Written Testimony of David Kirtley

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Before the House Committee on Science, Space, and Technology, Energy Subcommittee

Hearing titled "Theory to Reality: The Limitless Potential of Fusion Energy"

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I. Introduction

Mister Chairman, Mister Ranking Member, Honorable Members of the Subcommittee:

My name is Dr. David Kirtley, and I am a Co-Founder and the CEO of Helion Energy. I want to thank the Energy Subcommittee and Science Committee more broadly for your time today and your strong support of fusion over the years, which has contributed immensely to bringing us to the cusp of commercial deployment. I'm pleased to talk with you today about our company, our progress, and how the government can help facilitate the deployment of low-cost, safe, and carbon free fusion power before the end of this decade.

Being here today is an honor. However, I would not have imagined being here to speak on the viability of commercializing fusion technology. I was, like many, a fusion skeptic. In fact, many years ago, when I was early in my career, I looked around in the fusion space and I thought there was no clear path to bringing this technology, which held so much promise, to the grid in my lifetime. I left fusion and started to pursue other technologies in aerospace.

That was until 2008, when I was drawn back to fusion through some exciting research funded by the US Department of Defense (DOD), NASA, and the Department of Energy (DOE). That early research, paired with a rapidly advancing power electronics landscape and new computing power, demonstrated that there could be a real path to putting fusion power on the grid before another colloquial "30 years" passed. This led to myself and my co-founders, Chris Pihl, Dr. George Votroubek, and Dr. John Slough, to found Helion. Since then, we continued to receive funds from the government in our early stages, including from the DOE Advanced Research Project Agency – Energy (ARPA-E), supporting our follow-on prototypes which set performance records amongst private fusion companies. I want to thank DOE for its early support, which was essential for our later successes.

Today, our team has more than 165 team members in Everett, WA, and our mission is to build the world's first fusion power plant, enabling a future with unlimited clean electricity. We believe our fusion technology will decarbonize the energy sector, promote environmental and energy justice, provide energy security for the United States and globe, and offer one of the lowest cost electricity sources on the planet.

Recognizing that there are still many challenges ahead, I will outline why I believe the fusion community will be able to commercialize this technology before the end of the decade, and how we as a country can prepare for not just a first fusion power plant, but many power plants in the 2030s. This requires continuously advancing fusion technology, while creating policies that support manufacturing, licensing, and deployment.

My testimony proceeds as follows:

- **Section II**: **Fusion: The Energy Game-Changer the World Needs**
    - An overview of the benefits fusion energy brings to battling climate change, providing energy security, and ensuring US energy leadership for the coming decades.
- **Section III**: **Helion's Technology**
    - An explanation of Helion's fusion technology, including key aspects that enable deployment of our first power plant this decade.
- **Section IV: Our Vision for Fusion – Moving to *Widespread Deployment* in a Decade**
    - An outline of Helion's goal to be ready to deploy hundreds of mass-manufactured fusion power plants on the grid annually by the 2030s.
- **Section V: US Policies Today Can Enable Fusion's Future**
    - A discussion of opportunities for the US government to implement a three-part policy to support manufacturing, licensing, and deployment of fusion at scale in parallel[1] as the technology comes to fruition.

II. Fusion: The Energy Game-Changer the World Needs

As the world faces the increasing impacts of climate change and geopolitical turbulence of energy security, countries are seeking to transition away from reliance on fossil fuels and other climate-intensive emitters. At the same time, however, global energy demand is growing at unprecedented speed. In a world where nearly 800 million people still lack basic access to electricity, we cannot expect that demand to slow.[2] Indeed, the introduction of new energy-intensive technologies like artificial intelligence will only stress our global grid capacity in new ways. By some estimates, we need 1 Gigawatt of clean electricity to come online every day (presuming 100% up-time) from 2030 to 2050 to meet our mid-century net-zero energy goals.[3] Ultimately, the world needs a new solution to both green and grow.

Fusion is a key part of the solution. Fusion is what powers the sun and all our stars, and by harnessing its power on Earth, we can unlock a clean, safe, and virtually limitless source of energy. Fusion brings the clean energy benefits of wind and solar, while consuming fewer resources to produce. It is resilient and can store years of fuel on site -- less than two barrels of fusion fuel (hydrogen and helium) can power a 50 MW power plant for 1 year. Moreover, fusion is a reliable source of firm power that can operate regardless of weather or other conditions. Its small scale means it can be sited almost anywhere, including near load centers or on existing coal power plant sites.

