C2ES CENTER FOR CLIMATE AND ENERGY SOLUTIONS

# REGIONAL ROUNDTABLE: FIRING UP CLEAN HYDROGEN IN TEXAS
# JUNE 15, 2023
# KEY TAKEAWAYS

**Note:** Key takeaways represent statements made in the roundtable discussion and do not necessarily reflect C2ES positions or opinion.

## Overall key takeaways

- As the energy capital of the world, Houston is well-positioned to lead the energy transition by utilizing its skilled workforce, concentration of thousands of companies across the energy industry, existing infrastructure, and access to domestic and global markets.
- The affordability and reliability of supply will be essential to enabling the uptake of low-carbon hydrogen globally.
- As the clean hydrogen industry scales up, infrastructure for each part of the value chain—from production, to distribution, to storage to utilization—must keep pace with the other parts. Significant funding has been invested to date into the development of hydrogen production, but less has been invested into the development of transport, storage, and distribution infrastructure, constraining the development of the industry as a whole.
- Equitably and holistically involving all stakeholders early in the process, especially those who will be impacted by projects or working on them, is essential to creating a path forward for development.
- A central challenge to the uptake of low-carbon hydrogen at scale will be building out accessible infrastructure for transport between the point of production to the point of end-use. Currently, there is no transparent regulatory framework for hydrogen transport at the federal or state levels as there is for natural gas. Regulators looking to update this framework for hydrogen should consider natural gas as precedent.
- With the combination of large-scale deployment of renewables, federal funding, new industry players, and unprecedented investment from the Department of Energy in research, development, demonstration, and deployment, the present moment is the "golden age of hydrogen"—an opportunity for large-scale commercialization.

## Promoting clean hydrogen production

- How "clean" hydrogen is defined impacts the near- to mid-term ability of the industry to scale at the pace necessary to meet mid-century emissions reduction goals. Hydrogen produced through electrolysis emits less carbon than hydrogen produced via steam methane reforming (SMR) using carbon capture and storage (CCS), but both of them have lower carbon intensity than the unabated hydrogen produced today. To meet global demand in the near term, an overwhelming proportion of hydrogen will need to be produced using SMR with CCS rather than electrolysis due to the many immediate challenges to scaling this production pathway. Hindering the development of SMR with CCS will diminish the volume of low-carbon hydrogen that can be produced in the coming decades.

- A stable regulatory environment is essential to enable the growth of the clean hydrogen industry. Regulatory authority must be clear and transparent to facilitate timely permitting decisions and near-term build-out at scale. Additionally, longer-term regulatory certainty is necessary to enable companies to make capital- and time-intensive investments.
- In the near-term, the challenge of building out all the pieces of the hydrogen value chain can be made more manageable by focusing on small, geographically concentrated areas with access to industry offtakers and distribution like ports. This is the basis for the "hubs" model in the United States and Europe.
- The current regulatory framework for natural gas and hydrogen transport and storage in Texas is insufficient to apply to clean hydrogen, although recent legislation is helping to update it. Additional updates are necessary to support hydrogen produced through pathways not associated with oil and gas development, i.e. hydrogen produced using renewables.
- More pathways for hydrogen development exist outside of the traditional SMR or electrolyzer production pathways; for example, hydrogen produced through biotechnology, can utilize existing oil and gas reservoirs while producing few process emissions. Also, methane pyrolysis decomposes natural gas under high temperatures and generates no carbon dioxide, only hydrogen and solid carbon.

## Creating clean hydrogen demand

- A carbon tax or other means of internalizing the cost of carbon at the point of purchase could help shift purchasing behavior to lower carbon products by reducing the difference in the cost to consumer between conventional fuels and low-carbon fuels.
    - In cases where low carbon intensity (CI) products are more expensive than high carbon intensity products, even if the difference in price is very small, the designation of the lower CI products as "green" or "clean"—i.e., subjectively better—is not generally enough to overcome consumers' objections to higher cost products.
- Building out the infrastructure to support transporting hydrogen overseas could help clean hydrogen producers in Texas access international markets like Europe and Asia. Ammonia ($NH_3$) could be utilized as a medium to transport low-carbon hydrogen over long distances, i.e. overseas via shipping, at a lower cost than moving $H_2$.
- First movers who are willing to pay incrementally more for clean hydrogen over high carbon intensity hydrogen could jumpstart a global market for decarbonized hydrogen solutions. These first movers need an avenue to communicate to producers that they are willing to pay this premium for the fuel.
- Some existing gas turbines are already designed to use a blend of hydrogen to generate electricity at a scale much greater than the volume of clean hydrogen that can be supplied cost effectively. Along this utilization pathway, demand could far outstrip supply, and most near-term challenges are concentrated on the production and distribution side.
- As the cost of electricity scales nearly linearly with the cost of fuel inputs used to produce it, significant increases in the prices of fuel inputs for generating electricity (e.g., shifting from natural gas to hydrogen for power production, currently around an eight-fold price increase) will significantly

