Commission *on* *the* Scaling *of* Fusion Energy

OCTOBER 2025

Fusion Forward

Powering America's Future

Commission on the Scaling of Fusion Energy

Letter from the Commission Co-Chairs

As co-chairs of the Commission on Scaling of Fusion Energy, we are grateful for all the work the Commission members, countless experts, and stakeholders have contributed towards crafting this groundbreaking report.

Since the publication of the Commission's preliminary report in February 2025, awareness of the potential and promise of fusion energy has continued to grow. We share this enthusiasm and believe that the opportunities a fusion-powered future could deliver for the United States warrants continued government focus aimed at spurring the private sector to develop and rapidly deploy fusion energy generation facilities.

As this report finds, the global race for fusion energy has reached a critical inflection point, and the nation that is able to win this competition could enjoy robust, dependable, and virtually limitless supplies of electricity and process heat. Such energy abundance would not only provide for prosperity but also security, positioning the United States as a global leader in this transformational industry. China has made massive investments in fusion research and development and only continues to accelerate its efforts. The United States must maintain its competitive edge, set the standards, and prepare to capture the massive global market for this transformative technology.

We again extend our gratitude to the Commissioners for proposing strategies to help ensure America leads the scaling and commercialization of fusion energy.

Sincerely,

James Risch
U.S. Senator (R-ID)

Maria Cantwell
U.S. Senator (D-WA)

Ylli Bajraktari
President, Special Competitive Studies Project

SPECIAL COMPETITIVE STUDIES PROJECT

Letter from the Chairman

Fusion energy—what promises to be a baseload, dispatchable, carbon-free source of energy—is on the cusp of transforming how humanity fuels its future. Once thought to be decades away, recent scientific milestones and rapid progress in enabling technologies have brought fusion within reach of demonstration in the coming decade. Achieving fusion energy at scale would ensure energy security, drive economic prosperity, and provide a sustainable power source for generations to come.

Given the strategic and transformative potential of fusion, it is imperative that the United States lead in its scientific discovery, demonstration, and commercialization. Leadership in this field will not only secure our nation's energy future, but will also reinforce our position as a global powerhouse of innovation.

As with other breakthrough technologies, maintaining U.S. leadership in fusion will require accelerating research, development, and demonstration efforts; streamlining regulations; and cultivating robust markets. The recommendations outlined in this report provide a roadmap to achieve these goals, combining ambitious public investment with strategic public–private partnerships and forward-looking policies. This effort is the result of a collaborative effort among leading experts from academia, the private sector, and government, all dedicated to ensuring that the United States leads in the global race to commercialize fusion energy.

The urgency to act has never been greater. While the United States has long been at the forefront of fusion research, the international competition is intensifying. China, in particular, is rapidly advancing its fusion energy capabilities through massive state investments and aggressive technological development, narrowing the window for American leadership. Without decisive action, the United States risks falling behind in an industry poised to reshape the global energy landscape far sooner than many anticipated. U.S. leadership in fusion is not just a matter of scientific progress—it is a geopolitical necessity to maintain technological supremacy and ensure national security.

This Commission concludes its work at a crucial moment in our nation's history. The coming years will determine whether the United States sets the pace of fusion innovation or follows in the wake of others. By leveraging our unparalleled scientific base, fostering innovation, and enacting bold policy, we have the opportunity to usher in a new era of clean, abundant, and secure energy. With continued commitment and investment, fusion energy can move from promise to reality—transforming our economy, strengthening our security, and ensuring a sustainable and prosperous future for all.

Sincerely,

Eric Schmidt
Chairman, SCSP

About the Commission

Mission

The Commission on the Scaling of Fusion Energy, convened by the Special Competitive Studies Project (SCSP), is dedicated to ensuring that the United States, alongside key allies and partners, leads in the global race to commercialize fusion energy. With a bold vision for achieving large-scale domestic power generation from fusion within a decade, the Commission aims to position the United States as the global leader in this transformative technology.

Commission Leadership

Senator Jim Risch (R-ID), *Co-Chair*
Senator Maria Cantwell (D-WA), *Co-Chair*
Ylli Bajraktari, President of SCSP, *Co-Chair*

Commissioners

Manu Asthana, President and CEO of PJM Interconnection
Dr. Kimberly Budil, Director of Lawrence Livermore National Laboratory
Dr. Steven Cowley, Director of Princeton Plasma Physics Laboratory
The Honorable Paul Dabbar*, Deputy Secretary of Commerce
Dr. David Kirtley, CEO of Helion Energy
Michael Kuiken, Distinguished Visiting Fellow at the Hoover Institution
The Honorable Mark Menezes, President and CEO of the United States Energy Association
Dr. Bob Mumgaard, CEO of Commonwealth Fusion Systems
Luke Murry, Head of Government Affairs at Marvell Technology
Dr. Rachel Slaybaugh, Partner at DCVC

**Commissioner Emeritus*

Scope of Work and Progress Since February 2025

Following the release of its preliminary report, *Fusion Power: Enabling 21st Century American Dominance*, in February 2025, the Commission intensified its activities, focusing on developing actionable implementation guidance to facilitate the three-pillar strategy for U.S. fusion leadership. Through the Commission's three working groups—R&D Acceleration, Authorities, and Resources— and plenary sessions, Commissioners received 48 briefings from fusion stakeholders, including from 14 private companies, 12 current and former Department of Energy (DOE) representatives, and 16 other experts from government, non-governmental organizations, research, legal, and private capital communities.

These engagements resulted in several key deliverables that form the foundation of this Fall Report:

- An updated assessment of the U.S.–China competition landscape in fusion;
- An updated analysis of the emerging fusion supply chain and recommendations for addressing critical vulnerabilities and opportunities;
- Recommendations for implementing the National Fusion Goal, including a fusion Executive Order; and
- A Roadmap for Authorities to Deploy Fusion Energy and Progress Report detailing the next steps in fusion regulation.

Table of Contents

Executive Summary

This report underscores the urgent need for the United States to prioritize the rapid commercialization of fusion energy to secure U.S. national security and restore American energy dominance. Fusion, the process that powers the stars, offers the potential for an abundant, clean, and geographically unconstrained energy source, poised to revolutionize the global energy landscape and boost economic growth.

The Stakes Have Increased. The nation that leads in fusion will secure significant economic advantages, ensure its energy independence, and maintain its technological edge in critical areas, including AI and national security. In our preliminary report, *Fusion Power: Enabling 21st Century Dominance,* we set forth a bold National Fusion Goal: to begin construction on the world's first commercial fusion power plant within this decade, anchored in a clear, three-part strategy for success.

The global fusion race continues to evolve rapidly. The United States leads in scientific breakthroughs and predictive understanding, a lead that must be preserved. It also leads in private investment. However, China is executing an infrastructure-first strategy, outpacing the United States in building critical R&D facilities, taking major steps in commercialization, and positioning itself to dominate the future fusion supply chain. Failing to act decisively now will result in the United States ceding this critical industry to China.

This report consequently raises the level of ambition. There is no time to waste. This administration has the opportunity to unleash a thriving American fusion industry. In our revised **National Fusion Goal**, we call for America to initiate construction on more than one industry-led demonstration fusion power plant in the United States by the end of 2028 that leads to commercialization. Achieving this goal requires immediate and concerted action in the following areas:

1. **Declare Fusion Energy a National Security Priority.** The Federal Government must officially recognize fusion energy as critical to national security.

    a. We recommend that the President immediately issue an **Executive Order on advancing fusion energy as a national security priority.** This EO would establish the National Fusion Goal, drive continued U.S. scientific leadership, and direct support across the interagency for the U.S. fusion industry.

2. **Expand Fusion Leadership and Inject $10 Billion to Drive Commercialization.** To bring fusion to the grid, the Department of Energy must take organized, sustained action across fusion research, development, and demonstration (RD&D). A $10 billion investment is needed to achieve the National Fusion Goal.
    a. **Organize for a Commercialization-Oriented Mission:** We recommend that the Secretary of Energy designate a National Fusion Lead, create a temporary project office to achieve the

National Fusion Goal, and align the mission and budget of DOE fusion programs around its execution while preserving U.S. leadership in predictive fusion science.

b. **Invest in Strategic RD&D:** A $10 billion funding injection would enable the nation to execute this goal on a competition-relevant timeline. Funds should go towards (1) supporting the necessary R&D infrastructure to close remaining technical gaps; (2) fully funding and expanding existing programs and partnerships focused on fusion commercialization; and (3) adding a demonstration tier to the existing Milestone-Based Fusion Development Program to de-risk the construction of industry-led demonstration fusion power plants.

3. **Strategic Actions to Win the Fusion Race.** Winning the fusion race will also require bringing together multiple departments and agencies, as well as the private sector.

a. **Scale Regulatory Progress:** Execute the roadmap detailed in the **Roadmap for Authorities to Deploy Fusion Energy (Appendix 1).** This includes ensuring that the Nuclear Regulatory Commission (NRC), which has already laid a great foundation for fusion, finalizes an efficient licensing framework under 10 CFR Part 30 and that state regulators are resourced to execute. We also need to look beyond the NRC to fast-tracking environmental reviews; directing FERC to expedite grid interconnection for clean, firm power, including with co-located loads like data centers; and ensuring global regulatory bodies align with U.S. positions to enable U.S. exports.

b. **Secure Key Resources:** Mitigate critical vulnerabilities and build an America-friendly fusion supply chain. This requires prioritizing investments in domestic manufacturing for key components through incentives like the Section 45X tax credit and government funding, and incentivizing commercial sources of fusion fuel inputs.

c. **Lead in modern digital design:** U.S. leadership in predictive fusion science and in applying AI to fusion control and design should be strengthened to fully seize the opportunities of digital fusion optimization. Enhanced digital tools can significantly accelerate progress in the U.S. private fusion sector by helping to distinguish the true potential of many new concepts being proposed.

d. **Build the Fusion Workforce:** Ensure that a capable stream of experts are ready to design, build, and operate the power plants of tomorrow. Support graduate researchers and partnerships with universities, community colleges, and trade schools.