Fusion offers these benefits while avoiding the complexities of nuclear fission. Fusion uses a completely different process from fission and fundamentally cannot have a runaway chain reaction or produce high-level, long-lived radioactive waste. This is reflected in the US Nuclear Regulatory Commission's (NRC) decision to license fusion devices under the same framework applied to industrial facilities, particle

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[1] White House Office of Science and Technology Policy, *Parallel Processing the Path to Commercialization of Fusion Energy* (June 3, 2022).

[2] Intl. Energy Agency, *SDG7: Data and Projections, Access to Electricity* (Apr. 2022).

[3] For example, according to one analysis by the International Energy Agency, over 1.1 TW of wind and solar energy capacity alone would be required between 2030 and 2050 to facilitate a zero-carbon transition, while presuming contributions from other sources. Intl. Energy Agency, *Net Zero by 2050 - A Roadmap for the Global Energy Sector* (May 2021) (at pg. 74). Normalizing for capacity factor and presuming an optimistic overall 1/3 capacity factor on average, this means that an equivalent 1 GW of generation at 100% capacity factor would have to be put on the grid between 2030 and 2050 to meet a net-zero 2050 goal. *See also* Energy Info. Admin, *Elec. Power Monthly, Table 6.07.B*, *Capacity Factors for Utility Scale Generators Primarily Using Non-Fossil Fuels*; Intl. Energy Agency, *Update to Net Zero by 2050 Analysis* (2022) (at pg. 137).

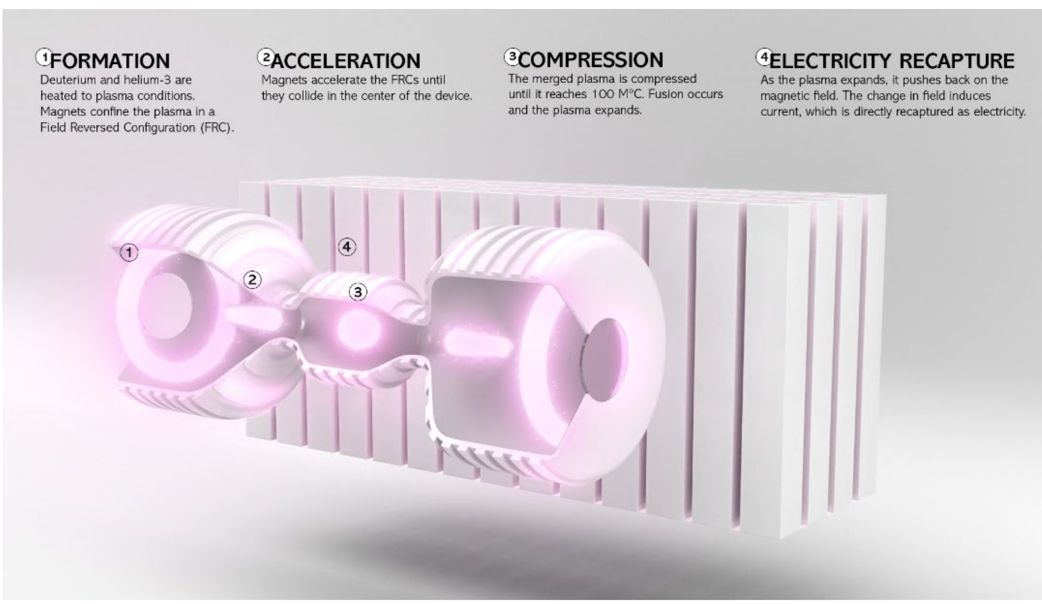
accelerators, and hospitals. This regulatory framework is separate from the framework the NRC uses for licensing fission reactors.[4]

Finally, fusion represents an opportunity to holistically revitalize energy communities by leveraging a workforce and infrastructure that is already in place. Our flexible siting criteria mean that fusion power plants are well-suited for repowering coal sites and leveraging their energy-ready community and grid infrastructure. Beyond the power plants themselves, fusion will bring local communities billions of dollars in investment to build new manufacturing facilities—for key components such as power electronics, magnets, and vacuum vessels—and for assembly of the complete fusion power plants themselves.[5]

All these pieces together highlight fusion's promise, which is why fusion scientists and engineers have been working for decades to realize this technology. Today, thanks to your help and work across the federal government, we have reached an inflection point signifying that fusion deployment is imminent. New fusion approaches abound, ancillary technologies have been realized, and policies are starting to fall into place that clear the path to getting fusion on the grid.

