Executive Briefing

How Much, How Fast: Infrastructure Requirements of EPA's Proposed Power Plant Rules

In February 2023, the Energy Futures Initiative (EFI) released **The U.S. Hydrogen Demand Action Plan**, recommending policies for accelerating domestic hydrogen offtake. The EFI Foundation is following up with a new report series, called the **U.S. Hydrogen Infrastructure Action Plan**, analyzing the opportunities of hydrogen infrastructure for enabling market formation.

How Much, How Fast: Infrastructure Requirements of EPA's Proposed Power Plant Rules, is the first report in this series, focusing on the infrastructure needs of the U.S. Environmental Protection Agency's (EPA's) proposed rules for fossil-fueled power plant emissions reductions. This modeling-driven study analyzes the potential outcomes of EPA's proposal on the energy system by region, including the costs of the potential electricity, hydrogen, and carbon dioxide (CO_2) infrastructure requirements.

The study reached three main takeaways:

Takeaway 1: EPA's proposal reflects the need for very aggressive power sector decarbonization

EPA is proposing new emission standards for fossil fuel-fired power plants. EPA finds that its proposal could reduce power sector emissions by more than 40 million tons (Mt) per year from 2028 and 2042.[1,a] The proposal requires all existing coal plants and large natural gas generators adopt new emission reduction technologies starting in 2030 and 2032, respectively. EPA's proposal specifies highly-efficient generation, blending clean hydrogen with natural gas, and carbon capture and storage (CCS) as the low-carbon technologies for compliance. Together, these technologies are also called the "best system of emission reduction" (BSER).

This proposal comes at a dynamic time for the power sector. Electricity emissions have fallen by 40% from 2005 to 2022, driven primarily by the shift to natural gas and renewables.[2] The Biden administration set a target of 100% carbon pollution-free electricity by 2035, and utilities covering nearly 80% of U.S. customers have set 100% carbon reduction targets.[3] Meanwhile, the Infrastructure Investment and Jobs Act (IIJA) and the Inflation Reduction Act (IRA) offer a range of financial incentives across the CCS and clean hydrogen value chains.

EPA's proposal recognizes an important role for natural gas in the electricity mix. EPA's projections show this proposal will increase gas-fired generation through 2030 (before falling by 2040) and expand gas generation capacity by 2040. EPA also sees modest increases of gas-fired generation with CCS (8 GW by 2040) and co-firing hydrogen with natural gas (17 GW total by 2040).

---

[a] In July 2023, EPA issued updated modeling results with 9,419 MMT of cumulative emission reduction through 2042. Because the update did not include the full suite of modeling assumptions, the RIA analysis was used for reference in this report.

