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Hearing to examine the use of existing energy infrastructure in building a U.S. hydrogen economy
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Chairman Manchin, Ranking Member Barrasso, and Members of the Committee, thank you for the opportunity to testify today on the opportunities and challenges of building a robust hydrogen economy in the United States.

My name is Brian Hlavinka and I currently direct the New Energy Ventures group within Williams. My group is a business development team committed to building sustainable, decarbonization solutions for a clean energy future. I am the founding Vice Chairman of the Clean Hydrogen Future Coalition, a Leadership Advisory Board Member of the Coalition for Renewable Natural Gas, and an Energy-Tech Leadership Council Member of Tulsa Innovation Labs. I graduated with a Chemical Engineering degree from Texas A&M University and hold an Executive Masters of Business Administration from the University of Houston.

Williams was the first North American midstream company to establish a climate commitment, which sets a near-term goal of a 56% reduction in greenhouse gas emissions by 2030 from 2005 levels. This is well in line with the country's recently announced Nationally Determined Contribution target of a 50-52% emissions reduction by 2030. Williams is leveraging its natural gas-focused strategy and technology that is available today to capture immediate opportunities to reduce emissions and scale solutions to build a clean energy economy – while looking forward and anticipating future innovations and technologies. Our path to net zero by 2050 involves a combination of immediate and long-term solutions, including investments in renewables, low carbon solutions, technology and a talented workforce committed to doing what is right.

Specifically, Williams is placing an increasing focus on the unlocked vast potential of clean hydrogen. As one of the largest and most experienced midstream companies in the United States, Williams serves as the link between upstream energy producers and downstream users. We own and operate more than 30,000 miles of pipelines system wide – including Transco, the nation's largest by volume and fastest growing pipeline. We handle approximately 30 percent of the natural gas in the United States that is used every day for clean-power generation, heating and industrial use. Williams serves major markets from the Gulf Coast to the Atlantic Seaboard, the Northeast (including Washington D.C. and New York City) as well as the population centers in the Pacific Northwest.

Our nationwide pipeline and asset footprint is well-positioned with end-use demand, particularly in highly populated areas, to participate in hydrogen-based energy transportation and storage at scale. The potential to blend hydrogen into our existing natural gas stream is a significant advantage to accelerate the use of hydrogen in reducing carbon emissions across many sectors and applications particularly those most difficult to decarbonize. In addition to helping our customers meet their environmental goals, hydrogen has great promise in helping Williams meet its own goals.

We appreciate you holding this hearing and appreciate the committee's interest in hydrogen. While the production, transportation and use of clean hydrogen in the United States is in its early days with research and pilot projects, and associated technical manufacturing underway, we believe the nation's best-in-class

energy infrastructure provides a super-highway for moving large amounts of hydrogen to key markets in the coming decades.

Hydrogen Basics

Hydrogen is the simplest and most abundant element in the universe. Stars including our sun are mostly hydrogen. The giant engines that powered NASA's Saturn V rockets to the moon and the space shuttle used hydrogen as a fuel. Hydrogen is an incredibly versatile molecule as it can be used in fueling applications, as feedstock and energy storage. Today, most of the hydrogen used in the world is for industrial processes, in particular refining and petrochemical applications such as ammonia production for fertilizer. However, hydrogen can also power vehicles such as long-haul trucks, heat homes and buildings, provide fuel for large-scale power generation, offer carbon free combustion and act as storage for massive amounts of renewable energy and load response for grid stability.

Hydrogen can be produced from a variety of sources including natural gas, renewables, coal and even nuclear power. The manner in which hydrogen is produced determines its emissions profile. There are two primary methods for producing "clean hydrogen" with low or zero emissions. The first is using natural gas in traditional steam methane reforming but then followed by carbon capture and storage and/or utilization to produce clean hydrogen. This is commonly referred to as "blue" hydrogen by industry. The second is taking electricity from renewables such as wind and solar and running it through a process called water electrolysis to produce what is known as "green" hydrogen. This concept can balance the intermittency of wind and solar power to create a dispatchable, clean molecule to meet energy demand. These two hydrogen production methods are generating the greatest interest in the energy industry because of their environmental benefits.

Clean hydrogen production is significantly more expensive than traditional hydrogen production methods with higher emissions primarily because of the costs of renewable power, electrolyzer technology and carbon capture. The cost of solar and wind power generation continues to rapidly decrease and electrolyzer costs are expected to drop significantly with increased demand and scale-up of market opportunities and production facilities. Advances in technology continue to provide new ways to produce clean hydrogen with ever improving economics.

Global momentum is building quickly to tap into the versatility of hydrogen and its potential for reducing carbon emissions. According to the Hydrogen Council, a leading international hydrogen advocacy organization, more than 520 hydrogen projects were announced in 2021, up significantly from those 2020. More than half of the announced hydrogen projects are in Europe, but there are also many announced in Asia, Oceania, North America, the Middle East, Africa and Latin America. Many of these projects are still in the funding and feasibility stages and need the right regulatory framework to move forward.