III. Helion's Technology

Helion uses an approach to fusion called magneto-inertial fusion (MIF). Our technology forms two ring-shaped plasmoids (called Field Reversed Configurations (FRCs)) on each end of a cylindrical vessel. We then use magnets to accelerate the FRCs to the center of our machine until they collide. When the plasmoids collide, they combine into a single plasmoid, which is then compressed by very strong magnets to the point that particles become hot enough and dense enough to fuse in substantial quantities, releasing energy in the process. [6]



Overview of Helion's fusion process

[4] SRM-SECY-0001, *Options for Licensing and Regulating Fusion Energy Systems* (Apr. 13, 2023); NRC Press Release, *NRC to Regulate Fusion Energy Systems Based on Existing Nuclear Materials Licensing* (Apr. 14, 2023).

[5] *See, e.g.,* Helion Energy, Inc., *Response to Request for Information: Implementation of the CHIPS Incentives Program Regulations.Gov Docket DOC-2022-0001* (Nov. 14, 2022).

[6] For more about Helion's approach, please see the following videos: Real Engineering, *A New Way to Achieve Nuclear Fusion: Helion* (Dec. 17, 2022); Helion Energy Inc., *Helion's Approach to Fusion: How it Works* (Feb. 17, 2022).

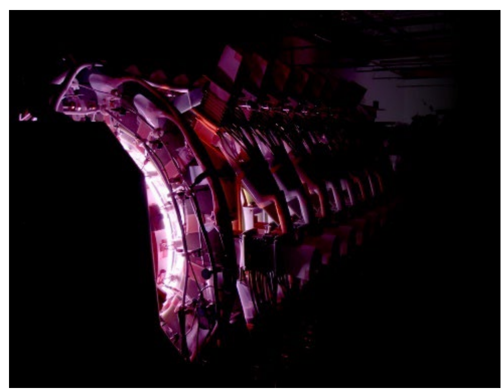
Compared to other approaches in the field, our magneto-inertial fusion approach has three key differences:

1. **Our machine is pulsed** rather than steady state. This helps us overcome the hardest physics challenges in fusion, particularly around sustaining long-life plasmas. It also allows us to build more efficient devices, solve certain materials and impurity challenges, and adjust the power output based on need.
2. **We directly capture energy** from the expanding FRC during the fusion process instead of heating water to turn a steam turbine, while also recycling the energy used to create the initial pulse. The efficiency gains from directly capturing the fusion energy, while simultaneously saving the energy that goes into the fusion pulse, enables compact systems that can achieve commercial viability at much lower (and easier to achieve) levels of fusion gain (potentially as low as $Q_E < 3$).
3. **We use deuterium and helium-3 as fuel** instead of deuterium and tritium. Deuterium and helium-3 are the ideal fuels for generating electricity because fusing these elements results in a proton and a normal helium nucleus—both charged particles whose energies can be directly converted to electricity.[7] This fuel cycle also reduces neutron emissions, substantially reducing many of the engineering challenges faced by users of deuterium-tritium fuels.[8]

Helion's MIF technology largely benefited from early US government support, which helped de-risk our core technology in its earliest stages, helping set the foundation for our continued progress.

Because our approach enables small, compact fusion systems, we were able to move from the drawing board to the shop floor quickly and start building prototypes. These prototypes and the progress they demonstrated in turn helped us raise the private sector funding needed to develop the final fusion technology we are using today. To date, our team has built six working fusion prototypes, which achieved record-breaking results and technological milestones. These prototypes have allowed us to learn from engineering and building working systems and ultimately bring theory to reality, giving us confidence in our ability to deploy.[9]

Helion's 6th fusion prototype, Trenta



Formation section of Trenta in operation

[7] In deuterium-tritium fueled fusion systems, energy released from the fusion reaction is primarily held by neutrons, which do not interact with magnetic fields and thus have to heat a working fluid like water that then moves a turbine to create energy.
[8] While the core deuterium-heliuim-3 fusion process is aneutronic, Helion's approach to fusion does result in generation of neutrons from deuterium-deuterium side reactions that occur during fusion. The neutrons produced from Helion's process still must be safety managed, but benefit from being lower in number than for deuterium-tritium fusion power plants, and at lower energy levels (2.45 MeV compared to 14.1 MeV).
[9] *See supra* n. 6.

