhouse gas emissions that perpetuate the climate crisis. It is currently the cheapest and most common way of producing hydrogen gas.

Brown or Black Hydrogen is produced through the gasification of brown (lignite) or black (bituminous) coal. Under high pressure and heat, coal reacts with air and steam or water to produce hydrogen gas along with carbon monoxide, carbon dioxide, and other byproducts. Approximately 22 percent of hydrogen produced globally comes from coal gasification. This is a highly polluting process due to the mining of coal and the carbon pollutants released during its gasification.

Blue Hydrogen is produced through the same processes of producing gray, brown, or black hydrogen explained above—that is, producing hydrogen via methane or coal—with the additional use of carbon capture, utilization and storage (CCUS) technology. It has been embraced by the fossil fuel industry because it preserves a role for methane gas production while appearing to be a "low carbon" solution. Yet the technology is neither proven at scale, nor affordable, nor even particularly low emitting. A 2021 study of the lifecycle greenhouse gas emissions of blue hydrogen found 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,"** and that "total carbon dioxide equivalent emissions for blue hydrogen are only 9%-12% less than for gray hydrogen. While carbon dioxide emissions are lower, 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."

Green Hydrogen is the only main type of hydrogen production that does not *necessarily* involve fossil fuels or create greenhouse gas pollution as a byproduct. It does, however, require large quantities of water. "Green" hydrogen is produced through the electrolysis of water, by which electricity generated by renewable energy sources like solar or wind is used to separate hydrogen from oxygen. Green hydrogen makes up less than one percent of global hydrogen production today. It is currently significantly more expensive than producing hydrogen from fossil fuels through steam-methane reforming or coal gasification. Note that **if hydrogen is produced through electrolysis *powered by non-renewable energy sources,* it has a major greenhouse gas emissions footprint, more than twice as high as that of gray hydrogen.** This is in part because green hydrogen is energy intensive to make, while incurring significant energy losses. According to the International Renewable Energy Agency, "About 30-35% of the energy used to produce hydrogen through electrolysis is lost."

Thus, all hydrogen produced by electrolysis is not, in fact, “green.” Without major safeguards ensuring that the electrolysis is powered solely by new renewable energy (see our “additionality” section on page 15 for further complexities) while utilizing sustainable water sources (like potentially wastewater), which is a bar higher than most hydrogen companies are willing to clear, “green” hydrogen production results in greenhouse gas emissions and strains water resources.

The hydrogen production methods outlined above are the main methods, but there are other rare and/or currently hypothetical production methods within the “hydrogen rainbow.” One of them is **pink hydrogen**, which is hydrogen made through electrolysis (as outlined above in the green hydrogen section) powered by nuclear energy. Thus there are some nuclear industry players invested in the hydrogen industry, including the Nuclear Energy Institute. As of 2021, there were about a dozen demonstration projects planned for powering hydrogen production with nuclear power, most of which haven’t been realized. In May 2023, the DOE announced funding for two new pink hydrogen projects led by General Electric and Westinghouse Electric Company, LLC. DOE has previously funded several other projects exploring hydrogen production powered by nuclear energy.

How is Hydrogen Used?

Hydrogen runs the gamut in terms of the degree of ecological harm involved in its production. In its uses, too, there is quite a range of climate impact. Hydrogen’s primary current uses are as a feedstock in industrial processes and as a fuel. The DOE has identified existing and emerging demands for hydrogen in the areas of industrial feedstocks production, transportation, power generation and energy storage, and for blending with natural gas for use in for residential heating and in power plants. Within energy systems, the two main applications of hydrogen gas are in fuel cells and power plants.

Fuel cells, which are electrochemical cells, work similarly to batteries, but produce electricity from the chemical energy of hydrogen. (Because hydrogen doesn’t exist freely in nature, the hydrogen used to generate electricity in fuel cells must be produced in a prior process.) Fuel cell applications include powering electric vehicles and providing heat and electricity to buildings. A 2015 net energy analysis of hydrogen fuel cells compared to renewable energy -powered lithium ion batteries found that lithium ion batteries have much higher round-trip energy efficiency (a measure of how much energy is put into a system versus how much energy the system dispatches) than hydrogen fuel cells, and emphasized the need for “improved electrolyzer and fuel cell performance.” Hydrogen fuel cells have a round-trip efficiency of about 30 percent, compared with lithium-ion batteries’ round-trip efficiency of over 90 percent.

Hydrogen fuel cells do not emit greenhouse gasses, only warm air and water vapor. But there are significant challenges to scaling them up. The high cost of manufacturing fuel cells is one of the barriers to their increased deployment. According to the DOE, “Unlike a battery, where most of the cost comes from the raw materials used to make it, the most expensive part of a fuel cell

is manufacturing the fuel cell stack itself—not the materials to produce it." Fuel cell stacks are complex systems made up of potentially hundreds of fuel cells. High density storage of hydrogen also presents a challenge for mobile uses in vehicles, as hydrogen is less energy-dense than gasoline.

The other use of hydrogen in energy systems is for combustion in existing gas plants, most often mixing hydrogen with natural gas—commonly called "co-firing." Though touted as lower in carbon emissions than just burning natural gas, that claim should be viewed with skepticism: the combustion of hydrogen produces nitrogen oxides (NOx), a criteria air pollutant known to be harmful to the human respiratory system. As *E&E News* has reported, "Even projects that use renewables to create the fuel, [climate activists] argue, could have a local environmental impact, since hydrogen emits NOx when burned directly—as would be the case if it were blended into a natural gas pipeline." Given that the hydrogen blended with methane is likely to have been produced through a process that burned natural gas, which releases planet-warming methane into the atmosphere, there's even less reason to assume that blending hydrogen with natural gas for combustion reduces overall greenhouse gas emissions.

The only niche for hydrogen in true decarbonization would be for green hydrogen produced through electrolysis of water, powered by renewable energy sources, for use in fuel cells to generate electricity, or as a feedstock to decarbonize certain industrial processes. These are targeted applications with high development costs, but they are also the only emissions-free pathways for hydrogen use under mainstream consideration today. Every other use of hydrogen gas as an energy source necessitates the continued combustion of fossil fuels and results in further greenhouse gas pollution.

The Biden administration is tremendously bullish on clean hydrogen. The Department of Energy asserts that "if clean hydrogen is scaled globally, the hydrogen industry has projected the potential for $2.5 trillion in annual revenues and 30 million jobs globally, along with 20 percent global emissions reductions by 2050." But which methods of hydrogen production are considered "clean" by the government?

According to the DOE, "Several technologies can produce clean hydrogen, including electrolyzers powered by the Nation's growing share of clean energy, methane reformation with carbon capture and storage, gasification, or thermal conversion of biomass and/or solid wastes with carbon capture and storage, and many other emerging technologies." Most of these production methods would be a boon to companies that burn gas, coal, and organic matter, and necessitate hundreds of miles of new pipelines for transporting captured carbon.

Baking in a reliance on carbon capture and storage, instead of preventing emissions altogether, is yet another lifeline sought by the fossil fuel industry in what Food and Water Watch calls "the fossil fuel industry's biggest scheme yet to persuade people that the climate crisis can be solved while still depending on what they're selling." Food and Water Watch outlines several reasons why the hype around carbon capture and storage is misleading, including that the government has already spent billions on it over decades without any real success stories; that carbon

capture is so energy-intensive its use has caused far more emissions than it has prevented; and that continued investment in carbon capture extends the lifespan of fossil fuel infrastructure without tangibly cutting its emissions. All the while, investment in carbon capture dilutes investment in renewable energy, a phenomenon called "mitigation deterrence."

How is corporate influence involved?

Many of the biggest players in the hydrogen industry work at all stages of hydrogen production, transportation and utilization. Others are more specialized to one segment of the hydrogen supply chain. What they have in common is a desire to influence federal policy and regulation in their favor.

Upstream, Midstream, and Downstream Players

The upstream hydrogen market includes companies involved in the production of hydrogen through steam-methane reforming, electrolysis, gasification, and other methods. Upstream companies include manufacturers of electrolyzers and other components and subsystems involved in hydrogen production. Companies involved in upstream hydrogen operations include electrolyzer developer Ohmium, as well as fossil fuel companies Shell, Chevron, and ExxonMobil, and chemical companies Air Products Inc and Linde plc.

The midstream hydrogen market includes companies involved in the storage and transportation of hydrogen by pipeline, tanker, truck, and rail. Midstream companies include pipeline companies and other existing transportation infrastructure companies that work within the umbrella of the gas industry. Carbon capture and storage tax incentives are relevant to midstream operators, as pipeline companies can capitalize upon the Biden administration's support for CO2 pipeline build-out to transport captured carbon, including from "blue" hydrogen production. Companies involved in midstream hydrogen operations include Humble Midstream, Moda Midstream, LLC, Pinon Midstream, and pipeline operator TC Energy (known for building the Keystone Pipeline).

