

Testimony of Tim Cortes, Chief Technology Officer on behalf of Plug Power Inc. before the U.S. House Appropriations Subcommittee of Energy and Water Development March 17, 2021

Good afternoon. Thank you to Chairwoman Kaptur, Ranking Member Simpson, and the entire Subcommittee for inviting me to testify before you today regarding **Domestic Manufacturing for a Clean Energy Future** and ongoing work within the U.S. Department of Energy's (DOE) Hydrogen and Fuel Cell Technologies Office (HFTO). I would like to begin by thanking the members of this committee for the opportunity to testify today and to discuss the exciting economic and environmental advantages that will benefit the United States as it employs hydrogen, thus decarbonizing its economy in the coming years. The federal government has a critical role to play in this process. Our team looks forward to working with you as you explore ways to accelerate deployment of clean hydrogen and fuel cell technologies across a wide spectrum of industries and economic sectors.

Background and Introduction

My name is Tim Cortes. Since 2015, I have been with Plug Power, Inc, and am currently the Chief Technology Officer. In my position, I am responsible for the company's long-term technology strategy and vision. When I joined the team, I was tasked with building a world class hydrogen business. Today, I am proud to say that we have developed an excellent management team focused on the installation, engineering and service of Plug Power's hydrogen fueling systems. As I will discuss later, we have grown significantly since our inception, expanding our vision to include our manufacturing capabilities.

Prior to joining Plug Power, I served as the Chief Technology Officer and Vice President of Engineering at Smiths Power. Throughout my career, I have focused on the development of critical power infrastructures in both the data center and telecommunications markets. Previous positions include working within AT&T Bell Laboratories, GNB/Exide Technologies and Power Distribution Incorporated.

About Fuel Cells

A hydrogen fuel cell (HFC) is an electrochemical power generator that combines hydrogen and oxygen to produce electricity without combustion, producing water and heat as by-products. Hydrogen fuel cells provide enough energy to power anything from commercial vehicles to drones. HFC technology offers a clean and reliable alternative energy source that is both efficient and scalable. This zero emission alternative energy source can be used in a growing number of applications. This includes a variety of electric vehicles such as forklifts, delivery vans and cars. Additionally HFCs can produce enough energy to provide both primary and backup power for a variety of commercial, industrial and residential buildings. It is also being applied to more futuristic applications like drones and mobile phone recharging.

The Benefits of a Hydrogen Economy

The 2020 McKinsey report, "[*Road Map to a US Hydrogen Economy*](#)," shared a vision of the U.S. in 2030 and 2050. In this vision hydrogen is a driver of economic growth and a tool for significant

decarbonization. It is estimated that by 2030 the U.S. hydrogen economy could generate \$140 billion per year in revenue and support 700,000 jobs across the hydrogen value chain. By 2050, this number has the potential to raise to \$750 billion per year in revenue and a cumulative 3.4 million jobs. At the same time, hydrogen has the potential to meet 14 percent of U.S. energy demand by 2050. In this application, carbon emissions would also be lowered by 16 percent, thus eliminating tailpipe particulates (nitrogen oxides and sulfur oxides) for vehicles running on hydrogen.

Achieving this vision requires collaboration between both the federal government and the private sector to establish key economic incentives that drive innovation and investment. There are key elements in creating a successful national strategy for hydrogen use in assisting the U.S. economy. Each one individually assists in building clean tech manufacturing and job creation.

1. Federal government support, through the use of its appropriating power, to support key programs at the Department of Energy (DOE,) and other agencies throughout the U.S. government. These programs empower innovative hydrogen and fuel cell research, development, demonstration and deployment. Through the procurement of hydrogen solutions, the decarbonization of the U.S. economy may be accelerated.
2. Favorable tax applications enabling the scaling up of clean hydrogen production. This assists in achieving economies of scale, thus reducing the cost of hydrogen.
3. Federal government investment in large-scale clean hydrogen production, scaling up of manufacturing of electrolyzers and fuel cells, establishing a nation-wide refueling network for on and off road zero emission vehicles, and building the infrastructure needed to transport hydrogen around the country efficiently and inexpensively.