IV. Our Vision for Fusion – Moving to *Widespread Deployment* in a Decade

A. Fusion is ready to deploy.

I am confident fusion will be on the grid within a decade. Although there are still many challenges to address, from my origins as a fusion skeptic I now firmly believe that we, and others, will overcome them and deploy a commercially viable fusion power plant. The Committee and DOE deserve substantial credit for advancing the fusion science to lead us to this point. And this work has been complemented by progress in enabling technologies outside of fusion, such as power electronics, fiber optics, and computer processing.

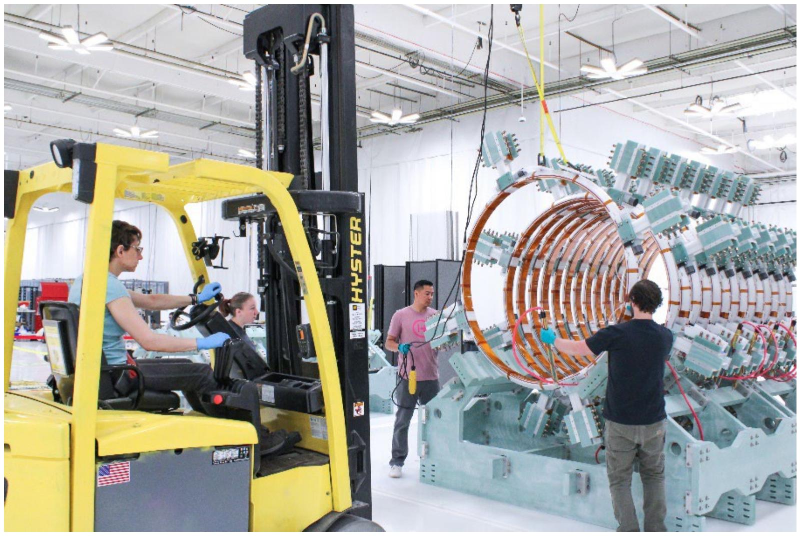
For example, key aspects of Helion's fundamental approach to fusion, such as pulsed compression of magnetized plasmas, were discovered last century. However, for this or our eventual refined approach (pulsed compression of merged FRCs) to work to its full potential, it requires communications systems that can control magnet operation on nanosecond timescales, along with electronics that can deliver megaamps of current to those magnets in microseconds, repeatedly. These were not available before the turn of the century, but thanks to advances in everything from telecommunications to transportation electrification, these components became available at the required quantities and cost to pursue Helion's approach.

We are not alone. In the last five years, my industry peers have taken advantage of new modeling tools and other technologies to increase their fusion performance, demonstrate important new magnet technologies, and start marching closer to realizing the commercial fusion vision. These developments, along with a growing number of physicists and engineers who have been approaching fusion from varying perspectives, have helped the dozens of private fusion companies in the United States, and more globally, achieve remarkable results. This progress is exemplified by the incredible news from the National Ignition Facility last year of their achievement of net energy.[10]

I am extremely proud that Helion has been a part of that story of progress too. To date, we have built six working fusion prototypes, each building on the failures and successes of its predecessor. Our earliest prototypes were funded by research grants from the US government, including from ARPA-E. In 2020, our 6th fusion prototype, Trenta, was the first privately funded fusion device to reach 100-million-degree Celsius thermonuclear plasma temperatures, demonstrating there was a path for bringing Helion's approach to fusion on the grid. This is considered by scientists as the temperature needed for fusion reactions to occur at commercial scale.[11] Additionally, Trenta completed a 16-month fusion testing campaign, which demonstrated the reliability of our systems.

The results from Trenta enabled us to raise $500 million in November 2021, which is now being used to build our 7th fusion prototype, Polaris. While currently still under construction, if successful, we expect Polaris to be the first machine to demonstrate the production of electricity. Our team is on track to finish construction of Polaris in early 2024. I believe Polaris will address many of the remaining scientific and engineering challenges associated with our fusion process, setting us on course for commercial fusion deployment.

[10] Lawrence Livermore National Laboratory (LLNL), *LLNL Achieves Fusion Ignition* (Dec. 14, 2022).
[11] For clarity, 100 million degrees is considered a viable temperature for commercial deuterium-tritium fusion power plants. For deuterium-helium-3 fusion, ideal fusion cross sections occur at higher temperatures, which Polaris will demonstrate.



Polaris' formation section during final assembly phase

Following Polaris, we will build our first 50 MW fusion power plant, under the world's first fusion Power Purchase Agreement (PPA), with Microsoft. This plan is slated to come online in 2028,[12] and Constellation will serve as the power marketer for the project. This commitment signals, unequivocally, that fusion has arrived.