The downstream hydrogen market includes companies that utilize hydrogen in various industries, including for agricultural applications, in the transportation sector, in petroleum refining, and in gas-burning power plants. It also includes companies that manufacture fuel cells and hydrogen combustion engines. Petroleum refineries use large amounts of hydrogen in the desulfurization of crude oil to make diesel and other fossil fuels. Downstream companies include fuel cell developer Plug Power Inc, hydrogen combustion engine developer Cummins Inc., fossil fuel companies like BP, utilities like Entergy, NextEra Energy and National Grid, and fertilizer companies like Nutrien.

Corporations invested in the upstream and downstream sectors of the emerging hydrogen industry have lobbied to influence recent legislation related to transportation infrastructure, fuel and energy infrastructure, tax credits for hydrogen production, and defining clean energy, among other areas. Prominent examples from 2021-2023 include:

- H.R. 5376 - Inflation Reduction Act (now Public Law 117-169)
- H.R. 3684 - Infrastructure Investment and Jobs Act (now Public Law 117-58)
- S. 2188 - Clean Energy for America Act
- H.R. 848 - Growing Renewable Energy and Efficiency Now (GREEN) Act
- H.R. 5965 - Clean Hydrogen Deployment Act of 2021
- H.R. 1684, S. 627 - Energy Storage Tax Incentive and Deployment Act
- S. 2291, H.R. 4024 - Zero-Emission Nuclear Power Production Credit Act
- S. 1016 - Electric Power Infrastructure Improvement Act

Industry Influence Groups

The member pages of major hydrogen industry coalitions reveal that fossil fuel interests are largely inextricable from groups advancing "clean" hydrogen.

The **Fuel Cell & Hydrogen Energy Association**'s principal members include Air Liquide, Air Products, Amazon, Anglo American, Constellation, ExxonMobil, General Motors, Honda, Orsted, Southern Company, and Toyota. The organization has been lobbying hard for weaker hydrogen regulation from Treasury, publishing full-page ads in *The New York Times* and sponsoring the Punchbowl News' newsletter with the message that "if U.S. regulators require additionality for the hydrogen production tax credit, our clean hydrogen future could be stopped before it's even started." See our section on additionality on page 15 for context on that line of industry argument. (See also David Dayen in *The American Prospect* on "Amazon's Quiet Role in the Green Hydrogen Debate.")

The **Clean Hydrogen Future Coalition** (CHFC) includes a long roster of fossil fuel companies, with BP, ExxonMobil, Southern Company, Equinor, Shell, AGA, One Gas, Chevron, Sempre, and other oil and gas companies on its board. The Tennessee Valley Authority, a federally owned utility company notoriously involved with fossil fuel interests, is also a CHFC board member. CHFC has opposed "overly restrictive policies too early in the process," coming out against additionality requirements and strict time-matching requirements. (See our sections on time-matching and additionality on pages 14-15 for context.)

The **Green Hydrogen Coalition** (GHC), which identifies itself as "the only 501(c)3 non-profit dedicated to deploying green hydrogen at scale for multi-sectoral decarbonization," is not as dominated by major oil and gas companies as the Clean Hydrogen Future Coalition, but has many gas utilities among its sponsors. The GHC says it "advocates for relaxed, introductory standards that only last a prescribed period of time – no later than 2030," and for a

"technology-agnostic" approach that "is inclusive of all production types," including hydrogen production via gas, coal, and biomass.

There's also **Hydrogen Forward**, a coalition formed in 2021 by eleven major companies: Air Liquide, Anglo American, Bloom Energy, CF Industries, Chart Industries, Cummins Inc., Hyundai, Linde, McDermott, Shell and Toyota. Unsurprisingly, Hydrogen Forward wants the DOE to "accelerate the growth" of the hydrogen industry by establishing a "technology-neutral framework" that allows "every region in the U.S. to use locally available resources, whether it's renewables, fossil fuels with carbon capture, nuclear, or biomass or other primary energy sources and production methods, to produce clean hydrogen," while allowing a wide-range of market mechanisms for calculating and offsetting emissions. In other words, they want lax rules and lax accounting.

On the regional scale, there's the Pacific Northwest-based policy advocacy trade association **Renewable Hydrogen Alliance**, whose members include gas utilities, local transit authorities, private sector companies, tribal officials, law firms, and labor associations. Though the Renewable Hydrogen Alliance claims to advocate for "climate-neutral fuels," it has urged the Department of Energy not to consider hydrogen leakage rates in the analysis of hydrogen's lifecycle emissions, and not to consider the carbon intensity of how the hydrogen, once produced, is utilized.

Various gas industry associations are also invested in the future of the hydrogen industry. Gas industry groups who have commented on agencies' proposed hydrogen rulemakings include the American Gas Association, the American Public Gas Association, the Interstate Natural Gas Association of America, the Coalition for Renewable Natural Gas, the American Biogas Council, and the Alternative Fuels & Chemicals Coalition.

The **American Gas Association** (AGA) stands out as particularly aggressive among the many fossil fuel trade associations with obstructionist lobbying agendas on climate policy. The AGA wants Treasury's hydrogen guidance to help its member companies "significantly scale up the use of low-carbon gas resources," and wants the federal government to "expand investment" in "advanced gas technologies, mitigation technologies, natural gas distributed generation, renewable natural gas sources, renewable hydrogen or methanated renewable hydrogen for use in the gas system, carbon capture utilization and sequestration, and other technologies." Along with several fossil fuel companies, the AGA backed the **Clean Hydrogen Future Coalition** from its founding in 2021.

The top recipient of AGA PAC funds in 2022 was House Transportation and Infrastructure Chair Sam Graves (R-MO), who has also received donations from many of the other industry groups listed here. Graves oversees hearings on issues related to vehicle standards, pipeline safety standards, and other issues closely tied to areas of policymaking and industry interest related to hydrogen.

Aviation industry organizations are also invested in hydrogen as an aviation fuel, including the **SAF BTC Coalition**, which is an informal coalition of dozens of airlines and aviation associations, including Airlines for America, the Advanced Biofuels Association, the National Air Transportation Association, the National Business Aviation Association, the General Aviation Manufacturers Association, and others. The coalition takes its name from the Sustainable Aviation Fuel Blender's Tax Credit included in the IRA and effective January 2023.

What are the executive branch issues the hydrogen industry cares about?

Distribution of Federal Money

The Infrastructure Investment And Jobs Act of 2021 includes a whopping $9.5 billion for hydrogen initiatives, including $8 billion for Regional Clean Hydrogen Hubs, $1 billion for a Clean Hydrogen Electrolysis Program, and $500 million for Clean Hydrogen Manufacturing and Recycling Initiatives. The DOE received 79 initial applications for Regional Clean Hydrogen Hubs in 2022, and encouraged 33 of those applicants to submit full applications by spring 2023. Resources for the Future maintains a Hydrogen Hub Explorer documenting the 27 projects vying for federal money that made public announcements of their intent. The final selection of Hydrogen Hub applicants is expected in fall 2023.

The Inflation Reduction Act of 2022 offers a production tax credit for clean hydrogen known as the "45V" tax credit. The tax credit isn't capped and could offer more than $100 billion in incentives over the credit's lifetime. Tax credits are offered on a sliding scale relevant to a project's lifecycle greenhouse gas emissions rate. Fossil fuel companies spent millions of dollars lobbying in support of hydrogen tax credits in the months leading up to the IRA's passage.

The government's definition of "clean" hydrogen is hydrogen produced through a process that results in a lifecycle greenhouse gas emissions rate of not greater than four kilograms of CO2e per kilogram of hydrogen produced. This emissions threshold for qualifying as "clean" hydrogen allows for quite a bit of pollution; environmental advocacy groups including the Center for Biological Diversity and Earthjustice pushed DOE to establish a threshold of only one kg of pollution allowable per one kg of hydrogen produced, but DOE went with the lenient threshold that "received wide support" in stakeholder comments.

Treasury is currently working on contentious guidance for how to implement the tax credit, including how companies will be expected to calculate hydrogen's lifecycle emissions. Along with the IRA's production tax credit, the IRA also offers an investment tax credit under section 48C that manufacturers of clean hydrogen production equipment and technologies like electrolyzers can access. Treasury's guidance has been delayed beyond its August 2023 deadline and is expected in October 2023 at the earliest.