The time for bold action is now. We must seize this moment to ensure that fusion energy powers America's future.

Introduction: The Urgency Accelerates

Fusion energy, the process that powers the stars, offers humanity its best chance to harness an abundant, clean, dispatchable source of power. Achieving fusion at scale would secure U.S. energy independence, unleash economic prosperity, and affirm America's role as the world's innovation leader.

In February 2025, this Commission issued its preliminary report, highlighting the importance of fusion energy to U.S. national security and energy dominance, and offering a strategy to secure U.S. leadership. We set forth a bold National Fusion Goal: to begin construction on the world's first commercial fusion power plant within this decade, anchored in a clear three-part strategy for success.

The urgency of this mission has only accelerated. American scientists continue to deliver historic breakthroughs—most recently, the National Ignition Facility's (NIF) achievement of energy gain[1] greater than four[2] in 2025, building on its 2022 ignition milestone. U.S. predictive fusion models lead the world and steer many of the private sector's efforts. U.S. fusion companies are making progress on delivering net energy gain at facility scale; building demonstration power plants; and entering ambitious partnerships with utilities, industry, and government.

At the same time, global competition is intensifying. China is executing an aggressive, state-led, infrastructure-first strategy—having mobilized at least $6.5 billion since the NIF first achieved ignition—to dominate fusion's commercial ecosystem.[3] The race is no longer theoretical; it is unfolding now, and the consequences of losing would reverberate across energy security, economic leadership, and national power.

We have thus decided to raise the level of ambition in this report. There is no time to waste. This administration has the opportunity to unleash a thriving American fusion industry. In our revised National Fusion Goal, we call for America to initiate construction on more than one industry-led demonstration fusion power plant in the United States by the end of 2028 that leads to commercialization.

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[1] Energy gain, often abbreviated as Q, is the ratio of fusion energy released to energy input to the reaction. Energy gain can be defined in two different ways depending on where the energy input is measured. Scientific energy gain (which is what we use here) considers the energy delivered across the vacuum vessel boundary. Wall-plug energy gain considers the input electricity to run the experiment. While the NIF has now achieved scientific $Q > 4$, a fusion power plant would need a higher number. Approaches involving direct energy recapture (e.g., from magnetic fields produced by the plasma, rather than more conventional heat extraction) claim to yield economical results with $Q < 10$, but most ventures will likely seek to have $Q \geq 30$. *See* Arthur Turrell, The Star Builders: Nuclear Fusion and the Race to Power the Planet, Scribner at 190 (2021); Sam Wurzel & Scott Hsu, Continuing progress toward fusion energy breakeven and gain as measured against the Lawson criteria, Fusion Energy Base (2025).

[2] Tim De Chant, Laser-powered fusion experiment more than doubles its power output, TechCrunch (2025).

[3] Cash, Scale, and Speed: Why China's $6.5 Billion Fusion Buildout Should Shock the World, Special Competitive Studies Project (2025).

Secretary of Energy Chris Wright has framed the moment with urgency and ambition. "Fusion has hit that tipping point where things are going to happen fast,"[4] he observed earlier this year, while noting that fusion technology has "huge room to run."[5] He has also recognized the rapid speed of progress, saying, "I believe we will know the commercial pathway to fusion during the Trump administration.... Commercial electricity from fusion energy could be as fast as eight years, and I'd be very surprised if it's more than fifteen."[6]

In addition, a White House memorandum published in late September listed fusion as one of its R&D budgetary priorities for Fiscal Year 2027. Specifically, it directed agencies to prioritize investments in "affordable, reliable, and secure energy technologies," including fusion, and "support the technological development and demonstration" of fusion energy.[7] This is a step in the right direction. Action needs to be taken immediately to ensure that the United States does not fall behind in the fusion race.

Without decisive steps, the United States risks ceding leadership in an industry that will redefine the global energy and national security landscape. This report offers an updated net assessment of the global fusion competitions and a detailed strategy for the United States to win the fusion race, with a dedicated National Fusion Goal and the steps needed to achieve it.

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[4] Special Competitive Studies Project, Episode 25: A Conversation with the Secretary of Energy, Chris Wright, YouTube at 11:05 (2025).
[5] Nomination Hearing on Chris Wright to be the Secretary of Energy, Senate Committee on Energy and Natural Resources (2025).
[6] Ari Natter, Edward Ludlow, and Caroline Hyde, Fusion Power Possible in Eight Years, US Energy Chief Says, Bloomberg (2025).
[7] M-25-34 / NSTM-2, Fiscal Year (FY) 2027 Administration Research and Development Budget Priorities and Cross-Cutting Actions, The White House at 4 (2025).

The Shifting Fusion Landscape: A U.S.–China Comparative Analysis

The global race for fusion energy has reached a critical inflection point. The policy decisions and investments Washington makes in the next few years could shape the geopolitical energy landscape for decades to come. For generations, the United States has led the world in fusion science,[8] most famously resulting in the historic achievement of ignition at the NIF in 2022—a feat yet to be replicated at any other fusion machine in the world. This legacy of scientific leadership has helped foster the world's largest and most dynamic private fusion industry.

However, the race is rapidly shifting from a contest of scientific discovery to a competition for commercial dominance. China, recognizing fusion's strategic importance, is mobilizing massive state resources not only to pursue scientific breakthroughs but also to build the infrastructure, supply chains, and industrial capacity required for deployment at scale—a proven strategy Beijing has already used to lead sectors like solar panels and advanced batteries.[9] We conservatively estimate that, since 2023, China has mobilized at least $6.5 billion for fusion infrastructure supporting a variety of approaches, though this figure could be as much as $13 billion.[10]

The central dynamic of the fusion race is clear: the United States laid the scientific groundwork; China is positioning to win the industry. An assessment of the global landscape reveals critical divergences in investments, infrastructure development, R&D, and supply chains that threaten America's ability to capitalize on its own innovations.

Below, we assess the evolving U.S.–China competition for fusion energy commercialization across the scientific and commercial value chain. We start by comparing the state of fusion R&D in the United States and China based on scientific breakthroughs, talent, and publications. Next, we look at each country's respective fusion commercialization efforts, examining the buildout of commercialization-relevant infrastructure, key companies, and levels of public and private investment. We then examine the emerging fusion supply chain by evaluating U.S. and Chinese access to the specialized components and materials that will be required for commercial fusion systems. Finally, we zoom out to look at

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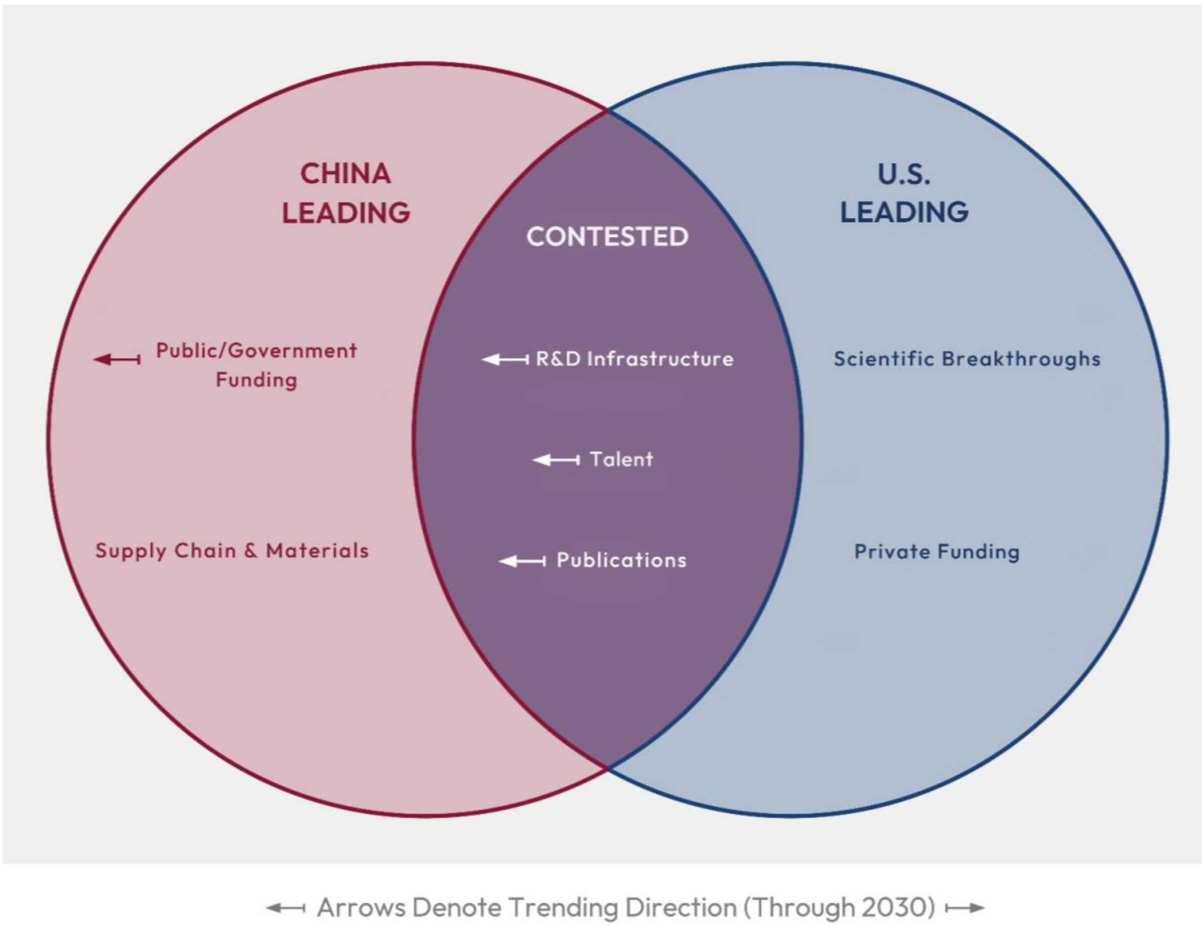
[8] History, U.S. Department of Energy (last accessed 2025).
[9] You Xiaoying, The 'New Three': How China Came to Lead Solar Cell, Lithium Battery and EV Manufacturing, Dialogue Earth (2023); Dan Wang, China's Hidden Tech Revolution: How Beijing Threatens U.S. Dominance, Foreign Affairs (2023).
[10] Cash, Scale, and Speed: Why China's $6.5 Billion Fusion Buildout Should Shock the World, Special Competitive Studies Project (2025).