Plug Power is Leading the Transition to a Green Hydrogen Economy

Plug Power is headquartered in Latham, New York and within Congressman Tonko's district. We also have offices in Rochester, NY, Spokane, WA; Dayton, OH (service center); Romeoville, IL (service center); Boston, MA (electrolyzer development); Charleston, TN (liquid hydrogen plant) and France (European headquarters). Plug Power's business model focuses on what is identified as green hydrogen. This is created by using emission-free renewable electricity to break apart water molecules. This process is known as electrolysis. Currently, the company is the leading provider of comprehensive hydrogen and fuel cell turnkey solutions. The company's innovative technology is used to power electric motors using hydrogen fuel cells. This technology is an example of the paradigm shift in the power, energy and transportation industries to address climate change and energy security, while striving to meet sustainability goals. From the production of green hydrogen to developing fueling stations, Plug Power's vertically-integrated solutions are activating the green hydrogen economy. We expect that we will build the first green hydrogen generation network across the U.S. Within this expectation, we are working with multiple renewable energy companies, across the country, to provide clean energy to our green hydrogen production facilities.

Plug Power created the first commercially-viable market for hydrogen fuel cell (HFC) technology. Since that time, we have deployed over 40,000 fuel cell systems for e-mobility. This roll out far exceeds the

level anyone else has accomplished - not only domestically, but internationally. Many of these systems are within your congressional districts and states. As a result, Plug Power has become the largest buyer of liquid hydrogen world-wide. This was used to build, and now operate a hydrogen highway that spans across North America through its customer facility locations. Plug Power delivers a significant value proposition to our end-users: environmental benefits, efficiency gains, fast fueling, and lower operational costs. Combined, this creates the perfect combination of incentives for businesses to invest in using clean energy. Our vertically-integrated GenKey solution ties together all critical elements to power, fuel, and provide service to customers such as Amazon, BMW, The Home Depot, Carrefour, and Walmart. The company is leveraging its know-how, modular product architecture and foundational customers to rapidly expand into other key markets including zero-emission on-road fleet vehicles, robotics, and data centers.

Today, Plug Power has deployed over 4,800 fuel cells to provide backup power for communications networks across the nation. Customers such as The Southern Company, AT&T, and CSX Railway use fuel cells to ensure that communications continue to first responders, as well as the public, during grid-impacting events such as hurricanes and firestorms.

In utilizing the technology and expanding our network nation-wide, we have created jobs across the country. Last year, during the COVID pandemic, our company added 427 new jobs. This is a 49.7% increase from the previous year. More importantly, we did not eliminate any positions during this time. Today, we employ over 1,300 people across the country and have almost 200 open positions that must be filled immediately. We also are honored to be a preferred employer for a 137 person veteran workforce. The green-collar jobs Plug Power provides, specifically on our service team, compliment the training and discipline our employees learned in the U.S. military.

Providing Industry Leadership

Plug Power's CEO, Andy Marsh, is the Chairman of the Fuel Cell and Hydrogen Energy Association (FCHEA). FCHEA represents the leading companies and organizations that are advancing innovative, clean, safe, and reliable hydrogen and fuel cell energy technologies. Their member organizations represent the full global supply chain for hydrogen and fuel cells, including automakers; material, component, stack and system manufacturers; hydrogen producers and energy companies; trade associations; utilities; and end users. Andy was also a member of the Hydrogen and Fuel Cell Technical Advisory Committee (HTAC), which was established in the Energy Policy Act of 2005 to provide technical and programmatic advice to the Energy Secretary on DOE's hydrogen research, development, and demonstration efforts. Unfortunately, HTAC was eliminated at the end of the Trump Administration and we believe it would be helpful to see a new committee created for industry to engage directly with the Secretary of Energy and her staff on the growth and needs of the burgeoning hydrogen industry.

Plug Power also participates on the Hydrogen Council[i], which is a global initiative of 90 leading energy, transport and industry companies with a united vision and long-term ambition for hydrogen to foster the energy transition. The council estimates that by 2050, hydrogen can help cut global CO2 emissions by as much as 20%, with substantial reductions coming from the transportation sector. In September

2018, the Council adopted a goal to completely decarbonize the production process [ii] for hydrogen transportation fuel by 2030.