The Department of Energy's Alternative Fuels Data Center maintains a list of all Federal laws and incentives related to hydrogen. There are over 30 laws and incentives listed. The majority of them pertain to fuel cell electric vehicles and transportation infrastructure.

Current Fights

Lifecycle Emissions Assessments Under the Clean Hydrogen Production Standard

While Treasury continues to work on developing its guidance for Section 45V of the IRA, the Department of Energy began the process a year prior for developing its guidance on how to evaluate hydrogen's emissions intensity to meet its Clean Hydrogen Production Standard (CHPS), as required by the Infrastructure Investment and Jobs Act of 2021 (IIJA). DOE released its draft guidance in fall 2022, and its finalized guidance in June 2023.

DOE's CHPS standard is a voluntary, not a regulatory standard; it applies to the hydrogen hubs funded by the IIJA, but not necessarily beyond them. DOE is allowed by law to select projects that do not meet the CHPS, "so long as DOE selects projects that 'demonstrably aid the achievement' of the CHPS by mitigating emissions as much as possible across the supply chain."

The CHPS guidance establishes an initial target for clean hydrogen production as having lifecycle greenhouse gas emissions of 4 kg or less of CO2 equivalent per kg of hydrogen produced. (As noted above, this is a lenient pollution standard.) In this context, "lifecycle" emissions for hydrogen are defined as "well-to-gate," which is **only through the point of production, not the utilization of hydrogen.** In other words, this standard doesn't take into consideration the emissions resulting from how hydrogen is used. The counterpart to "well-to-gate" is "gate-to-end," which would include the emissions from hydrogen being used in power plants, transportation, synthetic fuels, ammonia and fertilizer, metals production, chemical/industrial processes, heat/distributed power, and more. (In lifecycle assessments more broadly, the common terms are "cradle to gate" and "gate to grave," or, collectively, "cradle to grave.")

"Well-to-gate" is already the standard used by the DOE's Greenhouse Gases, Regulated Emissions, and Energy Use in Transportation (GREET) "fuel-cycle" model, and industry players largely support that standard continuing to apply. Without a standard for "gate-to-end" hydrogen pollution, there is no incentive for hydrogen producers receiving federal money to align themselves with hydrogen users pursuing decarbonization. The lack of a "gate-to-end" standard also means there are no reporting requirements tracking the relative greenhouse gas emissions intensity of various hydrogen applications.

Dr. Robert Howarth at Cornell, who with Dr. Mark Jacobson in 2021 published one of the only evaluations of blue hydrogen's greenhouse gas footprint, submitted a public comment on DOE's CHPS standard emphasizing that DOE's GREET model is "not consistent with the preponderance of peer-reviewed literature," and is "biased so as to severely underestimate the greenhouse gas footprint of blue hydrogen." Howarth outlined several ways in which the GREET model underestimates the methane emissions from natural gas infrastructure and their short-term potency for contributing to global warming. This makes the DOE's use of the GREET model for estimating emissions from natural gas-powered hydrogen production particularly concerning.

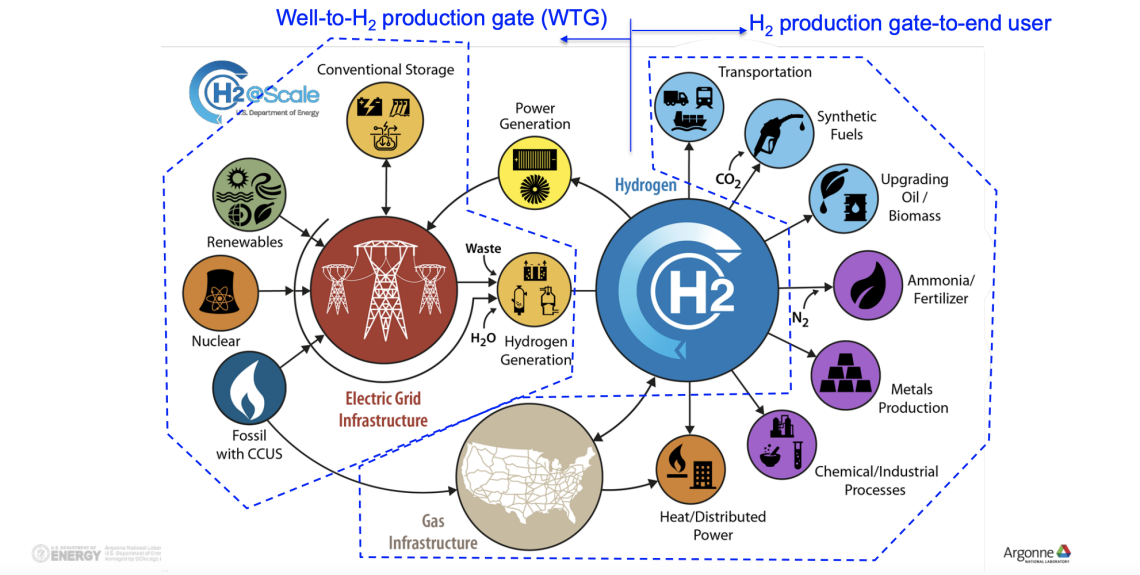

Image Credit: the Department of Energy Argonne National Laboratory

Time-Matching, Deliverability, Additionality

Strict emissions accounting for green hydrogen can be broken down to three safeguards: time matching, deliverability, and additionality.

One of the big points of contention over what constitutes "clean" hydrogen is the source of the electricity used for hydrogen produced through electrolysis. Like hydrogen, electricity is only as green as the energy sources that power its production. Hydrogen produced through electrolysis using electricity from the grid would have a large greenhouse gas footprint because most of the electricity produced in the U.S. today comes from burning fossil fuels.

There are two main methods of "time-matching" that regulators are considering to ensure that green hydrogen is produced via electricity from renewable sources. One is **hourly matching**, which would require a hydrogen facility to match the amount of electricity it consumes each hour with an equivalent amount of renewable power. This could mean that the hydrogen production facility would have on-site renewable energy to power the electrolysis. It could also mean purchasing renewable energy certificates with hourly energy tracking, which some renewable

energy certificate registries have set up. The other method is **annual matching**, which would require that the hydrogen facility over the course of a year procure enough renewable power to offset its yearly electricity consumption, likely through purchasing renewable energy certificates.

Unsurprisingly, most industry players would prefer the ease of annual matching through purchasing renewable energy credits, at the cost of reliably reducing emissions. A 2022 study from German researchers found that while hourly matching can push up the cost of green hydrogen, it is the only reliable way to keep emissions down. Other studies modeling the emissions profiles of annual versus hourly matching have also found that hourly matching yields fewer emissions than annual matching. If electrolysis was powered by additional renewable energy sources (meaning that, as electrolytic hydrogen facilities come online, renewable energy capacity comes online to meet that facility's energy needs,) hourly versus annual matching requirements would matter less. But for electrolysis powered by a mixed-energy-source grid, hourly matching is more accurate for avoiding powering hydrogen production with fossil-fueled electricity.

Many hydrogen industry heavyweights are pushing for purchasing renewable energy credits to be an acceptable alternative to directly powering hydrogen production with renewable energy for the purposes of receiving clean hydrogen tax credits. This would inevitably worsen the actual emissions profile of green hydrogen because of the serious additionality problems with renewable energy credits explained below.

The second safeguard, **deliverability**, requires that the electricity used to power electrolyzers is local enough to the hydrogen production facility that the power can be physically traceable between source and end user. This allows for accurate tracking of the fuel make-up powering the hydrogen production facility, and thus accurate assessment of the greenhouse gas emissions resulting from those operations. Deliverability "prevents hydrogen producers from purchasing renewable energy credits and claiming to be supplied by resources that are separated from the electrolyzer by grid constraints, while actually relying on dirtier generators closer to the electrolyzer," explains a report from Evolved Energy Research.

Then there is the principle of **additionality**. With "green" hydrogen, it's essential that the renewable energy that powers the electrolysis is "additional"—that hydrogen producers are not diverting existing renewable power to create hydrogen, causing an increased demand for fossil fuels elsewhere, but bringing new renewable energy supply online to cover increased hydrogen production. There's currently a vocal debate among industry players about the cost of additionality requirements both in the U.S. and abroad.

There are no additionality requirements for issuing or purchasing renewable energy certificates (RECs). The problem of increased hydrogen production cannibalizing existing renewable energy resources will not be solved by hourly *or* annual matching through RECs, and should be recognized as a dangerous distraction. Many firms are urging the Treasury to ensure that RECs can be used, including credits from so-called "renewable natural gas," which is the latest and greatest form of methane gas greenwashing.