other key players in the global landscape of fusion competition and examine the state of international fusion cooperation.

U.S.-China Comparative Analysis: Fusion Energy Metrics



Research & Development: Moving from Ignition to Deployment

The United States maintains a lead in scientific achievement, but China is swiftly expanding its capacity for innovation and workforce development.

Scientific Breakthroughs

The United States leads the world in demonstrated fusion performance. The NIF is the only facility in the world to have achieved fusion ignition and Q > 1. U.S. scientists have continued to improve this record, recently achieving a target gain of over four (Q > 4).[11] The United States also

[11] Achieving Fusion Ignition, Lawrence Livermore National Laboratory (last accessed 2025).

leads in the application of AI and advanced simulation to fusion, driving breakthroughs in plasma stability and optimized machine designs.[12]

China has not yet achieved ignition and trails the U.S. in laser fusion and plasma physics. However, China is making significant bets on magnetic confinement concepts. In 2025, the Experimental Advanced Superconducting Tokamak (EAST) set a record—since broken by the Tungsten Environment in Steady-state Tokamak (WEST) in France[13]—for the longest plasma sustainment.[14] This follows 2021 plasma temperature records of 120 million Celsius for 101 seconds and 160 million Celsius for 20 seconds.[15] Additionally, in its recent AI+ Energy plan, China named an explicit goal of using AI in plasma control, building on existing research programs.[16]

Talent and Publications

The United States has long been the foremost destination for the world's top scientific talent, but that advantage is rapidly slipping. In science, talent follows infrastructure and funding: when the United States led in both, it also dominated the global flow of researchers. Today, with little commercialization-focused public investment and limited new facilities at home, that gravitational pull is weakening. Although the United States has roughly doubled its number of publications in *Nuclear Fusion* (one of the field's premier research journals) since the early 2000s, researchers affiliated with Chinese institutions have massively increased the scale of their output in the past 15 years (see graph below). While publications are only one measure of scientific progress, the past decade has seen China surpass the United States in its share of publications in the journal.

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12 Rachel Kremen, Using Artificial Intelligence to Speed Up and Improve the Most Computationally Intensive Aspects of Plasma Physics in Fusion, Princeton Plasma Physics Laboratory (2024); Jaemin Seo, et al., Avoiding Fusion Plasma Tearing Instability with Deep Reinforcement Learning, Nature (2024).

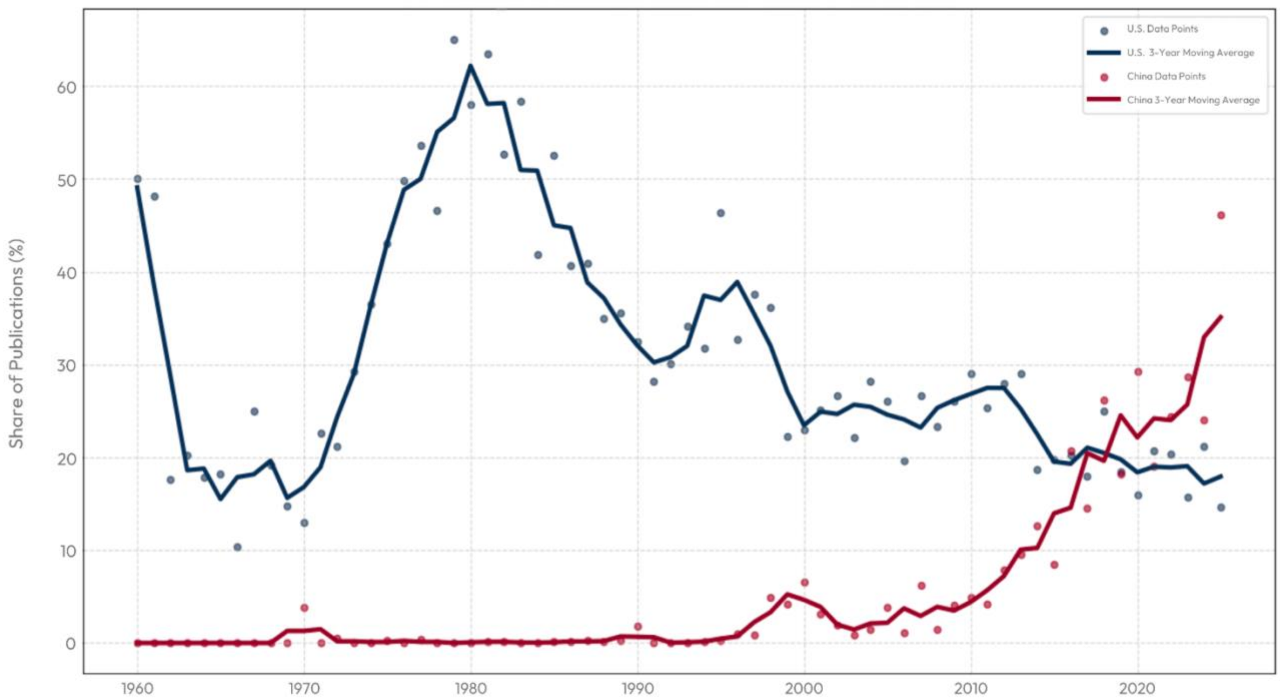
13 Nuclear fusion: WEST beats the world record for plasma duration, CEA (2025).

14 Although, the conditions of the reaction as a whole were not as close to Q = 1 as other tokamaks have been. Specifically, EAST achieved a relatively low triple product, the most common holistic metric by which a fusion machine's performance is measured. *See* Chen Na, Chinese "Artificial Sun" Sets New Record in Milestone Step Toward Fusion Power Generation, Chinese Academy of Sciences (2025).

15 China maintains 'artificial sun' at 120 million Celsius for over 100 seconds, setting new world record, People's Daily Online (2021).

16 EAST has been the beacon of China's plasma confinement AI research, resulting in a functional AI controller system. This research, the result of a previous DOE-sponsored collaboration with MIT, shows that Chinese scientists are following closely behind American researchers. Similar work is also underway on the newer HL-3 tokamak. *See* Bingxia Xiao, Plasma Control with Artificial Intelligence on EAST, 14th Technical Meeting on Control Systems, Data Acquisition, Data Management and Remote Participation in Fusion Research (2024); Deep dive: China's "AI + Energy" plan, Trivium China (2025); 国家发展改革委 国家能源局关于推进"人工智能+"能源高质量发展的实施意见 [Implementation Opinions of the National Development and Reform Commission and the National Energy Administration on Promoting the High-Quality Development of "Artificial Intelligence +" Energy], National Energy Administration (2025).

Percentage of Publications in the Journal "Nuclear Fusion" (U.S. versus China)



The percentage share of publications by researchers affiliated with Chinese institutions in the journal Nuclear Fusion has sharply increased over the past decade, overtaking the United States.[17]

China, on the other hand, is producing ten times more fusion Ph.D. graduates than the United States, a direct function of government funding.[18] On the intellectual property front, China also filed more fusion patents than the United States in 2023.[19] China will also be hosting the 30th IAEA Fusion Energy Conference, the preeminent international fusion conference, in Chengdu this October, providing an opportunity to showcase its burgeoning fusion ecosystem to global scientific talent.[20] Although China is still behind the U.S. in fusion simulation or the application of AI to fusion, a previous DOE-sponsored collaboration with MIT helped to close that gap.[21]

Despite U.S. leadership in major scientific milestones and advanced computation, China's massive investment in human capital is building the workforce necessary for long-term industrial dominance.

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[17] SCSP analyzed the authorships of each article in IAEA's Nuclear Fusion publication (the field's leading journal) since its inception. For the data in the above chart, the national affiliations of journal article authors were recorded, and papers of Chinese and American authors were charted. *See* IAEA Nuclear Fusion, IOPscience (last accessed 2025).