Additionally, Plug Power is a member of other hydrogen and fuel cell initiatives including the California Hydrogen Business Council (CHBC), the National Fuel Cell Research Center (NFCRC), the Ohio Fuel Cell Coalition.

How Technology Innovation Can Grow the Market

According to the Environmental Protection Agency, light-duty vehicles (LDVs) contributed to 59% of transportation GHG emissions in the United States in 2017. The remaining 41% of these emissions came from medium and heavy duty vehicles (23%), aircraft (9%), ships and boats (3%), rail (2%), and other sources such as material handling equipment (4%). Battery electric and hydrogen fuel cell technologies play a major role in decarbonizing light-duty transportation. Hydrogen fuel cell's advantages in range, efficiency, cargo capacity, and refueling times make them ideal for decarbonizing the other mobility sectors. Our team has already identified commercial class 5 to class 8 trucks as the next phase in expanding hydrogen fuel cell transportation.

To that end, we partnered with Lightning Systems to build 'middle-mile' delivery vehicles. The result was the production of the first electric, fuel cell-powered Class 6 truck. These vehicles are expected to be on the road this year. The team is currently working with Linde to implement our ProGen fuel cell engine in Class 6 and Class 8 vehicles, to be used, by Linde, for product delivery.

This technology isn't limited to vehicular utilization. In 2020, we released the GenSure HP product. This was designed to be used for large-scale backup power applications including data centers, energy storage systems, and microgrids. Our team has partnered with some of the largest U.S. data center customers. Together we are working toward a goal of implementing the technology in the second half of this year.

Plug Power is also dedicated to developing electrolyzer technology. By increasing the modular electrolyzer size to 1MW and designing integrated systems, Plug Power will soon be able to provide fully turnkey hydrogen generation systems. Due to internal generation demand as well as external market development, Plug Power's electrolyzer manufacturing will exceed 500 MW by 2022. The method of manufacturing can be efficiently replicated around the world to meet U.S. and global green hydrogen generation needs.

In early 2021, we announced multiple strategic partnerships, expanding and solidifying our global presence, including signing a memorandum of understanding (MOU) with Groupe Renault to launch a 50-50 JV. This provides Plug Power with a European platform and also takes us into the vehicle manufacturing business. This JV is targeting a 30% share of the fuel cell-powered light commercial vehicle (LCV) market in Europe, which is expected to be 500,000 vehicles by 2030. In addition, we also announced a strategic partnership with SK Group, the second largest conglomerate in Korea, to

accelerate hydrogen as an alternative energy source in Asian markets. The JV is expected to be established this year with some initial deployments in 2021.

Plug Power will be opening its Innovation Center, this year, at our Rochester, NY location. This will mark a significant expansion, based on need and demand, in the production and manufacturing capabilities for fuel cells and electrolyzers. The facility will house Plug Power's research and development for Membrane Electrode Assemblies (MEAs) and fuel cell stacks. These are the key components for our commercial products. Plug Power will invest \$125 million into the local economy, creating 375 jobs and bringing material and component suppliers to the region. This endeavor will use green electricity to produce electrolytic hydrogen that will be used to power portions of the Innovation Center facility. This also positions Rochester to lead the way in becoming a hydrogen economy and a hydrogen-enabled city. It is our goal to foster the existing relationships with the local colleges and universities to cultivate future qualified employees. Plug Power intends to replicate this gigafactory design in Europe and Asia.

INTERNATIONAL EMBRACE OF GREEN HYDROGEN

All around the globe, countries are developing strategies to decarbonize their economies with hydrogen. Germany, France, the Netherlands, Austria, Belgium, and Luxemburg united in a push to increase European funding and support for hydrogen technology. The European Commission pledged to allocate part of a €750 billion coronavirus recovery fund to support a clean hydrogen economy by publishing the EU Hydrogen Strategy in early July 2020. The European Commission also published its Hydrogen Roadmap, which recognized the need for €470 billion of investment into hydrogen energy to meet its 2050 environmental goals. Additionally, individual European countries are committing billions of dollars into hydrogen to achieve their 2030 climate goals. Germany made a €9 billion commitment, France committed to €7.2 billion, and Italy made their own €10 billion commitment.

