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U.S. DOE Releases Report on Clean Hydrogen Strategy and Roadmap

The United States recently took another important step in implementing a comprehensive strategy to advance the production, processing, delivery, storage, and use of clean hydrogen. On June 5, 2023, the Biden-Harris Administration released the U.S. National Clean Hydrogen Strategy and Roadmap (the “Hydrogen Roadmap”). The Hydrogen Roadmap serves as a summary of the current state of hydrogen production, transport, storage, and use in the United States. It also is forward-looking, providing predictions for how clean hydrogen will contribute to national decarbonization goals and estimates of future demand scenarios for clean hydrogen.

Below, we provide an overview of the key components of the Hydrogen Roadmap, focusing on:

- The need and opportunities for clean hydrogen;
- Challenges to achieving the benefits of clean hydrogen; and
- Strategies for helping to overcome these challenges.

THE NEED AND OPPORTUNITIES FOR CLEAN HYDROGEN

The Hydrogen Roadmap reaffirms unequivocally that hydrogen is a key tool available to support the United States’ transition to a net-zero economy (one in which carbon emissions associated with combustion of fossil fuels are essentially eliminated or captured and stored). As indicated in the Hydrogen Roadmap, hydrogen offers the promise of leveraging regional resources and creating equitable and sustainable growth in ways that displace sources of energy that generate greater carbon emissions. As a versatile energy carrier and chemical feedstock, hydrogen offers advantages that can improve the performance of other low-carbon energy resources, including renewables, nuclear, and fossil fuels with associated carbon capture and storage (CCS). Hydrogen is, therefore, an “enabling” technology, supporting the economics and reliability of renewable sources of electric generation through long-



duration energy storage and offering flexibility and multiple revenue streams to incentivize the development of clean power generation, such as advanced nuclear technology.

Having outlined the need for clean hydrogen to help the United States achieve its decarbonization goals, the Hydrogen Roadmap then discusses opportunities in the clean hydrogen space. These market opportunities are numerous because clean hydrogen can be produced from diverse domestic resources and used across sectors while being able to complement today's conventional grid and natural gas infrastructure. However, making hydrogen at large scale on a cost-competitive basis remains challenging. To help support initial project development efforts, the Bipartisan Infrastructure Law (the "BIL"), and the Inflation Reduction Act of 2022 (the "IRA"), provide a variety of tax incentive and grant and loan guarantee programs to support hydrogen-based projects.

Regional Clean Hydrogen Hubs. Regional Clean Hydrogen Hubs are networks that feature clean hydrogen producers, clean hydrogen consumers, and connective infrastructure located in close proximity to each other. The BIL provides \$8 billion to the Department of Energy ("DOE") to support the development of 4-8 large-scale regional hubs. DOE is currently reviewing applications for this program and intends to select recipients to begin initial development efforts in the coming year.

Tax Credits. The IRA provides several tax credits intended to support the development of both supply and demand for clean hydrogen. Tax credits cover the whole hydrogen ecosystem, from a clean hydrogen production tax credit ("PTC"), which provides a credit of up to \$3 per kilogram of clean hydrogen produced, to an investment tax credit for hydrogen storage equipment of up to 40 percent of qualifying costs if certain stringent domestic content requirements are met and even up to 50 percent if the domestic content requirements are satisfied and the hydrogen storage project is located within an "energy community," and tax credits for hydrogen fuel cell vehicles and their refueling stations.¹ Combined with state-level incentives such as a low carbon fuel standard (LCFS), the clean hydrogen PTC can make hydrogen more cost-competitive than would be possible without the subsidies, in some cases accelerating the breakeven point by more than a decade.

DOE Funding. The BIL and IRA also provide for tens of billions of dollars in additional DOE funding support for clean and renewable energy projects. This includes loan guarantee funding to support the development of hydrogen projects, including infrastructure-based projects repurposing oil and gas pipelines to use to transport hydrogen. There are also DOE funding opportunities to support the development of key parts of the supply chain for hydrogen projects, including electrolyzers and other essential equipment.

CHALLENGES TO ACHIEVING THE BENEFITS OF CLEAN HYDROGEN

Although clean hydrogen technology is improving and costs of producing clean hydrogen have decreased in recent years, there remain financial and technological challenges that stand in the way of continued growth of the domestic clean hydrogen economy. The Hydrogen Roadmap specifically notes that in addition to cost considerations, a "lack of ubiquitous hydrogen distribution infrastructure" and a lack of manufacturing at scale are two important challenges. As explained by DOE, "Hydrogen transportation —such as pipelines, tube trailers, liquefaction, siting, permitting, and materials compatibility —remains an obstacle" and some producers continue to struggle to find offtakers with sufficient hydrogen demand willing to sign long-term contracts. Furthermore, the weight and volume of hydrogen storage systems required to safely transport and store hydrogen can be cost prohibitive. To underscore these challenges, the Hydrogen Roadmap notes data from California which shows the delivered cost of hydrogen to fueling stations can be more than three times higher than the cost required to be competitive. The Hydrogen Roadmap emphasizes that logistical costs need to "fall significantly compared to their current level if hydrogen is to become competitive from a sustainable, market-driven perspective."