[18] Jennifer Hiller & Sha Hua, China Outspends the U.S. on Fusion in the Race for Energy's Holy Grail, Wall Street Journal (2024).

[19] Rimi Inomata, China Tops Nuclear Fusion Patent Ranking, Beating U.S., Nikkei Asia (2023).

[20] While Chengdu previously hosted the FEC conference in 2006, this will be the first major fusion conference hosted in China since it embarked on major fusion R&D infrastructure projects. *See* 30th IAEA Fusion Energy Conference (FEC2025), IAEA (last accessed 2025).

[21] Bingxia Xiao, Plasma Control with Artificial Intelligence on EAST, 14th Technical Meeting on Control Systems, Data Acquisition, Data Management and Remote Participation in Fusion Research (2024)

Cash, Scale, and Speed: Mobilizing Private vs. Government Capital

Since 2023, **China has mobilized over $6.5 billion across its fusion enterprise, almost three times the funding appropriated to the Department of Energy's Fusion Energy Sciences (FES) Program in roughly the same period of time.**[22] These investments, largely public but partly private, span the infrastructure for multiple approaches, the basic research and development to make those infrastructure projects work, and the companies to commercialize the technology. Annualized, this investment is almost double the 2023 estimate ($1.5 billion per year) of China's fusion spending.[23] This is a conservative estimate, which does not factor in the multibillion-dollar Mianyang laser fusion facility, the operational costs of EAST, or funding for university programs, and a reasonable party could have counted it as $10 billion or higher. It also fails to account for the fact that dollars spent in China go further than they would in the United States, owing to softer regulations and cheaper resources and labor.

This batch of spending includes investing $2.1 billion in a new state-owned consortium, China Fusion Energy Company (CFEC),[24] a single investment almost triple the size of FES's budget request for FY 2026.[25] China's largest fusion companies and infrastructure projects all feature significant backing from the national and/or provincial governments. While this is unsurprising in China's state-dominated energy sector, it underscores Beijing's readiness to absorb the risks of capital-intensive, infrastructure-heavy technologies, even at the pre-commercial stage.

Infrastructure

The United States has no significant public fusion infrastructure projects underway, and its last one, the NIF, opened over fifteen years ago. The United States' scientific community identified the important infrastructure in the 2020 Fusion Energy Sciences Advisory Committee's Long-Range Plan, but DOE **has not executed this plan** due to a lack of funding, ability, willpower, and policy prioritization.[26] Despite existing plans, the absence of infrastructure capable of closing key gaps in fusion science and technology creates a disconnect between public research and private commercialization efforts, hindering the development of new technologies.

China, on the other hand, is backing its fusion goals with massive infrastructure projects. The message is clear: Beijing is not just competing, it is aiming for global leadership in the deployment and commercialization of this potentially game-changing energy source. Its money is being spent on a comprehensive and realistic plan for the entirety of a fusion ecosystem, as seen through the facilities below.

- On Hefei Science Island in Anhui, construction is underway on China's next major fusion machine, the Burning plasma Experimental Superconducting Tokamak (BEST). It is a

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[22] Cash, Scale, and Speed: Why China's $6.5 Billion Fusion Buildout Should Shock the World, Special Competitive Studies Project (2025).
[23] Jean Paul Allain, Building Bridges: A Bold Vision for the DOE Fusion Energy Sciences, Department of Energy Office of Science (2023).
[24] China Launches Fusion-Focused Company, Nuclear Newswire (2025).
[25] FES requested $744.78 million for FY 2026. *See* Department of Energy FY 2026 Congressional Justification, Volume 5, Department of Energy at 133 (2025).
[26] Troy Carter, et al., Powering the Future: Fusion and Plasmas, Fusion Energy Sciences Advisory Committee (2020).

compact, high-field tokamak expected to go online in 2027 and designed to reach Q = 1–5.[27] BEST is located roughly a mile north of the Experimental Advanced Superconducting Tokamak (EAST), a separate fusion research facility that has been in operation since 2006.

The CRAFT Campus (north) and BEST machine (the construction area, south) in Hefei. The image on the left is from October 10, 2022, and the image on the right is from October 6, 2025. *Source: Planet Labs.*

- On the same science campus as BEST and EAST in Hefei, construction of the 14 research facilities that constitute the $570 million[28] Comprehensive Research Facilities for Fusion Technology (CRAFT) campus is nearing completion. The research facility broke ground in 2019 and is expected to be fully functional by the end of 2025.[29] The same campus will also be the planned home of the China Fusion Engineering Test Reactor (CFETR), which aims to produce a gigawatt of fusion power and go online in the 2030s, but has not yet begun construction.[30] Through the CRAFT campus, China will be able to design the materials and parts that will bring fusion plants into the commercial market.

[27] Jianwen Yan & Defeng Kong, Overview and updates of the Burning Plasma Experimental Superconducting Tokamak (BEST), Ninth DEMO and Fusion Plants Workshop (2025); Angela Dewan & Ella Nilsen, The US Led on Nuclear Fusion for Decades. Now China Is In Position to Win the Race, CNN (2024).

[28] Also reported elsewhere as $700 million. *See* Angela Dewan & Ella Nilsen, The US Led on Nuclear Fusion for Decades. Now China Is in Position to Win the Race, CNN (2024); Katie Tarasov, How the U.S. Is Losing Ground to China in Nuclear Fusion, as AI Power Needs Surge, CNBC (2025).

[29] Yuntao Song, Fusion Power Activities in ASIPP, Fusion Power Associates 43rd Annual Meeting (2022).

[30] Chinese Fusion Energy Programs Are A Growing Competitor in the Global Race to Fusion Power, Fusion Industry Association (2021).

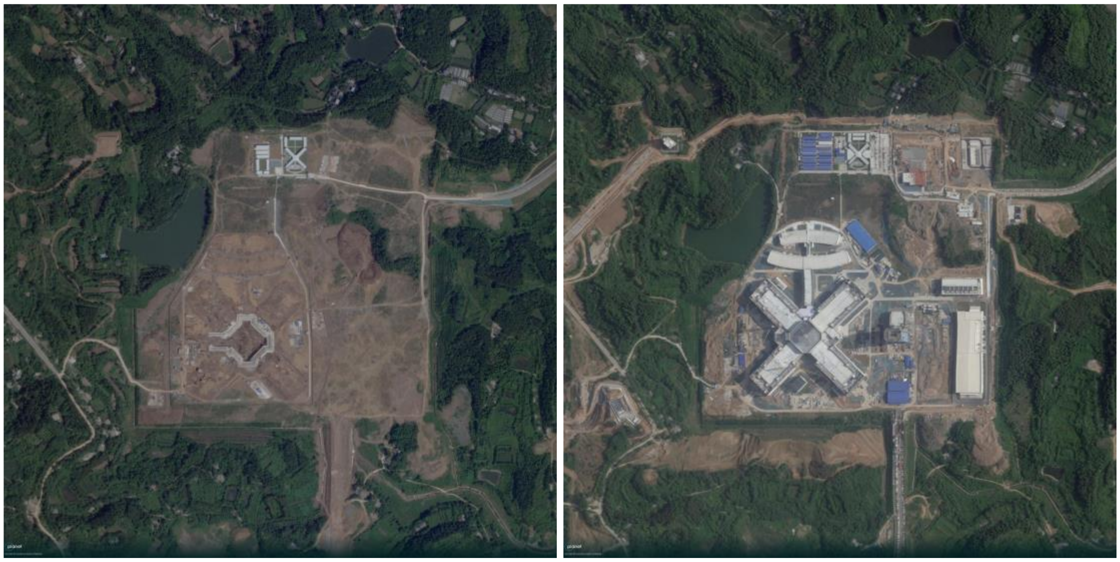
Yaohu Science Island,future home to Xinghuo. The image on the top was taken on March 30, 2023, and the image on the bottom was taken on October 9, 2025. *Source: Planet Labs.*

- Xinghuo, a 100 megawatt hybrid fission–fusion reactor[31] is to be built on Yaohu Science Island in China's southeastern provincial capital city of Nanchang, which plans to have a gain of over 30 and be operational by 2030.[32] Construction of the supporting buildings on its science island began in 2024, and environmental reviews for Xinghuo should be completed this year, although the full total of the $2.76 billion in required funding is still being raised.[33]

[31] Any fusion machine will likely use a neutron multiplier to produce its own fuel. In a fusion–fission hybrid, that multiplier will not be beryllium but rather uranium or plutonium, which would also produce heat like a typical fission reactor. A hybrid reactor would require lower fusion gain to be productive, but would also produce significant quantities of special nuclear material.

[32] China Plans World's First Fusion-Fission Power Plant, Nuclear Engineering International (2025).

[33] Nuclear Fusion Expert Exchange, Sina Finance (2025).



The Mianyang inertial fusion facility is under construction. The image on the left was taken on September 13, 2023, and the image on the right was taken on July 10, 2025. *Source: Planet Labs.*

- China is also building an NIF-style fusion research facility in Mianyang, in southwestern China.[34] The NIF-style device would entail significantly more laser power and would likely be capable of achieving ignition with a wider variety of experiments.[35] Not only would this be a potential gain to China's inertial fusion energy research, but it could also provide data to inform the simulation and design of nuclear weapons.[36]

The implications of this gap are severe. While the United States has stalled on building critical R&D infrastructure identified years ago, China is rapidly constructing a comprehensive suite of facilities designed to close critical technological gaps and accelerate commercial deployment.