While the rest of the world moves aggressively to embrace a hydrogen-based economy, the U.S. is falling behind. Since the first quarter of 2019, China surpassed total investments in hydrogen compared to the U.S. Japan's government has committed to turn the country into a hydrogen society. South Korea has planned the development of three hydrogen demonstration cities by 2022. This includes the application of hydrogen for transportation, electricity, heating, and cooling. While the U.S. lags behind in their investments, we are also relinquishing our leadership in hydrogen technologies to other countries.

This is the time for the U.S. to develop and implement a strong national hydrogen energy policy. Since rejoining the Paris Climate Agreement, accelerating our national investment in hydrogen will not only help us achieve our domestic climate goals; an investment will also strengthen international cooperation with our traditional allies on clean hydrogen policy and trade.

RECLAIMING U.S. LEADERSHIP

When the Apollo 11 mission put a man on the Moon in 1969, the Command Module's primary source of electricity and drinking water was from a set of three hydrogen fuel cells. In the ensuing decades, American scientific and industrial ingenuity ensured that our country became the global leader in

hydrogen and fuel cell technologies. This would not have been accomplished had it not been for the support and dedication of the United States Government – including that from this Committee.

Today, this support primarily comes from the HFTO, which is housed within the DOE's Office of Energy Efficiency and Renewable Energy (EERE.) HFTO leverages the resources of the country's national laboratories and partnerships with the private sector to research, develop, and demonstrate innovative, efficient solutions for advancing fuel cell systems and hydrogen energy. The results have been impressive, and the U.S now leads the world in deploying zero-emission hydrogen fuel cell forklifts and light-duty cars. There are also more than 550 MW of installed stationary fuel cell capacity nationwide. This provides clean, efficient and resilient energy to power office buildings, data centers, hospitals, universities, manufacturing and logistics facilities, and other stationary end users. Finally, the American hydrogen and fuel cell industry continues to push forward with novel applications for these technologies, including heavy duty trucking, maritime vessels, port vehicles, drones, military equipment, municipal and industrial microgrids, energy storage systems, and more.

The Crucial Role of DOE Research and Development

Since the company's inception, the DOE has been a partner in advancing our innovative fuel cell solutions. This began with basic research and development projects into the early 2000s, which led to proving the feasibility and utility of powering material handling equipment with hydrogen fuel cells and stationary systems for prime backup power. Once these first-generation systems were ready for deployment, the DOE's Market Transformation activities accelerated cost reductions and promoted consumer acceptance for this new, alternative energy technology. Because of this support, Plug Power was able to establish initial relationships with customers, helping the company to significantly expand, and create an entirely new market for hydrogen fuel cell systems. We continue to work with the DOE in an effort to further improve the efficiency of these systems, scale up the production of hydrogen fuel, bring advanced manufacturing processes for our technologies from the laboratory to the factory, and introduce hydrogen fuel cells to new markets and applications. Our company's collaboration with the DOE is a prime example of "government working right." And without this partnership our company, and the technology, would not be as advanced as it is today. A few successful projects in collaboration with the DOE include the following:

- **Fuel Cell Manufacturing:** On April 15, 2009, as a result of the American Recovery and Reinvestment Act of 2009 (Recovery Act), the Energy Department announced \$41.6 million in Recovery Act funding to accelerate the commercialization and deployment of fuel cells. The funding was to support the establishment of a robust fuel cell manufacturing industry in the U.S. Additionally, jobs were to be created in fuel cell manufacturing, installation, maintenance, and support services. By the end of December 2011, more than 450 fuel cells for material handling were operational at customer sites including Sysco Houston, Coca Cola, Kimberly Clark, Sysco Philadelphia, Wegmans and Whole Foods.
- **Ground Support Equipment (GSE):** The GSE program began at the FedEx Hub at the Memphis International Airport in 2015. A total of 15 Charlotte CT5E baggage tractors, equipped with Plug

Power hydrogen fuel cells, were deployed along with an on-site hydrogen delivery system. The two initial phases of the program were completed and, at the start of the third phase, the same program was launched at the Albany International Airport. We also delivered the first ProGen fuel cell-powered delivery van, to FedEx, at the start of 2018 . To date, the vehicle has delivered packages covering over 18,000 miles in varying weather conditions including ice, snow, rain, and extreme heat.