This April, four dozen companies involved in various stages of hydrogen production and utilization wrote a letter to Treasury, Energy, and White House officials urging them to support annual and not hourly matching. “Intermittent hydrogen production does not work for the downstream sectors that will be the early adopters of clean hydrogen,” they argued. “Generally operating at high temperature, these processes cannot simply shut down whenever renewables are unavailable.” As for utilizing batteries and hydrogen storage, well, they’re “very expensive.”

Raffi Garabedian, CEO and president of Electric Hydrogen Co., whose company did not sign that letter, told SP Global that he thought BP’s Vice President’s argument about capacity and cost was “disingenuous,” and argued that “the hydrogen industry instead should be focused on lowering the cost of electrolyzers. This would allow facilities to flexibly time-match hydrogen production with renewable resource availability, without having to worry about recovering the cost of the equipment.” Electric Hydrogen is among the electrolyzer startups working to improve electrolyzer technology.

Compatibility of U.S. Standards With EU Standards

In June 2023, the European Commission formally published two rules defining what constitutes renewable hydrogen within the EU market. The first rule defines exactly what constitutes “renewable” hydrogen, and the second rule outlines a methodology for calculating the lifecycle greenhouse gas emissions of renewable hydrogen and other renewable fuels of non-biological origin. These rules will apply to hydrogen produced by companies in the EU *and* to hydrogen imported into the EU. “Renewable hydrogen” in the EU does not include fossil fuels with carbon capture and storage; that falls into their “low-carbon hydrogen” category.

The EU rules incentivize a slow increase in renewable energy production by requiring that all renewable hydrogen produced by 2028 is connected to new, not existing, sources of renewable energy, with hourly time-matching requirements phasing in as of 2030, and “sets criteria to ensure that renewable hydrogen is only produced when and where it is needed.” This type of additionality requirement will eventually ensure that green hydrogen production in the EU does not “cannibalize” existing renewable energy production, increasing fossil fuel-powered electricity generation to serve other customers’ needs. But the phase-in timeline is slow.

In 2021, dozens of European hydrogen companies wrote to the European Commission indicating their support for the proposed rule, stating that “six out of ten largest electrolyser manufacturers in the world are European companies: electrolysers are a European technology and are crucial to meeting the objectives of the Green Deal.” At the same time, they argued that “Too stringent criteria in the [rule] would also put at stake the feasibility of complying with the binding target of 50% for renewable fuels of non-biological origin,” and argued for phasing-in the rule’s more stringent criteria, which the final rule did.

Analysts have criticized the amount of greenhouse gas emissions allowed to be produced by “renewable” hydrogen: 3.38 kg of CO2-equivalent (CO2e) for every kilogram of renewable

hydrogen produced. The Green Hydrogen Organisation said that the EU's standards would "amount to 340 million tonnes of CO2e entering the atmosphere which we simply can't afford," and BloombergNEF researchers called the threshold "insufficient," and said "it won't incentivise the production of net-zero H2." (As noted above, the U.S. threshold for emissions from "clean" hydrogen is even more lenient than the EU's: tax incentives kick in for hydrogen releasing as much as four kg of CO2-equivalent for every kg of hydrogen produced.)

Rachel Fakhry, a senior advocate at the Natural Resources Defense Council, noted to *E&E News* that "unlike the U.S., the European Union's regulators have established caps on emissions that will slash pollution from a broad range of sectors, including the power grid," so "the lack of a similar U.S. emissions cap makes it more important for Treasury to lay out tough conditions on green hydrogen developers." Fakhry's argument for why U.S. standards need to be tougher than EU standards is in stark contrast to the argument from Frank Wolak, CEO of the Fuel Cell and Hydrogen Energy Association, who told *E&E News* that "European-style rules could delay the rise of green hydrogen in the United States." Given that "green" hydrogen production is far from green without strong safeguards, and can be even more polluting than hydrogen produced by steam-methane reforming if the electricity powering it isn't clean, delaying the rise of green hydrogen is far from the worst outcome.

The Treasury Department should be attentive to the EU's requirements for hydrogen production as it develops its clean hydrogen tax guidance. As the U.S. and EU both constitute major hydrogen economies, the U.S. could propel a race to the top in terms of incentivizing the cleanest hydrogen production with rules at least as stringent as the EU's. But with weaker rules, the U.S. could also catalyze a race to the bottom, courting the least responsible companies from abroad to benefit from U.S. subsidies for dirtier hydrogen production than would be allowed in the EU. This would be an embarrassment and a travesty. It is also not unlikely, as hydrogen industry players wage their influence campaigns to keep U.S. standards weak.

An April 2023 report from Energy Innovation LLC stated that "loose 45V guidance could create tens to hundreds of millions of tons of GHG emissions annually at a cost of $30 billion annually in federal funding while setting the clean hydrogen industry up for failure. However, Treasury can implement rules that accurately account for electrolyzer emissions by following the design principles of additionality, deliverability, and time-matching, and this framework would build a clean hydrogen industry that is profitable from the start and can thrive after 45V expires."

Frontiers of Greenwashing

Hydrogen has longstanding uses in several industries, but the oil and gas industry has long been a primary user and producer. Consequently, the typical fossil fuel industry playbook is operative in the hydrogen space in terms of rampant greenwashing, false promises, and lobbying to secure tax credits and federal investments while pushing to keep regulatory requirements and enforcement as lax as possible.

Hydrogen is currently tethered to methane gas production, which is why Senator Joe Manchin is pushing for West Virginia to be "the new home of hydrogen energy production." (Sen. Manchin has made millions of dollars from his coal business, and receives hundreds of thousands of dollars in donations from the fossil fuel industry each year.) Blue hydrogen is just one of the many lifelines for continued fossil fuel production that the Biden administration continues to provide.

Hydrogen Co-Firing

The Environmental Protection Agency released a draft rule in May 2023 proposing revisions to greenhouse gas pollutant standards for the nation's largest power plants. The rule proposes an update to the "best system of emissions reduction" (BSER) for various types of power plants that would grow more stringent over time. Along with highly efficient generation of power, both carbon capture and storage (CCS) technology and co-firing "low-GHG" hydrogen are included as pathways for power plants to meet more stringent emissions reduction requirements.

EPA is proposing "(1) the use of CCS to achieve a 90 percent capture of GHG emissions by 2035 and (2) the co-firing of 30 percent (by volume) low-GHG hydrogen by 2032, and ramping up to 96 percent by volume low-GHG hydrogen by 2038." The agency sought comments on what percentages of hydrogen co-firing and CO2 capture to require, and by when. The EPA also solicited comments on how the two standards would differ in emissions reductions in both scale and time.

Frankly, there is no good argument for keeping gas-burning power plants online by replacing methane with increasing percentages of hydrogen. That hydrogen has to be produced through an energy-intensive process—energy that could be used to power the grid instead. **If you're burning methane gas to make hydrogen to replace burning methane gas, you're replacing nothing. And if you're using renewables to make hydrogen that's burned in power plants, why not just power the grid with renewables from the outset?** Hydrogen is not pollution-free when it's burned; burning hydrogen produces substantial amounts of NOx, a criteria air pollutant. These are not real solutions. These are yet again industry talking points to prolong the use of gas infrastructure.

The EPA's proposed rule acknowledged the danger of increased NOx emissions, but said the Agency "concluded that any potential increases in NOX emissions do not change the Agency's view that on balance, co-firing low-GHG hydrogen qualifies as a component of the BSER." The EPA noted that "By 2035, substantial additional amounts of renewable energy are expected to be available, which can support the production of low-GHG hydrogen through electrolysis." The EPA did not note that those "substantial additional amounts of renewable energy" could just power the grid in power plants' stead. There is a legal reason for that—the EPA's tools for reducing power plant emissions were limited by the Supreme Court in *West Virginia v. EPA* (2022), when the Court decided that the EPA could not on its own push power plants to take a "generation-shifting approach" and switch from fossil fuels to renewables. The Supreme Court bears much of the responsibility for the strange contortions of this proposed rule.

Ammonia Co-Firing

An April 2023 report from TransitionZero, a data modeling organization working to advance clean energy, documents how, while industry heavyweights in the U.S. are lobbying for hydrogen co-firing with methane gas, industry heavyweights in Japan are lobbying for ammonia co-firing with coal—yet another harmful and expensive greenwashing scheme. Ammonia production first requires hydrogen production, and then that hydrogen is fixed with nitrogen. It is an emissions and energy-intensive process.