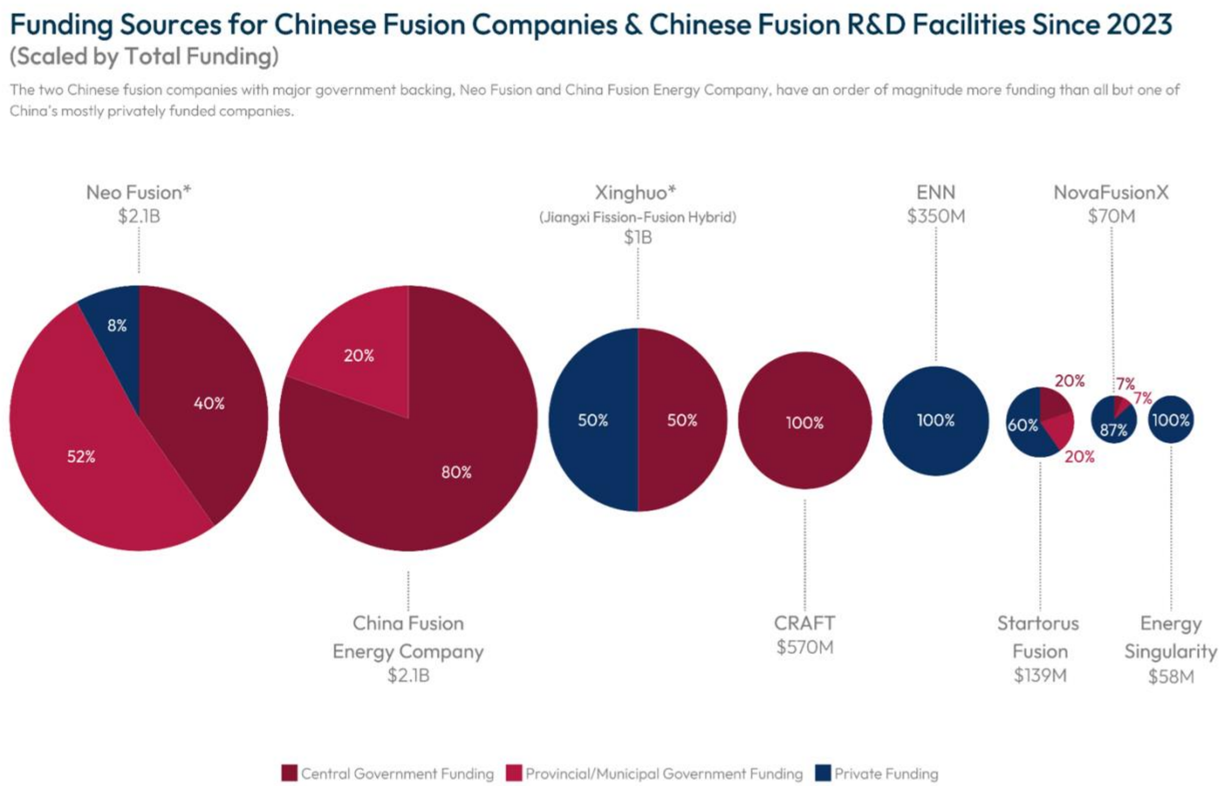
Funding

The United States leads the world in private investment. As of 2025, total global equity investment in private fusion companies has reached at least $13.9 billion, with $7.57 billion invested in U.S. firms; 29 of the world's 53 active fusion companies are based in the United States.[37] However, U.S. public funding has stagnated. While Congress allocated $790 million to DOE's Fusion Energy Sciences (FES) program in FY 2025, much of this supported legacy projects focused on science: for example, $240

[34] Gerry Doyle, Exclusive: Images Show China Building Huge Fusion Research Facility, Analysts Say, Reuters (2025).
[35] Dan Drollette Jr., Ferreting Out the Truth About Fusion: Interview with Bob Rosner, Bulletin of Atomic Scientists (2024).
[36] Gerry Doyle, Exclusive: Images Show China Building a Huge Fusion Research Facility, Analysts Say, Reuters (2025).
[37] This number still does not count investment into the Xinghuo fission-fusion hybrid reactor, estimated to cost $2.76 billion in total, or facilities like the Mianyang laser facility. *See* Sam Wurzel, September 2025 Fusion Equity Investment Update, Fusion Energy Base (2025).

million of that was directed towards the multilateral ITER project.[38] Commercialization-focused programs like the Milestone-Based Fusion Development Program have also received less funding than had been Congressionally authorized.[39] By one estimate, only 1.2% of U.S. Government funding for FES goes towards fusion commercialization.[40]

China's funding of fusion companies and projects, at least $6.5 billion since 2023, features a mix of backing from regional governments, the central government, venture capital, and individual private investors. The majority of this funding is provided by the central government (52%), with another sizable amount (26%) provided by regional governments. Private capital only accounts for 21% of China's company fusion funding. It is clear that China maintains a heavy lead in government investment in fusion projects, even if American entrepreneurs are ahead in accumulating private capital. Given the apparent state-backed efforts to bolster its fusion ecosystem, China is quickly catching up to the level of private investment in U.S. fusion companies.



*Neo Fusion, the commercialization company affiliated with BEST, is the only representation of BEST's funding in the above graphic, which could include funding from other sources. Xinghuo is not a company in itself, but a project jointly run by one public and one private company. Those companies, China Nuclear Industry 23 Construction Company (CNI23CC) and Lianovation Superconductor, are not represented elsewhere on this graph, although China National

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[38] FY 2024 DOE Office of Science, American Institute of Physics (2024); Elizabeth Gibney, ITER Delay: What It Means for Nuclear Fusion, Nature (2024); Jennifer Shiller & Sha Hua, China Outspends the U.S. on Fusion in the Race for Energy's Holy Grail, Wall Street Journal (2024).

[39] GAO-25-107037, Fusion Energy: Additional Planning Would Strengthen DOE's Efforts to Facilitate Commercialization, U.S. Government Accountability Office at 17 (2025).

[40] GAO-25-107037, Fusion Energy: Additional Planning Would Strengthen DOE's Efforts to Facilitate Commercialization, U.S. Government Accountability Office at 12 (2025).

Nuclear Company is a mutual investor in CNI23CC and China Fusion Energy Company. *Source: WireScreen; Special Competitive Studies Project.*

The companies listed here, many of which have some of the same backers, represent a strategy of taking multiple shots on goal.

- This past July, Beijing announced a staggering $2.1 billion investment in a new, state-owned fusion company called China Fusion Energy Company (CFEC), mostly owned by the China National Nuclear Corporation, which also operates the HL-3 tokamak through the Southwestern Institute of Physics.[41] This single public investment is almost three times the size of the U.S. Government's annual fusion energy budget.

- Neo Fusion, the commercialization arm of BEST, is mostly backed by the provincial government, with significant investment from the central government and some private backing by NIO and Anhui Wenergy Company.[42]

- Xinghuo, the fission-fusion hybrid reactor mentioned above, is funded as a 50-50 collaboration between the centrally owned China Nuclear Industry 23 Construction Company and the private Lianovation Superconductor, a subsidiary of Jiangxi Electronics.[43]

- ENN Energy Research Institute, which has raised $550 million in funding, is a subsidiary of the established energy player ENN Group, and is pursuing multiple approaches, most notably spherical tokamaks and proton-boron fuel.[44]

- Startorus Fusion, a $139 million spherical tokamak company backed by venture capital.[45]

- Energy Singularity, a $113 million compact tokamak company backed by NIO and other private investors.[46]

- NovaFusionX, a $70 million dual field reversed configuration (FRC) fusion company backed by private VC and central and provincial innovation funds.[47]