- **Hydrogen Storage and Compression:** In a partnership with Washington State University (WSU), Plug Power is developing technology intended to facilitate the use of hydrogen as fuel by reducing the cost of storage and compression. This program leverages and promotes the endothermic parahydrogen to orthohydrogen conversion to reduce cooling requirements and minimize hydrogen venting losses in liquid hydrogen infrastructure systems. Due to COVID19, there have been some delays to the program. WSU is leading the program and is developing the vortex tube and catalyst at lab scale. Theoretical work is also underway working to optimize the design of the vortex tube and catalyst. Once the technology performance is understood, they will scale up the design for a field test. Plug Power's role has been to provide the commercial and technical requirements and guide the development of a para-ortho conversion technology to fit into a commercial hydrogen process. Moving forward, this innovation will improve the operational efficiency of GenFuel liquid hydrogen architecture. This is critical for the high-volume hydrogen fueling needed to support the burgeoning on-road fuel cell electric vehicle market.
- **Automated Hydrogen Fueling Dispenser:** This project began in 2019 to develop automated fueling for fuel cell-powered equipment in both the material handling and automotive markets. The goal was to reduce labor costs for refueling autonomous vehicles that can operate around the clock. Plug Power teamed with Vecna Robotics and NREL to complete this project. The result will include creating skilled jobs in high tech areas such as robotics, autonomous vehicles, vision systems, fuel cell systems, hydrogen infrastructure and hydrogen generation. The proposed sub-cooling technology will allow Plug Power's fleet vehicle customers, including material handling lift truck fleets, to achieve lower fuel costs due to lower back-end costs of transportation and storage.

FEDERAL FUNDING RECOMMENDATIONS

With today's focus on mitigating climate change, industrialized countries are recognizing the crucial role that hydrogen energy and fuel cells can play in decarbonization policies across all sectors. In just the past few years, China, Germany, Japan, the United Kingdom, France, South Korea, Canada, Australia, and other developed nations have put forth implementation and funding plans worth billions of dollars to accelerate the deployment of these technologies. The focus is primarily on the transportation sector. To ensure that the U.S. does not lose its position as a global leader in this technology, we ask that Congress and the Executive Branch create policies and incentives available to American industry. Both will level

the international playing field, while both accelerating and encouraging further deployment of hydrogen and zero-emission technologies.

We are thankful to Congress for maintaining robust appropriations for DOE's Hydrogen and Fuel Cell Technologies program in recent years, and particularly for the helpful FY21 language and funding. The \$100 million in supplemental funding included in the House Energy and Water Report for the H2@Scale program has also been encouraging. With a new administration, additional priorities will emerge. Based on his comments during the campaign, we expect that President Biden and his team will champion the production and use of green hydrogen. We are also hopeful this Committee will continue its bipartisan commitment to providing leadership and robust funding to DOE to support early, mid and late stage research and development and technology acceleration, including market transformation activities. We are also encouraging the continued commitment to H2@Scale activities that enable large-scale, low carbon intensity hydrogen production, including next-generation liquefaction plants, hydrogen storage, and development systems and equipment for the delivery of hydrogen. A focus on hydrogen use for medium and heavy-duty transportation and industrial applications remains a priority for Plug Power. Specific priorities include:

HFTO

- **H2@Scale Initiative:** Facilitating wide-scale hydrogen production and utilization, including in the U.S., to enable resiliency of power generation and transmission, as well as the advancement of a wide range of industrial processes. We would like to see continued support for high-impact demonstrations and deployments for on and off-road zero emission vehicles.
- **Market Transformation Programs and Technology Acceleration:** This will allow hydrogen to expand to a diverse array of markets. This includes addressing the stationary power demand (i.e. data centers, microgrids, telecom). The result is the deep-decarbonization across many different sectors. Additional funding for advanced demonstrations for electrolysis, heavy and medium-duty trucking and beyond is also critical.
- **Expand Support for Research and Development:** Support additional fuel cell and hydrogen R&D to accelerate the pace of revolutionary developments that improve performance and reduce costs. This will result in making green hydrogen more accessible to all Americans. Plug Power's first worldwide Gigafactory will drive volume and vertical integration, while pursuing a 50% cost reduction by 2023.
- **Safety, Codes and Standards:** Maintaining a robust program and engaging with state and local agencies to support their technical needs relative to infrastructure, vehicle safety and for fast-developing fuel cell and hydrogen markets such as heavy-duty trucks.