STRATEGIES AND IMPLEMENTATION

The Hydrogen Roadmap identifies three strategies “to ensure that clean hydrogen is developed and adopted as an effective decarbonization tool and for maximum benefits for the United States.” These three strategies are: (1) target strategic, high-impact uses of clean hydrogen; (2) reduce the cost of clean hydrogen; and (3) focus on regional networks. The first strategy addresses the use of hydrogen in industrial applications such as chemicals and steelmaking, transportation, and the power sector. The second strategy contemplates reducing the cost of clean hydrogen to \$1 per kilogram in the next decade. The third strategy focuses on achieving large-scale, commercially viable deployment of clean hydrogen by matching the scaleup of clean hydrogen supplies with growing regional demand.

To implement the strategies, the Hydrogen Roadmap identifies actions the federal government is undertaking to achieve the benefits of clean hydrogen:

Funding. As described above, the IRA and BIL provide significant funding support for clean hydrogen projects and technology development and deployment.

Guidelines and standards. The Hydrogen Roadmap identifies a variety of steps DOE will take to address areas where uncertainty stands in the way of advancement of hydrogen projects and technologies.

For example, DOE is developing a Clean Hydrogen Production Standard, which will serve, among other things, as a guide for the Regional Clean Hydrogen Hubs and the Clean Hydrogen Research and Development Program. The standard will (1) support clean hydrogen production from specified low carbon energy sources (including but not limited to fossil fuels with carbon capture and sequestration; hydrogen-carrier fuels (including ethanol and methanol), renewable energy resources, including biomass, and nuclear energy); (2) define “clean hydrogen” to mean hydrogen produced with a carbon intensity equal to or less than 2 kilograms of carbon dioxide-equivalent produced at the site of production per kilogram of hydrogen produced; and (3) consider “technological and economic feasibility.” DOE aims to establish this standard sometime between 2023-2025.

DOE will also: (1) lay the regulatory groundwork for large-scale clean hydrogen deployments across production, processing, delivery, storage, and end-use; (2) develop streamlined guidance on hydrogen pipeline and large-scale project permitting; (3) address challenges to increase supply of electrolyzers available for renewable and nuclear energy efforts; and (4) develop national guidance for hydrogen blending limits.

Notwithstanding these promised government actions, the Hydrogen Roadmap does not address certain critical issues, such as the definition of clean hydrogen used to determine eligibility for the clean hydrogen PTC. It is unclear whether hydrogen production powered by nuclear energy, for example, qualifies. The question of “additionality”, whether hydrogen production needs to be powered by additional clean energy sources, and how that would even be measured, also remains open. DOE Secretary Granholm has stated it is something that is being weighed by DOE but she has not provided an indication of where DOE will land on this topic as it is very likely to influence the IRS’s view of clean hydrogen under the PTC.

Research. The Hydrogen Roadmap offers conceptual summaries of research that government can foster to fill technological gaps. For example, the Hydrogen Roadmap addresses research and development for uses of hydrogen in medium- and heavy-duty trucks, rail, maritime transportation, and aviation, as well as for the deployment of regional hydrogen networks.

Community Engagement. DOE describes guiding principles for defining success in communities in which hydrogen technologies will be deployed. DOE also plans to develop and implement frameworks for broad and inclusive community engagement, with specific focus on environmental justice and disadvantaged communities. The purpose of these efforts will be to ensure broad participation and to gather stakeholder feedback. The Hydrogen Roadmap does not address how



DOE will balance its community engagement objectives with other priorities, such as streamlined permitting and regional network location preferences.

OBSERVATIONS AND CONCLUSION

The Hydrogen Roadmap provides a useful overview of the burgeoning clean hydrogen industry in the United States and throughout the world, as well as the critical steps needed to push these efforts forward. It notes the transformative potential that hydrogen offers to support decarbonization efforts and the significant financial and regulatory support that the federal government is providing to help with these efforts. However, the Hydrogen Roadmap also notes the significant challenges that lie ahead, and the need for active engagement by industry, the government, and other stakeholders to ensure the broad commercial success of hydrogen through many different forms. A cross-practice group of attorneys at King & Spalding have been assisting clients across the entire spectrum of hydrogen-related projects (including the supply chain, hydrogen generation, transport, storage, and offtake, including their permitting, government incentive, and community engagement strategies) and are uniquely situated to help companies navigate both the opportunities and challenges identified in the Hydrogen Roadmap.

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¹ For more information on the clean hydrogen PTC and related tax credits, see our H₂ypothetical series. The first series can be found [here](#).