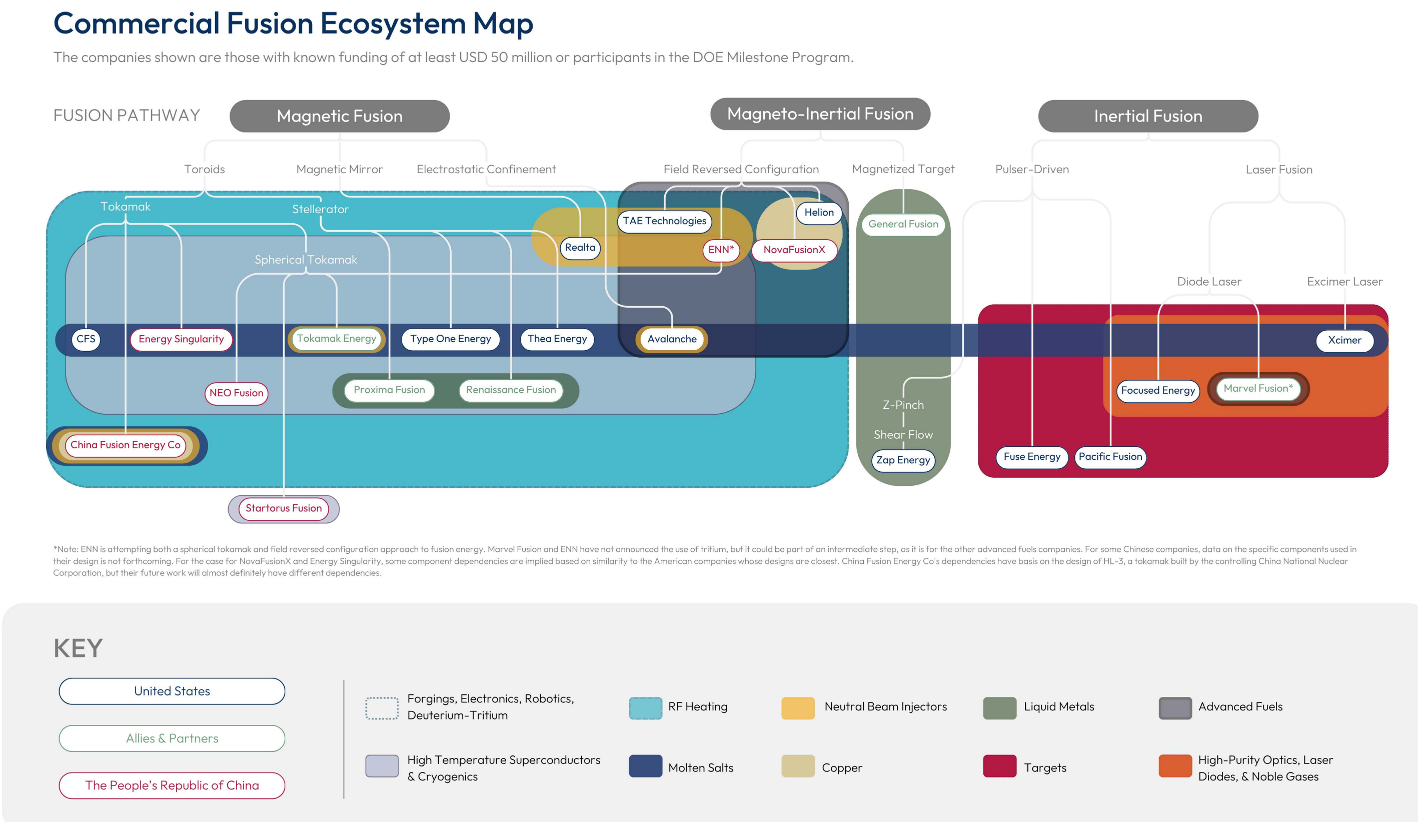
- Other companies, including Star Energy Xuanlight and Hanhai Ju Neng, which are both FRC approaches.[48]

China's landscape of fusion companies is diverse. Some are public, some are private, and many are a mix. Some embrace tokamaks, some field-reversed configurations, and one collaboration is notably building a fission-fusion hybrid. China has multiple $2+ billion efforts; the United States has only one

[41] China Launches Fusion-Focused Company, Nuclear Newswire (2025).
[42] Neo Fusion, Fusion Energy Base (last accessed 2025) and Wirescreen.
[43] China Plans to Build World's First Fusion-Fission Reactor by 2031, Climate Solutions News (2025).
[44] ENN, Fusion Energy Base (last accessed 2025); The Global Fusion Industry in 2025, Fusion Industry Association (2025); and ENN, ENN Energy Research Institute (last accessed 2025).
[45] The Global Fusion Industry in 2025, Fusion Industry Association (2025).
[46] The Global Fusion Industry in 2025, Fusion Industry Association (2025); Energy Singularity, Fusion Energy Base (last accessed 2025).
[47] NovaFusionX, Fusion Energy Base (last accessed 2025); Wirescreen.
[48] Star Energy Xuanlight, FusionXInvest (last accessed 2025); Hanhai Juneng completed an angel round of financing of tens of millions of yuan, led by Huaying Capital, iNews (2025).

so far. China's willingness to publicly fund its fusion ecosystem builds security through different economic environments, at the cost of the more dynamic and nimble nature of private capital.

Supply Chains: Controlling the Metals, Minerals, and Manufacturing



As fusion moves from the lab to the grid, control over specialized components and materials could be decisive in determining how quickly the technology can be deployed, adopted, and commercialized.

The United States will need to be proactive to win the competition to build out the future fusion supply chain, and it is already behind in many components. Even though fusion machines will depend less on raw materials than conventional energy industries, the existing suppliers of certain specialty components—some sourced from China—still pose risks. The United States has relative control over some components in the fusion supply chain, including the mining of beryllium and the construction of magnets using high-temperature superconducting tape. [49] Other components, like fusion-capable laser diodes and cryogenic systems, are largely manufactured by the United States and its allies, namely

[49] This almost all flows through Commonwealth Fusion Systems. The tape the magnets are made with, however, is almost all externally sourced. Japan, home of Faraday Factory, leads, but China is now increasing its HTS production to a very competitive level. *See* Stephen Shankland, How CFS is building a fusion factory, not just a single fusion machine, Commonwealth Fusion Systems Blog (2025).
Faraday Factory Japan: High-quality HTS tapes for a greener future, Innovation News Network (2025).

those in Japan and Europe.[50]

Yet China, by way of its command over the current global electronics supply chain, is well-positioned to control critical links in the fusion supply chain. It is difficult or impossible for fusion companies that need access to the following inputs or components to build a China-proof supply chain today:

- **Power Electronics:** High-power switches and high-voltage capacitors comprise major costs to many pulsed approaches to fusion, and are also used in steady-state fusion approaches. China has held a general lead in this industry. As well, computing chips that drive these electronics and fusion systems generally will be necessary for the design, simulation, and operation of fusion power plants, but the threat posed is shared among a wide variety of industries.

- **Tungsten and Vanadium:** Leading candidates for plasma-facing components; China produces 80% of the world's supply of tungsten and has over half of the world's known tungsten reserves.[51] China produces 67% of the world's vanadium.[52]

- **Lithium-6 Enrichment:** Used for breeding tritium fuel. Currently, there exists no commercially available supply for enriched lithium in the United States, and it is only produced in China and Russia.[53]

- **Laser Diodes:** China dominates the raw materials (gallium, indium,[54] and germanium) needed for laser diodes critical to inertial fusion, recently implementing export controls on both.[55]

- **High-Temperature Superconductors (HTS):** Common formulations of HTS tape require small amounts of rare-earth elements (REEs) like yttrium. China supplies 94% of the U.S. supply of yttrium,[56] and has recently implemented restrictions on the export of REEs and related processing technologies,[57] but this may not be a problem with appropriate production from MP Materials.[58] Production of the HTS tape/wire itself generally takes place in Japan, but China is growing its own capabilities.[59]

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[50] The Fusion Industry Supply Chain: Opportunities and Challenges, Fusion Industry Association (2023).
[51] Madhumitha Jaganmohan, Leading Countries Based on Reserves of Tungsten Worldwide in 2023, Statista (2024); Jessica Long, Four Reasons Behind the Ten-Year High in Chinese Tungsten Prices, Fastmarkets (2024).
[52] Georgia Williams, Top 4 Vanadium-producing Countries, Investing News Network (2025).
[53] It is possible that China is not producing their own supply, but rather is importing from Russia instead. *See* Jackie Park, Enriched lithium and the race for advanced nuclear technologies, Power Technologies (2025).
[54] Laura Dair, Indium Mineral Commodity Summaries 2025, U.S. Geological Survey (2025).
[55] Gracelin Baskaran and Meredith Schwartz, The Consequences of China's New Rare Earths Export Restrictions, Center for Strategic and International Studies (2025).
[56] Marcus Lu, Charted: China Dominates the Supply of U.S. Critical Minerals List, Visual Capitalist (2024); Mineral Commodity Summaries 2024, U.S. Geological Survey (2024).
[57] Keith Bradsher, What to Know About China's Halt of Rare Earth Exports, New York Times (2025); Evan Halper & Jeff Stein, US agencies alarmed by China's curbs on exports of rare-earth minerals, The Washington Post (2025).
[58] Heavy Rare Earth Concentrate (SEG+), MP Materials (last accessed 2025).
[59] Faraday Factory, Faraday Factory (last accessed 2025); Shanghai Creative Superconductor, Fusion Energy Base (last accessed 2025).

The United States government has not prioritized developing or securing the fusion supply chain, leaving the nascent industry vulnerable as China aggressively captures control over the critical materials and specialized components essential for fusion deployment.

The Global Landscape: Other Key Players

Beyond the United States and China, several advanced economies are pursuing distinctive fusion strategies that reflect their national strengths and policy priorities. From the UK's focused push on spherical tokamaks and regulatory innovation, to the EU's investment in large-scale demonstration projects, to Japan and South Korea's technology leadership and Canada's tritium supply chain, these countries are carving out niches that could shape the global fusion ecosystem.