Technical and Commercial Challenges

If a hydrogen economy is to be developed at a national or even regional level, massive volumes of the molecule will have to be produced and transported to service a wide variety of applications – from difficult to decarbonize industrial applications to home heating to electric power generation. Large scale hydrogen transportation infrastructure is in its early stages of development. There are just over 1,600 miles of dedicated hydrogen pipeline in the U.S. with the majority in the Gulf Coast, Texas and California. This compares to over 2.3 million miles of natural gas pipeline in the country. This massive amount of existing natural gas infrastructure presents the potential for companies to blend hydrogen in relatively small amounts into the natural gas stream and transport it to end users.

The use of pipelines for hydrogen transportation at scale is more cost effective than compressed tube or liquefied trailers, but there are technical and commercial challenges. While hydrogen has the highest

energy content of any fuel by mass, it is 9-10 times less dense than natural gas by volume. This and other characteristics must be considered in technical and commercial evaluations when blending hydrogen into natural gas streams. Cost competitiveness of clean hydrogen to traditional fossil fuel-based hydrogen and fossil fuels in general is needed to support growth at scale. Programs like the DOE Earthshot effort to achieve $1 per kilogram of clean hydrogen by 2030 are critical.

Utilization of hydrogen requires addressing associated safety considerations. There are technical issues to work through to maintain safety, reliability and asset integrity prior to development and widespread deployment. However, there is significant industry experience in hydrogen safety, operations and leak detection. Organizations such as the Pipeline Research Council International, of which Williams is a member, are actively working to address these and other technical challenges.

Williams is studying the impact of blending clean hydrogen with natural gas in our pipeline infrastructure. This key tool for decarbonization could reduce downstream greenhouse gas emissions for customers along our infrastructure network and aid them in achieving their own emissions reduction objectives. Williams will also be evaluating the potential to use hydrogen blended fuel for powering our own compression assets to reduce Scope 1 emissions. Additionally, there is potential for our processing facilities and compression assets, coupled with clean hydrogen sourced from renewable power and electrolysis, to generate synthetic natural gas and distribute to our customer base. This process known as methanation can reduce carbon dioxide and utilize hydrogen with no adverse impact on existing pipeline infrastructure.

Hydrogen Hubs & Pilot Projects

Williams is among a small number of energy infrastructure companies that can leverage its existing resources to develop the hydrogen value proposition of providing hydrogen storage and transport at scale for renewable power production that could otherwise be curtailed and low or carbon free combustion. Our Hydrogen Development Program creates an opportunity for Williams to play a role in developing a new market with significant growth potential. We are experts at treating, processing, storing and transporting gas. This experience and our asset base provide a natural fit for Williams to contribute to the growth of a hydrogen economy.

Williams is actively working on projects such as:

- Blending hydrogen into our existing transmission pipelines
- Clean hydrogen production via methane reforming with carbon capture or utilization
- Clean hydrogen production via electrolysis with renewable power such as wind and solar
- Utilizing hydrogen blends as fuel for our compressor stations to reduce Scope 1 emissions
- Developing hydrogen-dedicated pipelines
- Developing hydrogen storage solutions
- Producing synthetic methane, or renewable natural gas, from clean hydrogen combined with captured carbon dioxide

Our clean energy hub exploration includes working with partners to create economies of scale and meaningful emissions reductions. We are investing in emerging opportunities that have significant overlap and synergies with both each other and our core natural gas business.

A great example of this type of concept we are pursuing is a Williams Wyoming Clean Energy Hub to integrate renewable power, hydrogen, captured carbon dioxide and methanation into our existing natural gas assets that originate in Wyoming. We have a history of operating energy infrastructure in Wyoming and a large and talented workforce to support it. In 2021, the Wyoming Energy Authority awarded Williams a $1 million grant in partnership with the University of Wyoming School of Energy Resources

to complete a study by Spring 2023 on the potential development of a hydrogen hub in the Wamsutter and Opal areas in the southwestern part of the state where Williams has a large concentration of assets. Based on the outcome of the study, Williams independent development efforts, the availability of potential renewable power and accessible water, the future of hydrogen development in Wyoming could be significant.

In related efforts, Williams is working with international renewable energy developer Ørsted to identify ways to leverage their renewables and hydrogen expertise with Williams' natural gas infrastructure and processing experience to co-develop hydrogen or synthetic natural gas facilities powered by renewable energy. As part of the agreement, the parties are exploring a large-scale wind energy co-development in western Wyoming where Williams owns more than a million acres of land in addition to significant natural gas infrastructure.