I know that fusion is hard, and there will be many known and unknown challenges to face. There are a number of engineering questions still left for us to address, and we do not approach them lightly. But I believe these are not the same order of magnitude that had to be overcome to get to where we are today, and we are confident we and our peers can address them to meet our decadal goals.[13]

B. Fusion can reach *widespread deployment* within a decade, and the US needs to lead.

Given that we're already on the cusp of fusion deployment, the time is right to think beyond just the first fusion power plant. We see a see very ambitious but achievable goal: Deploying hundreds of American-manufactured fusion power plants on the grid every year by the 2030s.

Fusion is inherently suited for mass production—meaning that when we build one device, we will have built the infrastructure to build tens or hundreds more. This is fundamentally due to the inherent design of most fusion systems. Building a fusion power plant requires the manufacturing and assembly of thousands of small components (e.g., power semiconductors, capacitors, cables, connectors, segmented magnets, and vacuum vessel sections) that are suited for production and assembly on a factory line. And at the same time, for many or most designs building a fusion power plant generally does *not* require the forging of immense structures like pressure vessels, cooling towers, or complex steam turbine systems.

This means that fundamentally, fusion power plants can be factory-built, transported in assembled parts on large shipping containers, and quickly installed within a typical industrial building with very limited site work. This allows most of the work in building a fusion power plant to be done at the factory. As just one example, our manufacturing facilities in Everett are substantially larger than the approximately 27,000 sq.

[12] Helion Energy, Inc., *Helion Announces World's First Fusion Energy Purchase Agreement with Microsoft* (May 10, 2023).
[13] As discussed further below, the US government can play an important role to help accelerate certain technology solutions, and go even further to enable higher performing and more reliable fusion systems long term.

ft. building housing our 7th prototype, Polaris. We expect our commercial power plants to be roughly the same size, which, notably, takes up less space than a football field.

Helion's 27,000 sq. ft. Polaris facility, in front of our 150,000 sq. ft. Antares headquarters and manufacturing facility

Hence, as Helion looks to our first-of-a-kind fusion deployment in 2028, and beyond, we see a future where fusion power plants are produced at-scale on assembly lines every single day, similar to how airplanes are manufactured. The complexity and challenges associated with manufacturing and assembling a commercial fusion system are similar to those of a 150-seat aircraft. And just as Boeing (down the street from us in Everett, WA) can produce one airplane a day,[14] it is possible that by the 2030s, Helion as just one company can produce a number of 50 MW fusion power plants, or potentially one or more larger (up to 500 MW) fusion power plant *a day*—a very challenging but potentially realizable goal given the energy density and scalability of fusion.

This goal, if met, has the power to transform our power grid as early as the 2030s, and usher in an era of energy abundance that will enable the United States to lead in everything from steel manufacturing to AI deployment. But this will require the appropriate policies to accelerate deployment and help fusion reach this potential. And given the promise of fusion, the United States is not the only country with this vision. Multiple other countries are seeking to lead in fusion; some are focused specifically on the manufacturing base as the route to global leadership.

For example, right now, a machine is being built in China that looks just like schematics released by Helion in 2014.[15] China has made fusion a core part of its innovation strategy,[16] has hired US scientists to lead its programs, and is making substantial investments to achieve fusion power by the end of the decade.[17] Moreover, the country makes no effort to hide its ambitions to use advancements in civilian energy technologies to support its military ambitions pursuant to a military-civilian fusion policy.[18] And, critically, China can create a state-backed manufacturing capacity that could strangle our own efforts to build and deploy domestically—by leveraging the same well-documented playbook that unfolded in the solar and

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[14] Boeing, *Commercial Airplanes Fact Sheet* (as of Mar. 31, 2023) (showing 31 Boeing 737s produced a month, with plans to increase to 50-60 a month, and not accounting for other models).

[15] ENN Energy Research Institute, *ENN's HeLong Experiment (EHL Experiment)* (Google Web Cache Link as of June 9, 2023). From what we understand, it appears this experiment started after Helion announced its 100-million-degree Celsius milestone.

[16] More information is available at Fusion Industry Association Blog, *Chinese Fusion Energy Programs Are A Growing Competitor in the Global Race to Fusion Power* (updated Oct. 18, 2021).

[17] Newsweek, *China Aims to Have Nuclear Fusion Energy in Six Years With New 'Mega Lab'* (Sept. 15, 2022).