The TransitionZero report points out that "A 20% ammonia co-firing coal plant would emit 94% more CO2 than the average unabated gas plant in Malaysia, 77% more in Thailand, 60% more in the Philippines, and 44% more in Indonesia," and that co-firing ammonia "could even be worse for the environment than burning unabated coal due to the very high embedded upstream emissions and energy losses from production of hydrogen and NH_3." U.S. Ambassador to Japan, Rahm Emanuel, has spoken in favor of the U.S. providing Japan with "low-carbon hydrogen and ammonia production utilizing carbon capture and sequestration." (See our section on page 29 for more on Ambassador Emanuel's hydrogen position.)

Water Consumption

All methods of hydrogen production require varying but massive quantities of fresh water, which raises serious environmental concerns for hydrogen production in water-stressed regions—and in an increasingly water-stressed world.

Food and Water Watch estimated that "the DOE's goal of 50 MMT of hydrogen production annually in 2050 would require up to one trillion gallons of freshwater (or 4.6 trillion gallons of seawater), which is equivalent to over 34 million Americans' annual home water use." One trillion gallons is the amount of water in Florida's so-called "inland sea" Lake Okeechobee, which is three-quarters the size of Rhode Island.

The FWW researchers also pointed out that "many of the proposed hydrogen projects vying for federal funds are in areas currently experiencing historic drought compounded by climate change," including in California and New Mexico. They conclude by stressing that "a shift to hydrogen energy that entrenches fossil fuel infrastructure would come at the cost of a renewable energy future that has a small water and carbon footprint." The DOE plans to announce which six to ten regional Hydrogen Hubs will be selected for $7 billion in grants in fall 2023. Several hubs in drought-ridden regions have been proposed, including in California, Arizona, New Mexico, and Texas. A World Resources Institute analysis found that Arizona, California, New Mexico, and other states reliant on the Colorado River are experiencing water stress levels as high as arid countries like Saudi Arabia and Qatar.

Hydrogen Pipelines

Only 1,500 miles of hydrogen transmission pipelines exist in the U.S., compared with 300,000 miles of natural gas transmission pipelines and 2,300,000 miles of natural gas distribution

pipelines. The current push to build out new hydrogen pipeline networks is particularly concerning given the lack of regulatory expertise and oversight needed to prevent potentially catastrophic accidents from happening.

In November 2022, Pipeline Safety Trust commissioned a report on the safety of hydrogen transportation by pipeline from pipeline safety research and consulting firm Accufacts Inc. The report outlined how hydrogen's unique properties make transporting hydrogen via pipeline significantly more risky than conventional natural gas. Such properties include hydrogen's flammability, its lower autoignition temperature, its rapid and efficient combustion characteristics, and its small molecular size making it easier to escape containment, and to migrate once released.

Following the publication of this report, the Pipeline Safety Trust proposed several recommendations for improving the safety of hydrogen in transportation, arguing that hydrogen blending into gas distribution systems servicing residential and commercial buildings should not be permitted because of its propensity to explode, and that new, smaller diameter gas transmission pipelines servicing industrial facilities would only be suitable for hydrogen service "if knowledge gaps can be resolved, pipeline integrity can be demonstrated, and pipelines can be sited to ensure that failures will not result in deaths or injuries."

Some hydrogen industry stakeholders, including utilities, are pushing ahead with risky hydrogen ventures like blending hydrogen in natural gas distribution systems. Xcel Energy in Colorado, for instance, is lobbying against electrification while looking to blend hydrogen into the natural gas piped into residential homes. Without new regulatory intervention, and with major sums of federal money on the table, the Biden administration may soon be subsidizing corporate schemes to build-out novel hydrogen infrastructure that puts communities at risk.

Hydrogen and Carbon Capture Pipelines

So-called "blue" hydrogen, produced via methane gas, has carbon dioxide as a byproduct that is supposed to be captured and stored. (Usually it is just released into the atmosphere.) That's where carbon dioxide pipelines come in—transporting the carbon from the hydrogen production facility to where it is supposed to be sequestered underground.

In May 2023, the White House stated that one of its goals for energy permitting reform was for Congress to "address the siting of hydrogen and carbon dioxide pipelines and storage infrastructure and provide federal siting authority for such infrastructure. The Energy Policy Act of 2005 governs the designation of energy corridors on federal lands and covers oil, gas and hydrogen pipelines, and electric transmission lines. Such corridors are also suitable for carbon dioxide pipelines and need to be expanded in legislation to cover both prospectively designated and previously designated corridors."

There are several major issues with carbon dioxide pipelines:

- CO2 pipelines are dangerously under-regulated for the hazards that they pose. The Pipeline and Hazardous Materials Safety Administration currently only regulates pipelines that transport CO2 in a "supercritical" form, not as a liquid or gas. In 2022, PHMSA announced that it would initiate a new rulemaking to update safety standards for CO2 pipelines, but the agency doesn't intend to publish a notice of proposed rulemaking until 2024, with no date set for a final rule. Most of the legislative proposals to regulate these pipelines are at the state level in the Midwest, and have yet to be passed.

- CO2 is an asphyxiant. When carbon pipelines rupture, the carbon displaces breathable oxygen and can slowly suffocate the people in the vicinity. A 2020 rupture of a Mississippi pipeline sent 50 people nearby to the hospital. Scott Eustis of Healthy Gulf told Oil and Gas Watch that "a lot of them are now on permanent disability because they have brain damage."

- If carbon dioxide comes into contact with even a small amount of water, it dissolves to form carbonic acid, which corrodes steel pipelines, causing leaks. It is costly and risky to build and maintain carbon pipelines sufficiently to prevent any water contamination. Leaks from carbon pipelines would contribute to global warming and imperil public health.

- There are billions of dollars in new federal incentives for rapidly building out carbon transportation and storage infrastructure, even as major regulatory gaps and understaffing at regulatory agencies leave communities in jeopardy. To make matters worse, the federal Environmental Protection Agency is delegating much authority for overseeing these new pipelines to state agencies, which often have far worse environmental track records and typically even fewer expert staff.

- Existing pipeline companies like TC Energy, known for building the Keystone Pipeline, would likely be the companies in charge of building pipeline infrastructure for carbon capture and storage technology. TC Energy claims to be "a leader across the hydrogen value chain." TC Energy's Keystone Pipeline had a major spill in 2022, dumping almost 600,000 gallons of oil into a Kansas Creek. In May 2023, NPR reported that "Keystone was built with extra safety measures, yet it split open under run-of-the-mill pressure levels that less rigorously designed pipelines regularly withstand." An independent investigator's report found that TC Energy knew that the pipe which eventually burst was warped for over a decade, but didn't fix it. This is the kind of dangerous corporate behavior—and indeed, the very same corporation—that will be involved in the build-out of new hydrogen and carbon pipelines.

- Even if carbon is fully captured and safely transported, then what? Sequestering carbon underground has its own risks, including causing earthquakes and polluting groundwater. States are already transferring the liability for those risks to the public.

Which agencies is the hydrogen industry seeking to influence?

The U.S. lacks a comprehensive regulatory regime for hydrogen, but various agencies are involved in regulating various parts of hydrogen production, transportation, and utilization.

In June 2023, as required by the Bipartisan Infrastructure Law, the DOE published the first roadmap to an "all of government approach to clean hydrogen," which prescribes "collaboration across multiple federal agencies including the U.S. Departments of Agriculture, Commerce, Defense, Energy, Interior, Labor, State, Transportation, and Treasury, the Environmental Protection Agency, the National Aeronautics and Space Administration, the National Science Foundation, and the Office of Science and Technology Policy, in close coordination with the Executive Office of the President." This remarkable cross-section of executive branch departments and agencies demonstrates how the growing and federally backed hydrogen industry touches most corners of the administrative state.

Department of Transportation (DOT)

The Department of Transportation's Pipeline and Hazardous Materials Safety Administration (PHMSA) regulates the safety of hundreds of miles of hydrogen pipelines and the safety of hydrogen transported through other methods, including in fuel cells and in compressed form. However, there are significant gaps in PHMSA's regulatory oversight of hydrogen pipelines and the CO_2 pipelines necessary for transporting the CO_2 produced and captured in blue hydrogen production. A 2021 report from the Congressional Research Service highlighted that "because PHMSA's existing pipeline regulations are focused primarily on natural gas, they may not be adequate to address the safety risks of a widespread, dedicated hydrogen pipeline network." We may be years out from PHMSA undertaking new rulemaking to address the safety of hydrogen pipelines specifically. Biden has still yet to nominate an administrator to lead the PHMSA.

The Department of Transportation's Surface Transportation Board (STB) has limited authority to set rates for interstate hydrogen pipelines. The agency also acts as a forum for stakeholders to resolve disputes over pipelines within the STB's jurisdiction. For hydrogen blended in natural gas pipelines, the Federal Energy Regulatory Commission has the authority to set rates.