The United Kingdom is executing a focused strategy exemplified by the Spherical Tokamak for Energy Production (STEP) program, backed by a recent $3.4 billion investment.[60] Critically, the United Kingdom is moving to create the world's first fusion-specific siting and permitting regulations, has designated fusion as an Industrial Strategy priority,[61] and has a strong private fusion industry.[62] The United States and United Kingdom are pursuing a number of commercialization-focused fusion partnerships, including in the U.S.–UK Technology Prosperity Deal, which lists fusion as a key area for collaboration.[63]

The European Union prioritizes large-scale research and demonstration projects, including the France-based ITER project.[64] The European Commission's recent planned Euratom budget features allocating $6.3 billion towards fusion energy research.[65] France is also home to the Tungsten Environment in Steady-state Tokamak (WEST), which recently beat EAST's record for plasma sustainment, albeit at a lower temperature.[66] Germany is a prominent leader in a magnetic fusion concept known as the stellarator; this year, the Max Planck Institute's Wendelstein 7-X stellarator achieved a record-setting performance.[67] German-based companies are also advancing additional stellarator designs[68] and laser-driven designs.[69] Germany has set a goal of building the "world's first

[60] UK Government Commits Over £2.5 Billion ($3.4B) to Fusion Energy Amidst Global Race to Deployment, Fusion Industry Association (2025).
[61] Consultation on a New National Policy Statement for Fusion Energy, UK Department for Energy Security and Net Zero (2025); Clean Energy Industries Sector Plan, UK Department for Energy Security and Net Zero at 53–55 (2025).
[62] Most notable is the spherical tokamak company Tokamak Energy, which also has an American division. *See* Tokamak Energy, Tokamak Energy (last accessed 2025).
[63] Memorandum of Understanding between the Government of the United States of America and the Government of the United Kingdom of Great Britain and Northern Ireland regarding the Technology Prosperity Deal, Prime Minister's Office (2025).
[64] ITER, ITER (last accessed 2025).
[65] European Commission Proposes Record €6.7 Billion Euratom Budget With Major Boost for Fusion Energy, Fusion Energy Association (2025).
[66] Nuclear Fusion: WEST Beats the World Record for Plasma Duration!, French Alternative Energies and Atomic Energy Commission (2025).
[67] Wendelstein 7-X Sets New Fusion Performance Records, World Nuclear News (2025).
[68] Proxima Fusion, Proxima Fusion (last accessed 2025); Gauss Fusion, Gauss Fusion (last accessed 2025).
[69] Marvel Fusion, Marvel Fusion (last accessed 2025); Focused Energy, Focused Energy (last accessed 2025).

fusion power plant" domestically, and recently announced it would invest more than $2.3 billion by 2029 to support fusion research and pilot plant development.[70]

Japan concentrates on advanced technology development with projects like JT-60SA and the Fusion by Advanced Superconducting Tokamak (FAST) project.[71] This year, JT-60SA progressed through scheduled upgrades in preparation for its first experimental campaign in 2026, and the Japanese government released an updated national fusion strategy outlining a 10-year roadmap to commercialize fusion and position Japan as a global leader in the industry.[72]Japan's private fusion industry[73] excels in the depth of its suppliers.[74]

South Korea leads in high-temperature plasma research, showcased by KSTAR. In June 2025, South Korea launched a joint WEST–KSTAR experimental program to collaborate on long, tungsten-environment plasma operations, a key step toward ensuring power plant–relevant performance.[75]

Canada plays a key role as a major tritium supplier, thanks to its CANada Deuterium Uranium (CANDU) reactors and the Darlington Tritium Removal Facility—the world's largest civilian tritium producer.[76] Canadian Nuclear Laboratories (CNL) supports tritium R&D at its Chalk River site and is developing UNITY-2, a deuterium–tritium fuel cycle testbed, with Kyoto Fusioneering.[77] In 2024, CNL released a national fusion strategy.[78] Canada's limited private industry focuses on magnetized target fusion.[79]

Russia emphasizes fusion–fission hybrid technologies[80] and experimental plasma research with the T-15MD tokamak,[81] though with limited global collaboration. Rosatom, the Russian state-backed nuclear energy corporation, plans to have built the central part of a $1.42 –1.64 billion tokamak by 2030 that could be a feature of future Russian–Chinese cooperation.[82]

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[70] Deutschland auf dem Weg zum Fusionskraftwerk: Aktionsplan der Bundesregierung [Germany on the Path to Fusion Power Plants: Federal Government Action Plan], Bundesministerium für Forschung, Technologie und Raumfahrt (2025); Germany Boosts Funding for Fusion Research, World Nuclear News (2025).
[71] Fusion Energy Power Generation Demonstration Project, FAST, Launched in Japan, Kyoto Fusioneering (2024).
[72] Upgrading JT-60SA to Prepare for 2026 Experiments, ITER (2025); フュージョンエネルギー・イノベーション戦略 [Fusion Energy Innovation Strategy], Government of Japan Cabinet Office (2025); *See also* Japan Unveils Updated National Fusion Energy Strategy, Fusion Industry Association (2025).
[73] Which includes the fusion power companies Ex-Fusion, which uses a laser-based approach, and Helical Fusion, another stellarator company.
[74] Kyoto Fusioneering is a giant in the general fusion supply chain space, and Japan's high-temperature superconductor suppliers, like Faraday Factory, are the current global export leaders.
[75] Official Launch of the Joint WEST / KSTAR Experimental Program, Institute for Magnetic Fusion Research (2025).
[76] Jonathan Spencer Jones, Canada to Accelerate Fusion Development, Power Engineering International (2024).
[77] Tritium Facility, Canadian Nuclear Laboratories (last accessed 2025); Kyoto Fusioneering and Canadian Nuclear Laboratories Launch Joint Venture, Fusion Fuel Cycles Inc., Kyoto Fusioneering (2024).
[78] Fusion Energy for Canada: A Forward-Looking Vision and Call for Action, Canadian Nuclear Society (2024).
[79] General Fusion, one of the older fusion startups, is that company.
[80] Caroline Peachey, Russia Develops a Fission-Fusion Hybrid Reactor, Nuclear Engineering International (2018).
[81] Tracey Honney, Russia's T-15MD Tokamak Achieves First Stable Plasma, Nuclear Engineering International (2023).
[82] Russian state media has reported on China's interest in the project itself and in broader cooperation "in thermonuclear projects." *See* Rosatom plans to build tokamak with reactor technologies by 2030, TASS (2024).

Policy Recommendations: Winning the Fusion Race

The United States—long the world's leader in scientific innovation—must not allow China or other competitors to convert American breakthroughs into its own technological and economic dominance. For a technology as potentially consequential as fusion energy, the Commission recommends the U.S. Government reiterate the three pillars set forth by its preliminary report, and furthermore urges the adoption of the policy recommendations below.

The policy recommendations—which are further detailed below—include:

> **(1) *Declare fusion a national security priority*** and set an explicit **National Fusion Goal of breaking ground on more than one industry-led demonstration fusion power plant in the United States by the end of 2028 that leads to commercialization**;
>
> **(2) *Expand fusion leadership and drive commercialization*** by empowering a fusion lead to execute the National Fusion Goal and transition the DOE program structure to better support fusion commercialization;
>
> **(3) *Take strategic action to win the fusion race*,** including shaping a favorable regulatory landscape to execute fast, predictable licensing, siting, and interconnection at scale; building out a domestic supply chain; and training a reliable fusion workforce.

1. Declare Fusion a National Security Priority

To win the race for fusion energy, **we recommend that the President issue an Executive Order** that formally recognizes fusion as critical to U.S. national security and energy dominance, sets an ambitious goal for U.S. leadership in fusion commercialization, and lays the policy groundwork for achieving that goal. The Executive Order should include the following key components:

> **1.1 Launching a National Fusion Goal.** The Department of Energy should lead the execution of a National Fusion Goal to initiate construction on more than one industry-led demonstration fusion power plant in the United States by the end of 2028 that accelerates commercialization. This would empower DOE to lead a coordinated push in partnership with U.S. industry, the National Labs, U.S. universities, and strategic international partners, and receive interagency support when needed.
>
> **1.2 Ensure U.S. Leadership in Fusion Science.** Private industry alone cannot close the remaining scientific and technological gaps for fusion on the time scale needed to win against China. To cultivate a robust fusion industry, the United States should provide appropriate levels of funding and staffing to the world-leading National Labs, DOE public user facilities, and university programs that support priorities identified in the FESAC Long Range Plan and Facilities Construction Projects Subcommittee report.[83]

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[83] Troy Carter, et al., Powering the Future: Fusion and Plasmas, Fusion Energy Sciences Advisory Committee (2020); Brian Wirth, et al., Report of the FESAC Facilities Construction Projects Subcommittee, Fusion Energy Sciences Advisory Committee at 8–14 (2024).

1.3 Identify Threats and Defend American Industry. Within 90 days, the Director of National Intelligence, working with experts inside and outside the U.S. Government, should produce an annual intelligence assessment of adversaries' fusion programs, and the Department of Energy, Department of Justice, and Department of Homeland Security should publish a voluntary cybersecurity program to protect U.S. fusion firms from intellectual property (IP) theft.

1.4 Win the Global Market. Within two years, the Departments of Energy, Commerce, Defense, State, and the Treasury should propose for input and then establish expedited export procedures for U.S. fusion technology designed for speed and commercial dominance. Likewise, Commerce, State, EXIM, and the Development Finance Corporation should leverage their funding and authorities to support global markets for American-made fusion technologies.

1.5 Dominate the Supply Chain & Unleash American Industry. Within 30 days, Commerce should lead a multi-agency effort to map the global fusion supply chain and identify potential vulnerabilities and mitigations. The Secretary of Commerce, in coordination with other agencies, should leverage existing funds, programs, and authorities to mitigate vulnerabilities identified in this study. Further recommendations are found in 3.2.

2. Expand Fusion Leadership and Inject $10 Billion to Drive Commercialization

The United States has a narrow window to establish leadership in the commercialization of fusion energy. DOE must take immediate, organized, and sustained action across fusion research, development, and demonstration (RD&D). Additionally, a one-time investment of $10 billion would provide the fuel required to achieve the National Fusion Goal.