increase the cost of electricity, creating or exacerbating an energy burden on many, particularly low-income customers.
    - As the economics improve, utilizing hydrogen to produce dispatchable low-emission electricity to complement renewables could be a long term solution for decarbonizing the electricity sector.
- However, in the long term, the application of clean hydrogen in hard-to-abate sectors including long-haul transportation, steel production, methanol production, biofuel processing, crude oil refining, and other high-heat industrial processes will yield greater overall decarbonization benefits and energy efficiency gains than in the power sector.
- There is often a high discrepancy between the price of clean hydrogen at the point of production and delivery. For example, the retail price of hydrogen as a transportation fuel incorporates the cost of liquefaction, transportation, chilling, as well as building, operating, and maintaining the fueling station. With little innovation and investment in the design and deployment of hydrogen fueling stations, they may be costly, unreliable, or inefficient, making it more difficult for drivers to have the support and confidence they need to transition to hydrogen fuel cell powered vehicles.
    - Aging hydrogen fueling stations may be difficult to repair due to the small number of stations in existence. Many were built to outdated specifications that may be less efficient because they were set to match hydrogen produced using older technology.
- In the industrial sector, switching to clean hydrogen requires companies to make significant up-front capital investments. Reducing the risks associated with these investments will be key to supporting growth in the market for hydrogen.

## Transporting and distributing clean hydrogen

- A main challenge for the scalability of clean hydrogen is the ability to transport it from the point of production to the point of end use. Theoretically, existing natural gas pipelines could be utilized, but there are significant technological, economic, and regulatory constraints.
    - Physically, transporting a blend of hydrogen and natural gas at concentrations greater than ~20 percent hydrogen by volume is not currently possible as the hydrogen molecule is small and will leak and/or cause pipeline embrittlement.
    - The permitting process for new pipelines is challenging and can take years. In the case of hydrogen pipelines, particularly interstate pipelines, regulatory questions remain including those surrounding which federal agencies have jurisdiction, and how to balance federal and state regulations.
- An open access model for pipelines, based on the natural gas industry where any company who meets predetermined standards can access the infrastructure, could help create a robust market for clean hydrogen.
- Regulations setting limits on emissions from transportation and electricity generation could create a consistent timeline for the shift to lower carbon fuels, providing certainty not only for regulated companies, but those who are making products like hydrogen that will be crucial to compliance. At the same time, especially for applications in the trucking sector, financial incentives and safeguards should also be utilized to reduce the risk for individual operators making the switch to hydrogen. The interdependence of the segments of the hydrogen industry mean coordinated growth in both supply

and demand will be crucial to scaling the storage and transportation infrastructure necessary for the industry to grow.

## Engaging workers and communities

- Workers and communities must be proactively engaged in discussions *and* decisions about the energy transition, as they will be building and hosting the energy system of the future.
- When deploying new clean hydrogen infrastructure, project developers and infrastructure owners should engage with local communities to seek input and build buy-in among the residents and workers who will be directly impacted, with engagement beginning long before any project development starts. Federal funding and guidelines currently encourage community engagement and community benefits, including through the JUSTICE40 initiative, but the guidance must be clarified around several key programmatic parameters.
- There is a gap in public education about the opportunities and drawbacks of hydrogen deployment. In particular, communities that will be directly impacted by projects must have access to accessible, transparent, comprehensive information about the fuel and its associated infrastructure.
- Ports are often located among disadvantaged communities, producing harmful emissions that adversely impact health and reduce the economic prospects of local residents. Shifting to hydrogen fuel for local operations could help to reduce the air pollution impacting these communities. However, this comes with a trade-off; many communities may be skeptical or opposed to new hydrogen infrastructure. Ports must proactively and continuously engage with communities to ensure their concerns are heard and addressed.
- Companies can build buy-in among local communities by hiring local workers for new projects, ensuring positive outcomes from the project are shared with the communities that host them.
    - Paid, DOL-registered apprenticeship programs can help local workers build new skills to meet the needs of the industry while providing financial compensation and other wraparound support while workers are in training.
- Many of the necessary skills for work in the oil and gas sector are directly transferrable to work on clean hydrogen, not only in engineering and fabrication but also in business administration, construction, operations, and maintenance. There is also an opportunity for growth in relevant fields such as electrochemistry.
- There is an opportunity to diversify the workforce across all role types to better reflect the local community in Houston.
- Worker safety is crucial to growing and retaining the workforce in this industry. Many prospective workers are put off by the real and perceived safety concerns associated with jobs in the oil and gas and chemical industries. Apprenticeship programs, comprehensive and worker-driven training programs and policies can help improve safety and the appeal of these jobs. However, additional safety regulations, on par with those in other states, will be crucial to address worker safety, and workforce development goals in the state.
    - Expanding the clean hydrogen industry presents an opportunity to raise job standards, which can be reinforced by local and federal policies, employer practice change, cross-sector collaboration, and worker training.

- To inform communities about the opportunities and risks associated with hydrogen production, transport, and storage, companies, local NGOs, and policymakers should build an education model informed by the real needs of communities about the energy system as a whole, as well as the specific role of hydrogen among all decarbonization solutions. This educational information must be disseminated by a trusted messenger.
- In addition to quantifying the economic and environmental impacts of projects, developers should also measure and communicate the social impacts of projects to build buy-in among local communities.