Federal Energy Regulatory Commission (FERC)

The Federal Energy Regulatory Commission (FERC) regulates natural gas pipelines from cradle to grave. The Natural Gas Act requires FERC to regulate "natural" gas and any "artificial" gas blended with natural gas, so if hydrogen is transported via pipeline in a blended stream with

natural gas, it will be regulated by FERC. But regulatory jurisdiction over pure hydrogen gas transported in pipelines is not certain, and has been the subject of recent debate and analysis by firms including Venable LLP and Van Ness Feldman LLP. There is currently no federal authority for siting hydrogen pipelines, comparable to FERC's siting authority for natural gas pipelines; hydrogen pipeline developers apply to relevant state authorities.

Department of Energy (DOE)

The Department of Energy (DOE) plays a major role in research, development and support for the U.S. hydrogen industry through its Hydrogen Program led by the Hydrogen and Fuel Cell Technologies Office within the Office of Energy Efficiency and Renewable Energy. In 2020, the DOE pledged to spend $100 million on hydrogen R&D over the next five years. In 2021, the DOE launched its "Hydrogen Shot" with the goal of facilitating a $1 price for 1 kilogram of clean hydrogen in 1 decade. In June 2023, DOE published the U.S. National Clean Hydrogen Strategy and Roadmap in collaboration with several other federal agencies which outlines short, mid and long term priorities for supporting clean hydrogen deployment across agencies.

Current hydrogen R&D projects at DOE include the Hydrogen and Fuel Cell Technologies Office's program studying and addressing technical barriers to blending hydrogen in natural gas pipelines, and the $6.75 million SHASTA Project funded by the Office of Fossil Energy and Carbon Management (FECM), which seeks to "address technological hurdles and develop technologies to enable public acceptance of subsurface storage of pure hydrogen and hydrogen/natural gas mixtures as a safe and effective bulk energy storage option."

Environmental Protection Agency (EPA)

The Environmental Protection Agency (EPA) regulates hydrogen production through its Greenhouse Gas Reporting Program, Effluent Standards under the Clean Water Act, and Chemical Accident Prevention program.

In May 2023, the EPA put out a draft rule establishing new performance and emissions standards for new, modified, and reconstructed fossil fuel-fired power plants under Section 111 of the Clean Air Act. The "best system of emissions reduction" outlined by this rule endorses hydrogen co-firing at gas-powered facilities, carving out a new role for the EPA in facilitating hydrogen use at electricity-generating fossil fuel-fired power plants.

Occupational Safety and Health Administration (OSHA)

The Occupational Safety and Health Administration (OSHA) regulates the installation of hydrogen systems in which the hydrogen is delivered as a gas via pipes to consumers, as well as liquefied hydrogen storage. They also set several other standards relevant to employers and

employees in the hydrogen industry, including standards for emergency response, personal protective equipment, inspection requirements and more.

Treasury Department

The Treasury Department writes the tax guidance for credits and incentives pertaining to hydrogen production and utilization in the IRA, Bipartisan Infrastructure Law, and other laws. Given the volume of new tax credits for hydrogen production, Treasury has outsized discretion in shaping the contours of the changing and growing hydrogen industry.

Who are the hydrogen advocates who hold administration jobs?

Several executive branch personnel have direct work experience in hydrogen and hydrogen-related fields. Many others, including some high-level Biden appointees, have backgrounds working for BigLaw firms that now have highly developed work areas advising corporate clients on how to navigate emerging regulations in the hydrogen industry. These firms' positions range from grappling with the information that regulatory agencies are releasing and advising clients on navigating these regulations, to actively participating in the promotion of hydrogen writ large, with claims like "clean hydrogen is an energy source for the future."

While past work at these firms—including specifically on environmental regulation-focused projects—does not tell the whole story about executive branch appointees' agendas, it is indicative of the prevailing pro-hydrogen attitudes at the types of BigLaw firms that feed into high-level roles in government. As the hydrogen industry has grown, law firms whose core mission is to serve corporate clients have developed expertise and various degrees of proactive support for the industry.

It is fair to imagine that regulators who come from these kinds of work environments—and who describe advising corporations on navigating regulations as "environmental law"—may be more sympathetic to dominant approaches to producing hydrogen, including methods that produce significant greenhouse gasses, as described above.

Department of Energy Personnel

As noted above, the Department of Energy (DOE) is extremely supportive of hydrogen research and development, and funds hydrogen produced from various fuel sources including natural gas. Unsurprisingly, senior leadership at DOE including Secretary **Jennifer Granholm** has often spoken publicly in support of hydrogen development. In a letter to FERC commissioners articulating her support for the fracked gas Mountain Valley Pipeline, Sec. Granholm wrote that

“new pipeline infrastructure is needed to support the rapid growth of hydrogen as an emissions-free fuel, and to transport carbon dioxide from its point of capture to the location of its use or sequestration.”

David Crane, DOE’s Under Secretary for Infrastructure, spent a career working in investment banking and then for energy companies, including NRG Energy, El Paso Natural Gas, and GenOn Energy, before working with impact investment firm Pegasus Capital Advisors. Pegasus invested in “green and natural hydrogen” projects based in Canada and Africa, including during the time Crane worked there.

Crane also served from at least 2016 to 2021 as the CEO and President of ACWA Power, described as “a leading private developer, owner and operator of power generation and desalinated water and green hydrogen production plants.” Before his appointment as Under Secretary for Infrastructure at DOE, Crane headed the department’s Office of Clean Energy Demonstrations, where he was responsible for overseeing the distribution of $25 billion in funding for “clean hydrogen, carbon capture and other tough climate tech”—a notable responsibility for someone previously employed by organizations invested in the development of hydrogen technology.

DOE Office of Clean Energy Demonstrations (CED)

DOE’s Office of Clean Energy Demonstrations is responsible for partnering with the private sector to accelerate “the market adoption of clean energy technologies.” Under the Bipartisan Infrastructure Law, CED is charged with overseeing the disbursement of $8B in funding under the Regional Clean Hydrogen Hubs program. Even with David Crane’s departure from the senior leadership team, several top officials have notable ties to the energy industry and hydrogen in particular.

Douglas Schultz, Chief Operating Officer at CED, worked for natural gas-fired power plant developer KMR Power Corporation, and for K&M Engineering and Consulting, a “finance and engineering advisory firm [that advises] private investors and governments on the development of power, water and telecommunications.” K&M has a hydrogen work area, among other energy portfolios, and proclaims on its website: “As a zero emissions fuel, hydrogen has the potential to combat the deleterious effects of climate change and disrupt the power sector.” K&M includes both blue and green hydrogen in this category, though blue hydrogen is never “zero emissions,” and green hydrogen isn’t necessarily.

Robin Wong, Director of Technical and Engineering Support for CED, was a Senior Project Manager at Parsons Corporation from 2014-2016, where she “led technical teams that advised international public and private banks and development finance institutions interested in providing debt to commercial clean energy projects.” Parsons has been a frequent contractor with CED since 2008, and most recently in March 2023 was awarded a $14 million contract to supply “a range of technical, program and project management support” to CED across their portfolio of projects.

DOE Office of Fossil Energy and Carbon Management (FECM)

Hydrogen production and “carbon management” are priorities of the DOE’s Office of Fossil Energy and Carbon Management (FECM), so it’s unsurprising that the office’s leadership is heavily invested in preserving the role of hydrogen produced by fossil fuels.

Brad Crabtree, Assistant Secretary of FECM, has spoken positively about preserving a role for natural gas in hydrogen deployment and elsewhere, stressing in public statements that FECM has “not held back on permitting U.S. LNG exports” and celebrating the Bipartisan Infrastructure Law’s funding for “six fully commercially scaled carbon capture facilities, two of which must be on natural gas-fired power plants [and] four regional clean hydrogen hubs.”

Before working for DOE, Crabtree spent a career advocating for the development of carbon capture technology (as we’ve written about previously). He worked for ten years at the Carbon Capture Coalition, a coalition of more than 100 organizations “building federal policy support to enable economy wide, commercial scale deployment of carbon management technologies.” He was director of the coalition when he left.

Jennifer Wilcox, Principal Deputy Assistant Secretary of FECM, considers "clean" hydrogen production via gasification of biomass and wastes including plastics to enable "net-negative emissions" when coupled to carbon capture and storage. She has also stated that “parts of the criticism are correct: carbon capture and storage at natural-gas plants is enabling more gas production…But we don’t have a choice,” she adds. “It needs to be a part of our tool kit, and we need to invest today in order for us to even have the option.”