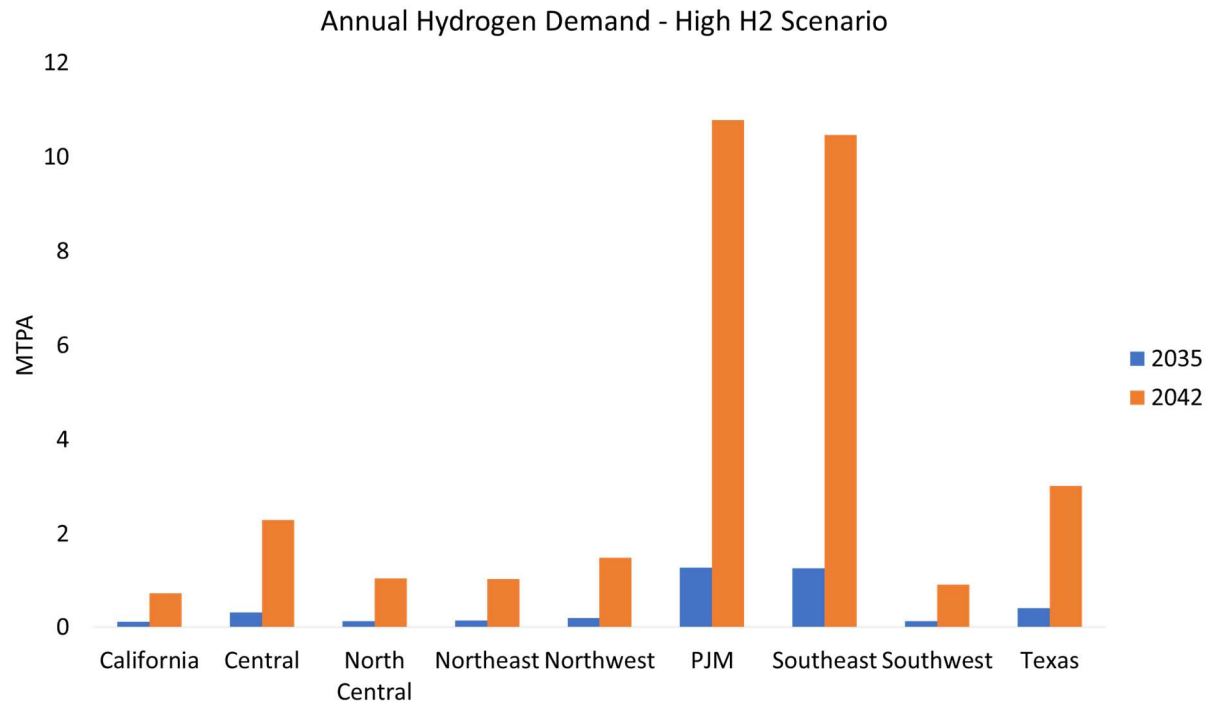
Takeaway 2: EPA's proposal creates challenging timeframes for scaling new clean energy resources

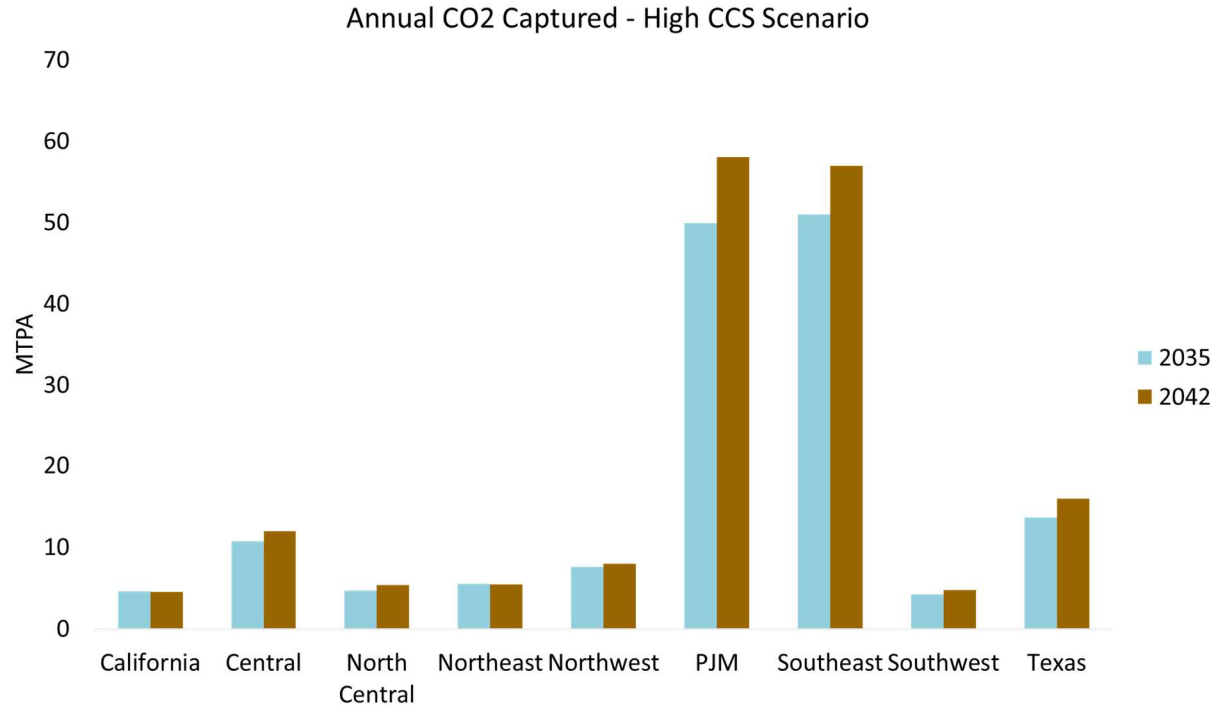
The EFI Foundation analyzed the possible infrastructure requirements of EPA's proposal using the Sustainable Energy System Analysis Modeling Environment (SESAME) modeling platform. Across all EFI Foundation scenarios, major infrastructure deployments are needed in the next decade that could limit implementation, especially due to the highly decentralized nature of fossil generators and regional electricity structures.