The concept of a hydrogen production and transportation hub in Wyoming would support the state's energy transition efforts. The hub would use large-scale local renewable energy to provide power for electrolysis to produce clean hydrogen. The hydrogen would then be injected into our pipeline assets as a blended fuel with natural gas and used within the state, as well as exported to the Pacific Northwest or other regions via our nearly 4,000-mile bi-direction transmission system known as Northwest Pipeline. This critical transmission pipeline network serves major markets in the western United States including large metropolitan areas such as Portland and Seattle. Our local Wyoming workforce brings the operational expertise while the University of Wyoming brings the technical expertise. When combined with the state's potential for large-scale renewable power production, Wyoming is a compelling fit.

In addition to our large-scale hub efforts in Wyoming, Williams is also evaluating and developing hydrogen pilot projects along our entire infrastructure footprint. One such example is a pilot project in New Jersey that when finalized will use renewable power coupled with clean hydrogen from electrolysis to deliver a blend of hydrogen and natural gas to customers in the state. This project while small in scale, will provide an excellent initial opportunity to demonstrate the capability of using established transmission infrastructure to support the development of the regional hydrogen economy and New Jersey's decarbonization efforts. We continue to work with an excellent partner in the state to develop the delivery of renewable power, the delivery of hydrogen and the overall commercialization of the project.

Williams is very active in developing other regional hydrogen hub efforts in response to the Department of Energy's request for clean projects across the entire hydrogen value chain. We are participating in hydrogen hub efforts in regions to include the Rocky Mountain region, the Gulf Coast, the Southeast, the Mid-Atlantic (Carolinas) and a region that includes Oklahoma, Arkansas and Louisiana. We will also engage in efforts in the Northeast, Pacific Northwest and Appalachia. Williams is working to be the midstream operator of choice for hydrogen hub efforts anywhere those efforts coincide with our infrastructure and can best be used to develop and deliver hydrogen at scale.

Many if not all regional efforts and development of a national hydrogen economy in general involve a strong alliance between private and public organizations. Williams is actively working with testing laboratories, industry associations, state governments, universities, utilities, customers and even selected international peer companies to take on the challenging technical issues hydrogen poses for development at scale and for continuing to promote the use of hydrogen as a major part of efforts to achieve significant decarbonization.

Williams is proud of our partnerships with universities who are developing research, technology and most importantly the workforce of tomorrow who will have the skills to thrive in an industry that will span a wide breadth of forms of energy including hydrogen. Williams is supporting the advancement of

hydrogen research at the University of Wyoming and will support multiple hydrogen and carbon capture related projects with the University of Oklahoma. We will continue to evaluate additional opportunities to partner with universities developing clean energy solutions.

Scaling Up a Hydrogen Economy

We understand that energy needs are local and distinct, and that many clean energy projects require government incentives in early developmental and operational stages to reach risk-adjusted returns. Economics will drive change at scale and equitable adoption. Incentives for hydrogen production and programs such as carbon pricing, carbon credits and development of a nascent hydrogen credit market will likely be required for zero emissions hydrogen to compete with fossil fuels and hydrogen produced with emissions. In addition, reduced capital expenditures of production equipment such as electrolyzers and market scale-up are also required for commercial readiness.

It is best to focus on the potential for hydrogen production to contribute to emissions reductions regardless of the source. This will allow for different regions of the country to leverage their respective local energy resources and economies to enable a hydrogen ecosystem at scale, as well as transition and grow the jobs that will come with it. To support this approach, any policy design should stimulate the production and use of clean hydrogen with a fully transparent lifecycle greenhouse gas accounting system applied consistently across the value chain. Policy should be fully transparent but color blind.

Williams is working with industry associations, regulators and governments to advocate for consistent policies that support retrofitting, siting and construction of clean energy infrastructure. Future work includes evaluation of mechanisms to monetize environmental attributes and achieve regulated rates of return for hydrogen projects.

Conclusion

Our country is currently facing an unprecedented challenge: meeting growing energy demand while simultaneously addressing the risks of climate change with practical solutions we can execute today. Americans want safe, reliable and affordable clean energy. As one of the largest energy infrastructure companies in the United States, we see firsthand the critical role natural gas plays today in a viable and sustainable low-carbon future by displacing carbon-heavy fossil fuels.

We also know that partnering hydrogen and renewables with natural gas supported by energy policies offers a pragmatic path toward achieving emissions reduction goals. For renewable and emerging technologies to reach their full potential, we must efficiently manage supply through the peaks and valleys of demand. Our nationwide natural gas infrastructure is adaptable to future fuels like hydrogen and we are committed to investing in these areas for the benefit of our company and the environment. Hydrogen alone cannot get the country to net-zero, but the country cannot get to net-zero without hydrogen.

Thank you for your leadership in holding this hearing today. We greatly appreciate the committee's focus on hydrogen. I would be glad to answer any questions today and to provide any additional information for the record at your request.