

**Testimony of
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Introduction

Thank you, Chairman Manchin, Ranking Member Barrasso, and distinguished Members of the Committee for your longstanding support of fusion energy R&D, including the visionary fusion energy authorizations in the Energy Act of 2020 and the CHIPS and Science Act, and your support for fusion R&D infrastructure in the Inflation Reduction Act. It is an honor to join you today as Lead Fusion Coordinator for the Department of Energy (DOE) to provide testimony regarding Federal support for the commercialization of fusion energy. While I now coordinate fusion-energy activities across multiple DOE program offices, I do not represent those offices. Thus, I may not be able to answer detailed questions about activities of particular program offices but would be pleased to provide written responses and ongoing collaboration with the Committee.

As this committee knows, the potential benefits of fusion energy are enormous. Fusion holds the promise of being an on-demand, safe, and abundant source of carbon-free primary energy and electricity. Fusion may completely transform the way humans generate and use energy, providing immense economic opportunities beyond commercial energy. In addition, fusion may enable new defense and space capabilities,^{1,2} with profound impacts for national security. Together, this means that the race to fusion is also a race for future global leadership. While fusion has long enjoyed international collaboration and should continue to do so, make no mistake, fusion is now also an international competition. Failure to act now may relegate the U.S. to being importers rather than exporters of fusion technology.

The US fusion R&D community, including both public and private-sector players, has spoken in unison, as manifested in the 2020 Fusion Energy Sciences Advisory Committee (or FESAC) Long-Range Plan³ and 2021 National Academies report *Bringing Fusion to the U.S. Grid*.⁴ They are ready to take on an energy-development mission, which will require a fundamental shift in the US fusion energy R&D strategy: firstly, a greater focus on public-private partnerships to ensure commercial relevance and to better harness the large amounts of private capital being injected into fusion R&D, and secondly, a much greater emphasis on developing and demonstrating the needed enabling materials and technologies for a fusion pilot plant,⁵ or FPP.

¹ <https://aerospace.org/article/sizing-compact-fusions-potential>.

² Dr. Jeff Waksman, Strategic Capabilities Office, Office of the Secretary of Defense (personal communication, 2022).

³ <https://usfusionandplasmas.org>.

⁴ <https://nap.nationalacademies.org/catalog/25991/bringing-fusion-to-the-us-grid>.

⁵ The National Academies report *Bringing Fusion to the U.S. Grid* (footnote 2) specifies that a fusion pilot plant (FPP) should generate a meaningful amount of net electricity (e.g., more than 50 MWe) for more than 3 continuous hours with a timely path to a full power year, at a capital cost that can attract private funding.

There are two primary reasons why fusion is poised for an energy-development mission. The first is fusion's scientific and technical readiness, as evidenced by multiple once-in-a-decade breakthroughs in the past year alone, for example reaching the cusp of fusion ignition on the National Ignition Facility at DOE's Lawrence Livermore National Laboratory and the demonstration of a fusion-scale magnet at nearly twice the previously available magnetic-field strength by a privately funded US fusion company. The second development is the enormous market pull for an energy technology with the characteristics of fusion energy, as evidenced by the nearly \$5B of private capital invested into predominantly US-based fusion companies.⁶

Bold Decadal Vision

In March of this year, the White House Office of Science and Technology Policy and the DOE co-hosted a White House Summit entitled *Developing a Bold Decadal Vision for Commercial Fusion Energy*.⁷ The *Bold Decadal Vision* aims to seize the opportunity enabled by private capital, which is now on par with public fusion funding, to translate longstanding US leadership in fusion science into a world-leading US-led commercial fusion industry. This would enable US technological leadership in the 21st century and beyond, provide sustainable global energy security and abundance, and support a just energy transition.

The *Bold Decadal Vision* aims to establish a strong partnership between the DOE and the fusion private sector with the following over-arching objectives: firstly, demonstrate net energy breakeven in the 2020s, by possibly more than one approach, while aggressively developing the enabling materials and technologies needed for an FPP; secondly, achieve at least one credible FPP design by the late 2020s that attracts significant private funding and commercialization partners for FPP construction and operation by the early 2030s; and, finally, enable commercial first-of-a-kind fusion plants by the late 2030s and rapid deployment throughout the 2040s and beyond.

As a foundation to the *Bold Decadal Vision*, we must also prepare the path broadly for fusion commercialization,⁸ going well beyond the R&D. This includes public engagement and energy justice, diverse workforce development, a regulatory framework that engenders public trust and supports timely deployment, market identification, attracting investment and commercialization partners, export control, nuclear nonproliferation, cybersecurity, international coordination, building critical supply chains and manufacturing capabilities, and waste disposition.

Since the White House Fusion Summit in March, DOE has engaged in a number of activities to support the development of the *Bold Decadal Vision*. First, DOE hosted a workshop in Washington, DC in June of this year, entitled *Fusion Energy Development via Public-Private Partnerships*,⁹ where we brought together a broad set of fusion stakeholders and multiple government agencies to have inclusive conversations about the path forward for the *Bold*

⁶ <https://www.fusionindustryassociation.org/copy-of-about-the-fusion-industry>.