These positions are unsurprising considering Wilcox’s professional experience. A researcher and professor, she authored the first textbook on carbon capture. She was also a Fellow at the World Resources Institute (WRI), which has provided research to guide DOE’s selection of hydrogen hubs. On its “clean hydrogen” webpage, WRI describes hydrogen hubs “sourced from fossil fuels as well as renewables and nuclear” energy as “clean hydrogen,” without addressing the climate impact of fossil-fueled hydrogen.

Kimberly Rasar, Deputy Assistant Secretary of Operations for FECM, came to the DOE from the private sector in 2004. She has spoken publicly about the importance of fossil fuels, stating in a 2019 panel appearance: “Fossil Energy is the lifeblood of both the U.S. and global economy in an ever-changing energy landscape, across the country and around the world—and it will continue to power the global economy for decades to come.”

Noah Deich, Deputy Assistant Secretary for the Office of Carbon Management in FECM, is focused on carbon capture and “hydrogen production with carbon management,” according to his DOE bio. Deich has past experience as a consultant with Accenture and ICF International—both firms with hydrogen portfolios—and as an entrepreneur, co-founding Carbon180, a “climate NGO” focused on scaling carbon removal technologies.

DOE Office of Energy Efficiency & Renewable Energy (EERE)

EERE's mission to accelerate technologies to transition the US to net-zero carbon emissions by 2050 is focused on decarbonizing the electricity, transportation, industrial, and agriculture sectors, and reducing the carbon footprint of buildings. The current Deputy Assistant Secretary for Sustainable Transportation & Fuels at EERE, **Michael Berube,** spent over twenty years in marketing and as an executive for automobile companies (notably Chrysler and Jeep). Berube has spoken publicly about the potential of hydrogen as a trucking fuel.

Under EERE's Sustainable Transportation & Fuels Portfolio, their Hydrogen and Fuel Cell Technologies Office (HFTO) focuses on "research, development, and demonstration of hydrogen and fuel cell technologies across multiple sectors."

HFTO Director **Sunita Satyapal** is an outspoken advocate for hydrogen technology, promoting "clean hydrogen" that includes fossil-driven hydrogen production. In a March 2023 interview, Satyapal reiterated greenwashing talking points related to hydrogen use, stating: "Hydrogen is often called the Swiss Army knife of clean energy because of its versatility. It enables our energy security and resiliency and can potentially reduce or eliminate emissions from key sectors. Many countries now realize they cannot meet climate goals without a carbon-free molecule like hydrogen…" This kind of advocacy, without caveats addressing the difficulty of producing and using hydrogen without producing substantial emissions, does not inspire confidence that the narrow utilization of green hydrogen described above will be HFTO's focus.

Satyapal has built a career researching and advocating for hydrogen technology. She worked for United Technologies Corporation, including on fuel cell development. UTC has supplied fuel cell technology for the development of hydrogen fuel cells; the fuel cell system UTC produced relied on natural gas as an input. From UTC, Satyapal started at DOE, serving in roles including Chief Engineer and Deputy Program Manager for the Fuel Cell Technologies Office from 2003-2010.

While at DOE, Satyapal has taken on roles in international coordination of hydrogen production efforts, serving as Chair (and now co-Chair) of the International Partnership for Hydrogen and Fuel Cells in the Economy, which aims to "facilitate and accelerate the transition to clean and efficient energy and mobility systems using hydrogen and fuel cell technologies across applications and sectors," without specifying what kind of hydrogen production methods they are promoting. Satyapal was also a featured speaker, alongside international state officials and corporate executives, at the 2023 World Hydrogen Summit & Exhibition.

Department of Transportation Personnel

The Department of Transportation's Pipeline and Hazardous Materials Safety Administration (PHMSA) is responsible for regulating hydrogen pipelines and transportation. While many

PHMSA officials have spent the majority of their careers in government, Associate Administrator for Pipeline Safety **Alan K. Mayberry** notes in his professional bio that he "has over 40 years of experience in the energy industry...equally divided between pipeline operations and design engineering." His official bio does not note the particular companies that previously employed him, and his LinkedIn profile also omits any jobs prior to his time in government, which began in 2006.

Other sources indicate that Mayberry was previously employed by Virginia utility Washington Gas. This affiliation is mentioned in a 2016 blog post by the American Public Gas Association. A 2004 alumni newsletter from Mayberry's alma mater specifies that he held the role of "area head for system operations" at the company. Washington Gas is a public utility company that has been and remains committed to the continued use of fossil fuels. As recently as 2022, Washington Gas lobbied Congress opposing legislation to transition buildings from renewable energy.

Other materials accessible online suggests Mayberry has maintained close relationships with the natural gas and pipeline industries throughout his time in the administration:

- A 2016 blog post from the American Public Gas Association (APGA) announcing Mayberry's appointment to PHMSA was very complimentary of Mayberry, stating, "APGA congratulates Alan and looks forward to working closely with him in his new duties as Associate Administrator."

- Mayberry delivered the 2019 keynote speech for the Fifth Annual Pipeline Leadership Conference, a gathering of 110 industry professionals with the theme "Building Your Advantage in the Pipeline Industry." The event was sponsored by pipeline companies, among other corporations and industry groups, and included a session called: "A User's Guide to Avoiding Tribal Protests on Pipeline Projects."

- A 2020 slide deck produced by Chris Kuhman, Policy Advisor for the American Petroleum Institute, for a gathering of the Young Pipeline Professionals (YPP) organization, lists members of the YPP Board of Directors. Board members include Alan Mayberry in his PHMSA capacity alongside representatives from Enbridge, Kinder Morgan, and other pipeline companies. The document also identifies Kuhman of API as YPP's "Younger Pipeliners International Liaison."

These connections to pipeline and natural gas industry groups and corporations raise questions about Mayberry's proximity to companies which prioritize profit over the kinds of stringent rules needed to reduce greenhouse gas emissions and combat climate change.

Federal Energy Regulatory Commission Personnel

Current FERC Chairman and Biden appointee **Willie Phillips** worked as an Associate at the lobbying firm Van Ness Feldman LLP from 2007-2010, where he advised gas companies and FERC-regulated electric utilities. While Phillips was at Van Ness Feldman LLP, the firm lobbied on behalf of hydrogen industry stakeholders including Air Products & Chemicals Inc, Duke Energy, Kinder Morgan, and others.

In recent years Van Ness Feldman LLP has published pro-hydrogen claims, including that "clean hydrogen is an energy source for the future." Van Ness Feldman has continued to celebrate Phillips' work and success, releasing congratulatory statements upon his appointment to the District of Columbia Public Service Commission in 2014, his nomination to be FERC commissioner in September 2021, and subsequent confirmation in November 2021. In these statements, the firm has described Phillips' work as "advis[ing] electric and gas utilities on regulatory, transactional policy, and litigation matters," and said, "We are proud of Chairman Phillips' accomplishments, and we are confident that he will continue to serve the public interest well in his new position."

Willie Phillips was on the board of the Keystone Policy Center through at least 2021. The Keystone Energy Board convenes private, invitation-only meetings with energy sector leaders, along with several executives of utilities expanding their hydrogen and gas portfolios including Duke Energy, Dominion Energy, NRG Energy, PG&E Corporation, and Xcel Energy. In 2020-2021, the federal government was funding Duke Energy and Siemen Energy's study of hydrogen as a fuel in power plants. Duke Energy and Dominion Energy are currently pursuing federal funding for a hydrogen hub in the southeast. Xcel Energy is pursuing federal funding for a hydrogen hub in Colorado.

Trump appointee and current FERC Commissioner **James Danly** worked at BigLaw firm Skadden, Arps, Slate, Meagher and Flom LLP prior to joining FERC as general counsel in 2017. Skadden has come out publicly in support of the hydrogen industry, with members co-authoring a piece in *Financier Worldwide* in April 2023 entitled, "Development of the US hydrogen market: incentives and challenges." The piece treats the continued development of hydrogen markets and infrastructure as a given, concluding, "The US is dedicated to expanding the production and use of clean hydrogen to reduce GHG emissions and strengthen domestic energy security. Significant challenges remain, which will require a concerted effort across government, industry and the financial sector."

Danly is vocal in his support of continued fossil fuel use: he has argued that "coal is required," that renewables are too cheap, and that "the need for natural gas to ensure system reliability continues to grow." Danly dissented from his own agency's attempt to incorporate climate decisions in gas pipeline approvals, and pushed against the EPA's timeline for requiring power plants to pursue either hydrogen co-firing or carbon capture—not because these are expensive and unproven solutions, but because he doesn't want to disrupt the status quo. Danly's term expired on June 30, 2023, but he continues to sit on the FERC commission, with Biden yet to renominate him or announce another nominee.