[18] US Department of State, *Military-Civilian Fusion and the People's Republic of China* (May 2020). In 2018, for example, the US government curtailed exports of civilian fission technology to China because of their impermissible redirection of those technologies to military applications. JDSupra (Reposting Hogan Lovells), *US Government Clamps Down On Nuclear Exports To China* (Oct. 12, 2018).

battery industries, where the United States was the first to invent but lost to China in our effort to scale deployment.[19]

V. US Policies Today Can Enable Fusion's Future

The strong work of this Committee has brought fusion to the brink of commercialization and secured American leadership in this field. And now the challenges are evolving as we move to the next stage. Even if the US is the first to invent the path to commercial fusion, that does not determine who will lead deployment. We need to ask not just "How can we further the fusion science?" but also "How can we lead the world in fusion's widespread deployment?" The opportunity here is similar to the dawn of aviation, and we can think on the same scale.

A great recent example of this forward thinking came from the NRC, with its decision to outline a distinct and right-sized path for fusion regulation in the United States based on the recognition that fusion's safety case is different from fission.[20] The Administration's Bold Decadal Vision for Fusion Energy has also called for the United States to rise to the challenge of deploying fusion by the early 2030s, and to apply this technology at scale as soon as possible to tackle our imperative climate and energy security challenges.[21]

Building off these important steps, we see an opportunity for Congress to implement a three-part policy to support manufacturing, licensing, and deployment of fusion at scale. These three policies together reflect a potential new "starshot" to move quickly and in parallel[22] to get ready for fusion deployment as the technology comes to fruition:

A. **Manufacture:** Prepare a domestic manufacturing base that can eventually produce up to a GW of fusion capacity a day. This will require an ecosystem capable of supplying, delivering, and maintaining the key components required to initiate commercial fusion deployment.

B. **License:** Enable mass-produced fusion devices to be licensed like airplanes, so that devices can be produced, sited, and interconnected as quickly as they are built.

C. **Deploy:** Bring together all arms of the US government to enable rapid siting of fusion plants near large loads and on retired fossil plants, export fusion power to our partners abroad, bring global regulatory alignment, develop next-level technologies to make fusion plants more durable, and train a diverse future fusion workforce.

These three prongs are detailed more below:

A. Manufacture

As the White House Office of Science and Technology Policy has stated, "[f]usion can be a part of a clean energy future that's made in America, and we must build the secure supply chains that underpin the clean energy transition."[23] The biggest driver of Helion's deployment schedule, and the greatest risk today to US

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[19] *See, e.g.,* Canary Media, *China Owns the Solar Supply Chain, Jeopardizing the Energy Transition* (July 25, 2022); NPR, *How China Dominates the Electric Vehicle Supply Chain* (Feb. 21, 2022).
[20] *See supra* n. 4.
[21] White House, *Readout of the White House Summit on Developing a Bold Decadal Vision for Commercial Fusion Energy* (Apr. 19, 2022).
[22] *See supra* n. 1.
[23] *See supra* n. 1.

leadership in fusion, is the manufacturing base. Right now, the United States and its allies are able to meet the needs of this nascent industry for the first plants, but not at scale.

For example, pulsed approaches to fusion (beyond just Helion) rely heavily on two types of power electronics to initiate the fusion process. The first is power semiconductors that finely control the flow of electricity in these systems, and the second is high voltage capacitors to provide the power surge for each pulse. For Helion, these constitute amongst the most expensive parts of Helion's fusion system—and our research devices already use a significant portion of the global supply of certain key components. On a commercial scale, beyond the first plants, the manufacturing base will significantly constrain our on-time deployment if we do not take action today.[24]

Worse yet, these key technologies are often encroached or sometimes outright controlled by our geostrategic competitors, such as China. We believe that today China controls or threatens to control multiple critical elements of the fusion supply chain, including in power electronics. For some technologies, China remains the only supplier, and in others we have seen China either procure important suppliers or drive them out of business in just the last few years. Recognizing that all fusion companies rely on a complex global supply chain, we need to be thoughtful and get ahead of this issue without crippling deployment. One right path forward can be to bring this manufacturing capability to the United States (and our allies where appropriate), which also presents a tremendous economic opportunity.

We imagine a fusion manufacturing base at scale that can be as large as, if not eventually larger than, the American aviation industry. Building out this domestic and friend-shored manufacturing base, to ensure all of fusion can deploy securely and rapidly, is a many-billion-dollar investment no one company can tackle. But it likewise can bring tremendous benefits outside of just fusion. Fortunately, the US government has existing tools (many of which are already fully appropriated) to overcome these challenges, and it is important they seriously consider fusion as part of their work. Targeted investments, which can be timed to align with when fusion companies hit their core technical milestones and de-risk the cost to the taxpayer, can dramatically accelerate deployment at low cost and high return.