We also encourage the Advanced Manufacturing Office (AMO) to work in coordination with HFTO to support high-impact demonstrations for the development and deployment of:

- **Large-scale hydrogen storage and electrolyzer supply chain** including stacks, MEAs, precious metals, power electronics, and other components
- **Fuel cell supply chain** including stacks, MEAs, and other components
- **Hydrogen infrastructure supply chain** including liquid and gaseous hydrogen tanks, compressors, nozzles, hoses, facility improvements for hydrogen safety needs, etc.

RELATED POLICIES

Although it is not in the jurisdiction of this committee, Congress should consider complementing its R&D investment with changes to the tax code and investments in nationwide hydrogen infrastructure. This would open the potential of a hydrogen and decarbonized economy.

Tax Incentives

It is our belief that modernizing the tax code and providing comprehensive, robust and durable tax incentives would accelerate production and utilization of clean hydrogen. This is a necessary component of a national clean hydrogen strategy. Our industry is working closely with lawmakers in the House and Senate to develop tax incentives to help scale up clean hydrogen production and further drive down costs. Key among these will be tax credits for hydrogen production, investment, storage, refueling infrastructure, fuel cells, and vehicle purchases.

Infrastructure Investment

- **Establishment of Clean Energy Manufacturing Grant Program:** This program, initiated by Congressman Tonko, is included in the recently introduced CLEAN Future Act. The bill authorizes \$10 billion for grants to reequip, expand, and establish facilities to support manufacturing of clean energy technologies and components. This includes the manufacture of electrolyzers, hydrogen fuel cells and other technologies related to the transportation, storage, delivery, and use of hydrogen, including for residential, commercial, industrial, and transportation. Grants are available for equipment and infrastructure to enable fuel or feedstock switching to hydrogen, renewable energy technologies, energy storage technologies, carbon capture, utilization and storage, zero-emission vehicles, and more.
- **Large-Scale Green Hydrogen Generation:** To achieve economies of scale, we hope Congress will consider adopting policies that will lead to the construction of 100 tons per day of green hydrogen generation capacity. This could utilize excess off peak electricity from renewable sources like solar, wind and hydro. Doing this would rapidly drive down the cost to produce green hydrogen. Scaling up PEM electrolysis technology and increasing manufacturing capacity in the U.S. will help in exceeding the ambitious European targets of building 40GW of electrolyzers and making 10 million tons of green hydrogen available for industrial use at a competitive price.
- **Invest in Nationwide Hydrogen Refueling Infrastructure:** Achieving this goal would give the entire U.S. clean hydrogen access. The Moving Forward Act of 2020 (H.R. 2), passed last year,

calls for an alternative fuel infrastructure investment. This includes hydrogen refueling stations. In our opinion, this should be expanded beyond on-road vehicles.

- **Pilot Project Financing:** DOE should be empowered to fund pilot projects that replace high-emissions technologies with low cost, low-emission green hydrogen technologies.

CLOSING

Again, I thank the members of this committee for giving me a chance to offer testimony on the ways in which the federal government may assist in the acceleration of the use of clean hydrogen to decarbonize and create new domestic jobs in the process.

Please let me know if you have any questions.

[i] Hydrogen Council, Hydrogen: scaling up, November 2017, <http://hydrogencouncil.com/wpcontent/uploads/2017/11/Hydrogen-scaling-up-Hydrogen-Council.pdf>.

[ii] "Our Goal: 100% Decarbonized Hydrogen Fuel in Transport by 2030," Hydrogen Council, September 14, 2018, <http://hydrogencouncil.com/our-2030-goal/>