Several members of senior staff at FERC—who are selected by FERC leadership, not directly by the president—also have notable ties to BigLaw firms with developed hydrogen practice areas. Director of the Office of Energy Market Regulation **Jette Gebhart,** whose FERC bio states she previously worked in "environmental law," spent a combined four years at Orrick, Herrington & Sutcliffe LLP and Baker Botts LLP, two firms with extensive hydrogen practice areas at present.

Matt Christiansen, General Counsel for FERC, spent time as an associate at Arnold & Porter from 2012-2013—another firm that by its own description has clients "engaged in all facets of the energy sector, including oil and gas, electricity, renewables, and developments in hydrogen and carbon capture, utilization, and storage technologies (CCUS)."

Ambassador Rahm Emanuel

Rahm Emanuel, scandal-plagued former mayor of Chicago, was appointed U.S. Ambassador to Japan in 2021. After leaving the mayor's office, Emanuel was paid millions of dollars by neoliberal and conservative institutions, including for a senior advisory role for conservative consulting firm Centerview Partners, LLC, which paid him $12 million over just a few years. While Emanuel was on the payroll, Centerview advised "a host of pharmaceutical companies, utilities, and fossil fuel companies on billions of dollars' worth of transactions."

Centerview is also a financial advisor to at least one major energy company investing in the hydrogen economy: Bloom Energy. As announced in an October 2021 press release, Bloom Energy and SK ecoplant, a South Korean energy company, are "expanding their existing partnership to fortify their market leadership in power generation and to establish market leadership in the hydrogen economy… Together, we can accelerate the hydrogen economy on a global basis."

These ties help contextualize Emanuel's continual public statements in support of expanding the hydrogen industry in his role as U.S. Ambassador to Japan. In October 2022, Emanuel made a statement on the "Alaska LNG Summit" convened by the US and Japan, saying: "I was pleased to join [U.S. and Japanese officials, bankers, and] industry leaders from both countries to discuss how Alaska LNG can provide stable, sustainable, and affordable energy sources to Japan*,* including future possibilities for low-carbon hydrogen and ammonia production utilizing carbon capture and sequestration."

As our friends at *The American Prospect* have reported, Emanuel helped convene the Alaska LNG Summit, which included major investors like Goldman Sachs and BlackRock, in an effort to secure funding for a struggling Alaska LNG project that the White House is now supporting through carbon capture subsidies in the Inflation Reduction Act. The project would include "a gas processing facility with carbon capture and an export terminal, connected by 800 miles of pipeline across melting permafrost."

Emanuel's goal, as he explained in a December 2022 op-ed for the *Wall Street Journal*, is to create "an export terminal on the West Coast of the U.S. [which] could help make Japan 'the energy export hub for the Indo-Pacific.'" Emanuel used this op-ed as an opportunity to argue that "clean hydrogen"—again, the greenwashing definition that includes hydrogen produced through burning fossil fuels, with CCS as an alleged mitigation strategy—should be a core part of Japan's energy strategy going forward. "Japanese companies such as Mitsubishi Heavy Industries, Kawasaki Heavy and Iwatani are leading the way on clean hydrogen, and Japan's natural abundance of freshwater is a major asset for deploying this energy source," Emanuel wrote. "Hydrogen has a chance to become a clean and stable energy alternative for heavy industry."

Given Emanuel's corporate ties and political influence as a U.S. Ambassador, his investment in what he considers "clean" hydrogen—that is, fossil-fueled hydrogen production, and the construction of carbon capture and sequestration pipelines—is notable.

What previous work experience should raise serious questions for Biden's nominees and appointees?

Beyond simply registered lobbying, there are a number professional and personal activities that should raise concerns or disqualify individuals from serving in an administration committed to serious climate action. These include:

- Working directly for a fossil fuel or fossil-fuel aligned corporation involved in the hydrogen industry, especially after previously working in a senior executive-branch position.

- Working directly for hydrogen industry stakeholders who have lobbied the federal government for weaker standards and safeguards for qualifying for federal tax credits for clean hydrogen production.

- Lobbying on behalf of a fossil fuel-aligned corporation involved in the hydrogen industry, on behalf of hydrogen industry coalitions, or on behalf of any other hydrogen industry players seeking looser and more lenient government regulation, either under their direct employ or as a client at a lobbying firm.

- Working for a law firm frequently or currently hired by hydrogen sector clients who have opposed strong government standards for clean hydrogen production, particularly to advise or defend such corporations on regulatory and legislative issues related to hydrogen.

- Working for a think tank, philanthropy, or advocacy non-profit funded significantly by hydrogen industry stakeholders who have opposed stronger safeguards or standards to work on hydrogen-relevant issues.

- Conducting academic research funded by companies involved in the hydrogen industry, especially research on topics relevant to that firm's interests and which is flattering to the firm overall.

- Conducting professional fundraising by targeting and receiving funds from executives and firms in the hydrogen sector.

- Working for or serving on the board of a company that idealizes an "all-of-the-above" approach to climate action, which preserves a role for fossil fuels in our energy future.

- Working or serving on the board of a company that holds investments in fossil fuels, insures fossil fuels, or encourages others to do the same.

What questions should nominees be required to answer?

In order to ensure all potential conflicts of interest are disclosed, Senators should ask the following questions of Biden's nominees for appointees who can be reasonably expected to work on matters relevant to the hydrogen industry during and after confirmation hearings:

- Have you ever been employed by a company involved in any segment of the hydrogen industry, or had such a company as a client for lobbying, consulting, legal, or other services?

- Have you ever provided policy, regulatory, or strategic advice to a company seeking federal contracts, grants, or tax credits for hydrogen-related operations? If so, how were you compensated, and how much were you compensated? Which clients have you advised, and what was the content of your assistance?

- Have you ever advised or been employed by a non-profit organization that receives funding from a company involved in the hydrogen economy? If so, were you compensated? Has this non-profit organization produced work relevant to the position for which you are now nominated? When did your employment by this organization end, and when did the organization stop marketing their association with you?

- Have you ever conducted research funded by a company involved in any aspect of the hydrogen industry (including production, transportation, utilization, storage, or research and development)? If so, was such research relevant to the position for which you are now nominated? Were you compensated by the firm(s)?

- If you have ever served in a professional fundraising role, have you raised funds from a company involved in the hydrogen industry, or its major executives and/or financial backers?

- If you have answered “Yes” to any of the above questions, in what ways do you expect to govern or regulate on issues relevant to the firms with which you have a past association? Do you predict that these firms will materially benefit from your governance decisions?

- What do you predict you shall pursue professionally after your time in government service?

- Do you think an association with a former regulator or political actor helps a firm convince investors or clients that it is legitimate, law-abiding, and effective at lobbying?

- How do you plan to utilize your power to quickly transition the U.S. economy away from fossil fuels, in line with a 1.5 degree Celsius warming target?

- Do you believe the fossil fuel industry has a place in a just transition to renewable energy?

- Do you consider fossil fuel industry figures’ claims that they are working towards decarbonization to be made in good faith?

- How would you define “clean” hydrogen, particularly as opposed to “green” hydrogen? Do you think that the definition of “clean” hydrogen should include hydrogen produced via dirty fuels, including natural gas and coal, or should it be required to be produced via renewable energy?

- In what ways do you think it is important that U.S. standards for clean hydrogen production align with or differ from the European Commission’s standards? Please explain.

- Do you have any concerns about hydrogen produced via electrolysis utilizing energy from the grid? (Concerns could include the risk of “cannibalizing” existing renewable energy resources, or of electrolysis having an outsized greenhouse gas footprint because of the energy make-up of the grid.) If so, what are your concerns? How would you address these concerns in the position for which you’ve been nominated?

- What is your position on the necessity of additionality requirements for hydrogen production? What about deliverability requirements? What about time-matching?

- What is your position on various degrees of stringency in time-matching renewable energy consumption to hydrogen production? Are you aware that current carbon accounting methodologies allow corporations matching their energy demand with renewable energy on an annual basis to claim zero emissions when the actual emissions

of the energy powering their operations are not zero?[1] Do you consider this to be a problem?

- What is your position on hydrogen companies purchasing renewable energy credits (RECs) to claim that they are powering their hydrogen production via renewable energy?

See also our work on climate-related questions that Senate-confirmed nominees should be required to answer.

[1] Google, a major hydrogen purchaser, acknowledges this is a problem in its comment to the Department of Energy on the Clean Hydrogen Production Standard.