We will soon be at a crossroads. We have the potential to build a fusion ecosystem in the United States that would create hundreds of thousands of jobs in one of the most advanced technology sectors on the planet. Or we can go the way of the solar and battery industries, where we cede leadership to countries like China that will lose to us on innovation but are already working today to out-build us at scale.

A few sample key areas should be considered as part of a broader US manufacturing policy on fusion:

(i) Loan Guarantees

The DOE Loan Programs Office (LPO) has obtained approximately $350 billion in new loan authority. The first fusion power plants are potentially well-suited to receive support from LPO, which can accelerate their deployment. LPO also has the potential to accelerate buildout of the key facilities to manufacture fusion components and assemble these plants, which would accelerate true long-term mass deployment.

[24] *See also* Fusion Industry Association, *The Fusion Industry Supply Chain: Opportunities and Strategies* (2023) (at pgs. 13-18) (also noting that a "number of companies raised serious concerns about the ability of existing suppliers to deliver key components and services and scale").

(ii) *CHIPS for America Fund*

As mentioned earlier, one of the most important aspects of Helion's deployment is the power semiconductor supply chain.[25] To get ahead of this challenge, Helion is currently exploring deployment of a power semiconductor fabrication facility in the United States. The CHIPS for America Fund is well poised to prioritize a domestic power semiconductor buildout for fusion. US leadership in fusion is critical to national security,[26] and by building out new American power semiconductor manufacturing facilities, the United States can support multiple other key areas as well, including the electric grid buildout, vehicle electrification, and important national defense efforts.

(iii) *Tax Policies*

Another way to support onshoring the fusion supply chain is through federal tax incentives. The US government's reinvigorated clean energy manufacturing incentive program in 26 USC 48C can greatly assist onshoring fusion, presuming it treats the technology on parity with other zero-carbon emission sources. In the longer term, there are opportunities to revisit US tax policy broadly to ensure fusion can compete on an even playing field with other zero-emission energy sources.

B. License

For the industry to take off, we need to license fusion power plants as fast as we can build them. The NRC has established a clear regulatory pathway for fusion under its "byproducts materials" framework, based on fusion's strong safety case. This decision fundamentally enables the industry and sets a clear path forward for our first fusion deployments. However, it only represents *one* important first step on a journey towards widespread deployment of fusion across the country.

As we look at US regulatory policy for fusion going forward, the US government can consider:

(i) *Licensing to Support Mass-Manufactured Fusion*

Under current regulatory frameworks, fusion power plants would be licensed site-by-site, one at a time. That works for first deployments, but this framework was not designed for mass-produced power. A reasonable evolution that would unlock the ability to truly scale this technology would be to license fusion power plants based on a design-specific basis, like how the Federal Aviation Administration effectively approves and oversees airplanes for mass deployment (moving nearly three million people a day).[27]

Given the potential for fusion to be mass-produced in the 2030s, the time is right to start assessing what this future framework for the licensing of mass-manufactured fusion energy systems could look like. While recognizing it would require careful evaluation and depends on fusion companies like Helion meeting their technical milestones, early engagement can avoid a chicken and egg problem. If we wait even just a few years to tackle this topic, the United States will find itself too far behind when fusion is ready to scale.

Fundamentally, if we can build fusion devices out of a factory like airplanes, we should also license them like airplanes—once per design instead of repeatedly per device or site. This will allow rapid deployment while still maintaining public acceptance and strict oversight of manufacturing quality and safe operations. Starting the conversation now is a low-cost way to be ready for deployment in the future.

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[25] *Supra* n. 5.
[26] *Supra* n. 21 (noting that fusion advancements support national security interests).
[27] US Federal Aviation Admin., *Air Traffic by the Numbers* (Apr. 2023).

(ii) *Interconnection Pathway*

As first-time power plant developers, we are new entrants to the broader discussion around our grid's interconnection challenges. However, we witnessed through the process of down-selecting locations for our first power plant that interconnection timelines are an important limiter, one that took many parts of the country off the map in terms of meeting our deployment timelines.