⁷ <https://www.whitehouse.gov/ostp/news-updates/2022/04/19/readout-of-the-white-house-summit-on-developing-a-bold-decadal-vision-for-commercial-fusion-energy>.

⁸ <https://www.whitehouse.gov/ostp/news-updates/2022/06/03/parallel-processing-the-path-to-commercialization-of-fusion-energy>.

⁹ <https://science.osti.gov/fes/Community-Resources/Workshop-Reports/Fusion-Energy-Development-via-Public-Private-Partnerships>.

Decadal Vision. Secondly, we are working hard to launch a milestone-based fusion development program, as first authorized in the Energy Act of 2020. This program, which is expected to be announced imminently, will support for-profit entities to develop FPP preconceptual designs and technology roadmaps, and to pursue applied R&D in partnership with national laboratories and universities to enable a successful FPP design. This will be a first-of-a-kind DOE program that will use DOE's Other Transactions authority. Third, a DOE Fusion Energy Crosscut Team has been formed with representatives from the Office of Science, ARPA-E, NNSA, Nuclear Energy, Economic Impact and Diversity, and Environmental Management. The crosscut team spans DOE's equities across broad areas of need in fusion energy R&D and commercialization. Going forward, the crosscut team will identify, recommend, and coordinate needed new activities and funding in support of the *Bold Decadal Vision*, including coordination with the interagency and the private sector. Finally, discussions internally at DOE and with external fusion R&D stakeholders are proceeding regarding possible new programs and test facilities aligned with the priorities of the FESAC Long-Range Plan and the technology roadmaps that will be early deliverables of the milestone-based development program. Much planning will need to occur over the next year and beyond so that we are prepared to rapidly implement new programs and initiate construction projects.

To realize an operating FPP on a decadal timescale will require increased funding, as well as attention to investment strategies that can amplify federal funding. ARPA-E has proven that federal investments can be amplified by private funding in its fusion programs, which to-date have garnered a 6-to-1 ratio of private follow-on funding to its fusion portfolio.

Role of ITER and International Collaborations in the Bold Decadal Vision

Change is occurring at ITER. Projection construction for ITER is 76 percent complete to First Plasma. US ITER is now 70 percent complete to First Plasma. ITER Director General Bernard Bigot passed away in May 2022. He was an extraordinarily gifted leader of the ITER Project, and his outstanding service will be remembered with much appreciation around the world. A search is underway to identify and hire the next ITER DG. Pandemic-related delays led to the need to rebaseline the ITER project. The new DG will want the opportunity to comment on the ITER rebaselined cost and schedule prior to approval by the ITER Council. We note that there was a recent Fusion Energy Sciences Basic Research Needs workshop on the US ITER Research Program so that US researchers are prepared to take advantage of the scientific opportunities presented by ITER first plasma and beyond; the draft report is available online.¹⁰

There are opportunities to maximize ITER benefits to the US and the *Bold Decadal Vision* starting immediately and before first plasma. Examples include placing more US people on the ground at ITER, including from US private industry, and enabling streamlined access by US fusion stakeholders to ITER data and experience with construction, supply chains, costing, systems integration, regulatory engagements, and public engagement.

Let me turn to the topic of international collaborations more generally. Governments and private companies from around the world are paying attention to the development of the *Bold Decadal Vision*. Several have reached out for discussions regarding potential partnerships. These discussions are ongoing but need to be accelerated. International collaborations may provide

¹⁰ <https://www.iterresearch.us>.

opportunities to accelerate fusion RD&D and reduce costs to the US Government in support of the *Bold Decadal Vision*. Such opportunities may include but are not limited to securing fuel supplies including startup tritium, personnel exchanges, design-code validation, workforce development, sharing of capital-intensive test facilities, regulatory coordination, developing robust supply chains and availability of critical materials, coordination on nuclear and cybersecurity. I note that there is an active FESAC charge to assess targeted and mutually beneficial collaborative activities on overseas facilities as well as the modalities for such collaborations, with a report due in Spring 2023.¹¹

Conclusion

Chairman Manchin, Ranking Member Barrasso, and Members of the Committee, thank you again for the opportunity to testify on Federal support for fusion commercialization and the status of the *Bold Decadal Vision*. As the Senate and its colleagues in the House continue to consider how to support the *Bold Decadal Vision for Commercial Fusion Energy*, the DOE is continuing to develop an “all-of-DOE” approach to accelerating fusion energy RD&D in close partnership with the private sector, guided by the visionary authorizations you and your House colleagues have already provided and the incredibly hard work that the fusion R&D community put into the 2020 FESAC Long-Range Plan and the 2021 National Academies report *Bringing Fusion to the U.S. Grid*. I would be happy to take questions.

¹¹ <https://science.osti.gov/-/media/fes/fesac/pdf/2022/FESAC-charge-on-international-benchmarking.pdf>.