- EFI Foundation modeling finds that unabated coal would phase out by 2035, as adopting CCS on existing coal by 2030—per the proposal—faces significant financial and permitting headwinds.
- Roughly a 5x increase in solar, a 3x increase in wind, and a 6x increase in battery storage capacity is needed by 2035, compared to today.
- Hydrogen demand may reach 4 million tons per year (MTPA) in 2035 and 32 MTPA by 2042 (Figure 1). As the regional analysis shows, this would take roughly 850 GWs of dedicated renewables to produce hydrogen at the life cycle emissions limit proposed by EPA, 0.45 kg CO_2e per kg H_2, by 2038. Building this amount of wind and solar dedicated to hydrogen production is 1.5x the scale that renewables are being added to the entire grid (i.e., 36 GWs in 2023) per year through 2042.
- To deliver this hydrogen production to the power plants, more than 11,000 miles of new hydrogen pipelines (transmission and distribution) and more than 5,000 compressed hydrogen storage sites (50 tons capacity each) will be needed by 2035. For context, there is around 1,600 miles of hydrogen pipeline in operation in the U.S. today.
- According to EFI Foundation modeling, the capital expenditures needed to meet EPA's proposal are intrinsically tied to broader decarbonization deployments; absent this policy, there will still need to be gigawatt-scale deployments of new wind and solar to reach net-zero emissions. EFI Foundation modeling scenarios show CAPEX requirements between $32 and $60 billion per year by 2035, with significant regional variation.

Achieving this level of infrastructure deployment requires complementary permitting reform for electricity, hydrogen, and CO_2 systems, enabled by a new workforce and extensive supply chains. While IIJA and IRA incentives offer game-changing support for these technologies, neither policy adequately addresses the permitting reform needed to scale CCS and clean hydrogen infrastructure in the proposal's timeframes. The White House and Congress put forth multiple proposals for energy permitting reform since the passage of the IRA to help fill this critical gap. Due to the cross-jurisdictional nature of electric power, CCS, and hydrogen projects, these reforms will need to greatly improve coordination between firms, sectors, and governments.

Figure 1. Comparing Regional Hydrogen Demand and CO_2 Capture in 2035 and 2045 Scenarios





Takeaway 3: EPA's proposal creates opportunities to advance CCS and clean hydrogen deployment

EPA's current proposal faces major implementation challenges, considering the amount of infrastructure that could be needed in the next decade to support potentially hundreds of new and existing generators throughout the country. EPA should consider ways to add flexibility, and more regionality, to its approaches to ensure large-scale decarbonization efforts are deployed moving forward. The following are three examples of how EPA and other relevant federal and state agencies can support CCS and clean hydrogen in electric sector decarbonization:

- *Align new federal policies advancing CCS and clean hydrogen deployment to the IRA.* The IRA directed tens of billions into new and expanded incentives for CCS and extended the construction window for eligibility of the 45Q credits to January 1, 2033. EPA's proposal requires coal-fired units that plan to operate beyond 2039 to place carbon capture into service by 2030, two years ahead of the 45Q credit deadline to begin construction. Aligning EPA with the existing 45Q policy requirements could improve investor confidence regarding the timing of developing and permitting CCS projects. EPA could adopt the IRA's definition of clean hydrogen. Cost-effectively reaching very low life cycle emissions is one of the biggest challenges for clean hydrogen projects. This is why the IRA created flexibility for accessing the 45V tax credits for hydrogen production with a Life Cycle Assessment (LCA) of <4.0 kg CO_2e/kg H_2. EPA's proposal, however, defines "clean" as LCA of 0.45 kg CO_2e/kg H_2, significantly impacting the cost and type, scale, and regional diversity of eligible projects. For example, EFI modeling finds the delivered cost of hydrogen in the Carolinas under the proposal is around $8/kg in 2035, compared to EPA's estimate of $0.5/kg.[4] As previously mentioned, in a *High H2* scenario, this policy could require 115 GWs of new wind and solar projects by 2035 dedicated to only clean hydrogen production.

- *Develop clear compliance metrics, with maximum regional flexibility, for new decarbonization proposals.* EPA's proposed BSER may lack sufficient regional flexibility to reach compliance in the proposed timeframes, while managing costs and reliability. Areas of the country without abundant, low-cost renewables, access to low-cost CO_2 storage, or other alternatives (e.g., existing nuclear) may see measurably higher costs when implementing EPA's proposal compared to other regions. The Clean Air Act (CAA) currently supports regional approaches through a state planning process, allowing regional entities to propose optimal systems of emission reduction for their own jurisdictions that must achieve the necessary environmental performance outlined by EPA's proposal. EPA should encourage the use of State Plans, offering robust federal-state collaboration and clear metrics for how each state plan can reach compliance (e.g., offering guidance on what qualifies as achieving the state equivalent of total emission reductions, aligned to EPA's proposal). EPA should be explicit about how each state can reach compliance. For example, EPA could clarify that emission trading regimes and technology emission performance "averaging" can be used in State Plans. EPA could also explicitly allow legislated state policies (e.g., Regional Greenhouse Gas Initiative[b]) for electricity decarbonization that meet or exceed the performance of EPA's proposal, creating a more synchronous federal and state policy environment. EPA should also consider developing a similar approach to State Plans that cover new generating units.

[b] https://www.rggi.org/

- *Create permitting reforms for rapid scaling of electricity, CO_2, and hydrogen, infrastructure.* EPA's proposed rules do not fully consider the risks of permitting delays, which can be significant when deploying first-of-a-kind (FOAK) technologies. Improving the permitting of new and refurbished clean energy infrastructure will require a whole-of-government effort and strong state, regional, and local partnerships. EPA should work with the White House and Congress to ensure that its decarbonization proposals reflect current permitting needs and challenges. Without complementary permitting reform, EPA could consider how to build in additional flexibility to address these uncertainties. EPA could also consider hub-like structures in its proposals to limit the sizeable infrastructure builds needed for individual plants across many regions of the country. Additionally, the Federal Energy Regulatory Commission (FERC) could begin the process of regulating the blending of hydrogen into interstate natural gas pipelines, an important step for hydrogen demonstrations that aligns with FERC authority.

---

[1] U.S. Environmental Protection Agency, Regulatory Impact Analysis for the Proposed New Source Performance Standards for Greenhouse Gas Emissions from New, Modified, and Reconstructed Fossil Fuel-Fired Electric Generating Units; Emission Guidelines for Greenhouse Gas Emissions from Existing Fossil Fuel-Fired Electric Generating Units; and Repeal of the Affordable Clean Energy Rule, EPA-452/R-23-006 (2023). https://www.epa.gov/system/files/documents/2023-05/utilities_ria_proposal_2023-05.pdf., p. 4-15

[2] U.S. Energy Information Administration, "Annual Energy Outlook 2023." Accessed October 2, 2023. https://www.eia.gov/outlooks/aeo/index.php.

[3] Smart Electric Power Alliance, "Utility Carbon-Reduction Tracker™." Accessed October 2, 2023. https://sepapower.org/utility-transformation-challenge/utility-carbon-reduction-tracker/.

[4] Energy Futures Initiative, "The U.S. Hydrogen Demand Action Plan," February 2023. https://efifoundation.org/wp-content/uploads/sites/3/2023/02/EFI-Hydrogen-Hubs-FINAL-2-1.pdf.