As fusion prepares to scale, interconnection timelines that are currently delaying deployment of clean energy on the grid will only escalate. Moving forward, Helion wants to contribute to the discussion about how the US government can evaluate and improve interconnection permitting so that mass-produced fusion devices do not sit in the queue waiting to be connected, like airplanes jammed on a tarmac.

C. Deploy

Manufacturing and licensing fusion at scale does not mean anything if we cannot ensure that our fusion devices end up operating and providing power to customers, here and abroad. Tackling this challenge requires an all-in approach from the government to enable fusion deployment, just as the country embraced the advent of commercial aviation. Today there are 5,000 public airports in the United States, and 45,000 flights that touch US airspace moving nearly 3 million passengers a day.[28] We have the chance to deploy fusion on the same scale, with thousands of plants delivering hundreds of thousands of Megawatts a day, by *or before* the middle of the century.

Areas of importance to enabling widespread fusion deployment include:

(i) *Domestic Siting:* Fusion is well-suited to deploy adjacent to and directly serve large, localized loads, such as future AI datacenters and energy-intensive industrial facilities. However, siting next to these large loads will present unique federal-state challenges. As well, fusion is well-suited to lead in repowering of coal sites and reengagement of coal communities, and the US government can be a facilitator in these areas. We are actively exploring siting our first-generation power plants in energy communities, and long-term we envision a world where every fossil plant can one day be repowered with fusion.

(ii) *Global Exports:* Internationally, US energy companies constantly face challenges competing with state-backed competitors. In fusion, while we may have an immense innovation edge, we will face the same challenges. The US government has many tools, diplomatic and financial, to ensure that US fusion competes on an even playing field.[29]

(iii) *Global Regulatory Alignment:* With the recent NRC decision, the United States has cemented its role as a leader in fusion regulation. However, for the United States to be the global leader in deployment, we need to work with our global partners to align on the core basic principles for regulating fusion (such as licensing under a right-sized framework that appropriately separates fusion from fission).

(iv) *Next-Level Technologies:* While Helion has a path forward to commercial deployment based on our current technology solutions, there is substantial work that can be done to tackle the remaining engineering challenges, including developing next-generation materials, magnets,

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[28] *Supra note* 27; US Federal Aviation Admin., *Airport Categories* (last updated Dec. 7, 2022) (also identifying 15,000 additional private airports in the United States).

[29] These tools include the Export-Import Bank of the United States, US International Development Finance Corporation, and various programs under the US Departments of State, Commerce, and Energy that support deployment of US energy technologies.

and other technologies that can enhance the performance and durability of commercial fusion systems, especially future-generation devices. The DOE and other arms of the federal government are capable of accelerating solutions to these challenges.

(v) *Ecosystem and Workforce Development:* Deploying fusion will create an immense ecosystem of suppliers, vendors, and operators. And not only do these new businesses need to be created, they will also require a workforce that is currently in its very early stages. Fortunately, the same skills used in other industries, including aviation, maritime, military, and traditional energy, can be directly applied to fusion manufacturing. The fusion ecosystem can eventually offer hundreds of thousands of high-paying jobs in manufacturing, operations, and engineering that will contribute billions of dollars to the US economy, and we will need to help to train the fusion engineers and operators of tomorrow.

In doing so, the fusion community should ensure inclusivity and reach out to underrepresented populations that have an incredible amount to offer the fusion energy transformation. We must likewise strive to ensure that the deployment of this new fusion ecosystem incorporates environmental justice considerations and benefits energy communities that have given so much to make this country the industrial and innovation superpower it is today.

VI. Conclusion

I want to thank again the Energy Subcommittee and Science Committee for their strong and unwavering support of fusion through the decades. This support has been essential to get us off the ground and ready to deploy. Thanks to that support, ahead of us is an opportunity to fundamentally change the world for better. It is no wonder that fusion is often cited as the “Holy Grail” of energy—it has the potential to eliminate all carbon emissions from our baseload power production, provide well-paying jobs to trade workers and engineers, promote a new standard of energy justice in areas that have long been excluded from the clean energy conversation, and offer a virtually limitless, affordable source of clean electricity.

To commercialize fusion this decade, our team has been rapidly iterating our technology, building out manufacturing capabilities, and working closely with several parts of the US government. We have a lot to do still, and are excited to take on the remaining challenges. This Committee is well positioned to help lead an expanded vision of fusion’s potential—beyond the construction of a single power plant this decade, and towards a commercial fusion industry that can deploy a power plant per day in the 2030s, at the same scale as today’s aviation industry.

I look forward to this continued collaboration so we can all see a fusion-enabled future.