2.1 Organize the Department of Energy's Fusion Efforts for Commercialization. The Secretary of Energy should appoint a singular "Fusion Lead" with decision-making and budget authority, streamlined and independent contracting mechanisms, and responsibility for coordinating and implementing DOE's fusion strategy. Furthermore, the Secretary of Energy should consider creating a temporary National Fusion Project Office to execute the National Fusion Goal and serve as a bridge between the current organizational structure (in which most civilian fusion energy efforts are housed in the Office of Science, with the exception of ARPA-E) and the eventual need for an applied office.

2.2 Make a One-Time Investment of $10 Billion to Enable and Accelerate U.S. Fusion Commercialization. The DOE fusion program's mission and budget should evolve into one that accelerates fusion R&D and industry-led demonstration activities. Building on existing FES funding levels, $10 billion in new funding should go towards a multi-pronged approach of:

2.2.1 Building commercialization-relevant R&D facilities to close scientific and technological gaps in key fusion components and systems needed to enable the National Fusion Goal and then build reliable power plants thereafter.[84]

2.2.2 Fully funding and expanding existing commercialization-focused programs and partnerships, in particular public–private partnerships aimed at de-risking the private sector's preliminary engineering designs for demonstration fusion power plants.[85]

2.2.3 Adding a demonstration tier to the Milestone Program to de-risk the construction of more than one industry-led demonstration fusion power plant and capping federal contributions at 50 percent.[86]

3. Strategic Actions to Win the Fusion Race

A number of further actions will require interagency collaboration or the interventions of agencies outside of the Department of Energy. In particular, the best path forward for fusion to reach the grid will require action from the NRC, the Federal Energy Regulatory Commission (FERC), the Department of Commerce (DOC), and Congress.

3.1 Shape the Regulatory Authorities Landscape (see Appendix 1 for additional details). Winning fast will require both the authorities and the capacity to license, site, and connect fusion to the grid at a speed that keeps pace with the technology.

3.1.1 Scale Licensing & Permitting Progress: The NRC has established a favorable regulatory framework for fusion. NRC should explore mass-manufacture licensing pathways, fund training for Agreement States to harmonize licensing processes, fast-track environmental reviews, and ensure the international community (such as the

[84] We estimate that upgrading and/or building the high priority R&D infrastructure would cost a total of $4–5 billion. The exact cost split between public and private participants will be determined by market forces, though DOE will likely bear a majority of the cost because these facilities benefit the nation as a whole. Pursuing greater industry and state involvement could reduce the cost to the U.S. Government, freeing up additional federal funds for commercialization-focused programs.

[85] An additional $1 billion would enable the full realization and continuation of initiatives such as the Milestone-Based Fusion Development Program, the FIRE Collaboratives, and the INFUSE program. The Milestone Program was authorized in 2020 and updated in 2022 for authorization of $415 million, $86 million of which has been appropriated and $46 million was obligated by DOE. DOE announced $180 million of anticipated funding for the FIRE Collaboratives, and INFUSE provided $19.5 million of in-kind support to projects during FY 2020–FY 2023. *See* GAO-25-107037, Fusion Energy: Additional Planning Would Strengthen DOE's Efforts to Facilitate Commercialization, U.S. Government Accountability Office at 17, 18, and 20 (2025). In September 2025, DOE announced $128 million in funding for the FIRE Collaboratives and $6.1 million for INFUSE. *See* Energy Department Announces $134 Million to Advance U.S. Fusion Leadership Through Targeted Research, Department of Energy (2025).

[86] We estimate that the government's share of two competitively awarded, technologically diverse, industry-led demonstration fusion power plants would cost approximately $2 billion each, requiring a total of $4 billion in government funding, assuming a capped 50% cost-share with industry. Like with the Advanced Reactor Demonstration Program, a second tier of awards could be made available to accelerate other promising designs with either remaining or additional funds.

International Atomic Energy Agency) adopts a similar framework so the U.S. can export fusion to global customers.[87]

3.1.2 Accelerate Grid Integration & Deployment: Direct FERC to expedite interconnection for clean, firm power and enable co-location with large industrial loads.

3.1.3 Incentivize Progress: Tie federal investments to concrete milestones while creating incentives through tariff code adjustments and targeted exemptions for fusion components.

3.2 Build the supply chain that a successful fusion industry will need. Pair DOE's commercialization program with immediate, targeted supply-chain moves to avoid chokepoints and ensure access to critical components. Some components may be naturally procured by the incentives of a fusion plant under construction, but others will require deliberate effort made in advance.

3.2.1 Onshore and Friendshore Manufacturing Capacity: Use tax credits, such as the 45X and 48C credits, to encourage domestic supply chain development of key enabling technologies, including: high-temperature superconducting tape, power electronics, radiofrequency and neutral beam heating devices, and laser diodes.[88] Use the Loan Programs Office as another avenue for the government to support these efforts, as well as applications like an isotope separation facility for lithium-6. In the near and medium term, strategically partner with like-minded nations and include specialized fusion components like cryogenics and gyrotrons in trade deals and tariff exemptions. Include fusion in third-party manufacturing hubs. Create a third-party data hub for training datasets for the robotics that will be used in fusion machines.

3.2.2 Strategically Manage Critical Materials: Ensure domestic commercial production of certain raw materials, including rare earths. Leverage 45X tax incentives, the Loan Programs Office, and other incentives to accelerate U.S. mining and production of fusion-relevant materials like copper, beryllium, gallium, germanium, lithium, silicon carbide, tungsten, molybdenum, and graphite.

3.2.3 Ensure Commercial Sources of Fusion Fuel Materials: Where appropriate, ensure commercial availability of the necessary elements for fusion fuel cycles, including access to deuterium, startup tritium, enriched lithium-6 (for tritium breeding blankets), and alternative fuels such as helium-3.

3.3 Strategic Fusion Workforce Investment. While China is rapidly building a national fusion workforce pipeline, the United States has underinvested relative to its scientific

[87] The recent U.S.–UK Technology Prosperity MOU incorporated international harmonization of fusion regulation in its parameters. *See* Memorandum of Understanding between the Government of the United States of America and the Government of the United Kingdom of Great Britain and Northern Ireland regarding the Technology Prosperity Deal, Prime Minister's Office (2025).
[88] One example of how tax credits are being considered for fusion energy development includes H.R. 5441, Fusion Advanced Manufacturing Parity Act (2025).

leadership and commercial goals. Reversing this trend will require targeted, sustained investment across the talent pipeline—from technicians and tradesmen to engineers and plasma physicists—along with new incentives to attract both domestic and international expertise.

3.3.1 Scale Graduate and Postdoctoral Fusion Talent: Support 100 additional graduate students and 100 postdoctoral researchers annually at DOE through 2030. In addition to federal support, private-sector stakeholders should co-invest through industry-sponsored fellowships, postdoc placements, and faculty endowments, coordinated via public–private partnerships at labs, research universities, and industry-led demonstration power plant sites. Without increased and stable investment, U.S. programs will struggle to scale, weakening the talent base needed for commercial deployment.

3.3.2 Leverage AI to Accelerate Workforce Development: Federal agencies and industry should co-develop AI-enabled tools for training, simulation, and plant design. These platforms can shorten learning curves, reduce safety risks, and help fill critical technical roles. DOE's $29 million in AI and data infrastructure for fusion is a starting point, but broader investment is needed to scale impact.

3.3.3 Support Regional Partnerships and Training Pathways: DOE and Commerce should fund regional partnerships for universities, regional colleges, community colleges, and vocational schools to grow the fusion workforce across education levels. Priorities include fellowships, Research Experiences for Undergraduates (REUs), lab-based apprenticeships, and certificate or accelerated training programs for mid-career professionals from adjacent fields. A **fusion-focused update to the National Defense Education Act** would build institutional capacity and expand participation.

Conclusion: The Path to Fusion Dominance

The United States stands at a critical juncture in the race for fusion energy leadership. China's substantial investments and infrastructure-first strategy threaten traditional U.S. advantages. Without immediate action, the United States risks falling behind in a technology that will reshape the global balance of power and can unleash energy dominance at home and abroad.

Our recommendations demand bold investment and unwavering resolve—even substantial investments will be far less costly than the price of inaction. Fusion energy will transform the shape of the economy, domestically and abroad. The nation first to master this technology will gain advantages that may prove decisive in the competition for global leadership in the 21st century.

America's scientific capabilities and private sector remain the most innovative in the world. But these advantages alone are not enough. We need a coordinated national strategy, sustained investment, and focused execution—and we cannot afford to lose. By declaring fusion a national security priority, setting an ambitious and achievable National Fusion Goal, organizing and streamlining DOE to drive fusion commercialization, shaping favorable regulatory authorities, fostering a robust domestic supply chain, and investing in the fusion workforce, America can still win the race for fusion energy.

With decisive action and unwavering commitment, America can seize this pivotal moment and secure its place at the forefront of the fusion energy revolution, shaping a future of prosperity and security for generations to come.

Appendix 1: Roadmap for Authorities to Deploy Fusion Energy

Introduction

As fusion energy moves closer toward commercial deployment, U.S. policymakers have an opportunity to shape a regulatory system that will not only accommodate but actively encourage the deployment of fusion power plants, both today and in the years ahead.

Recent federal actions mark significant progress. The Nuclear Regulatory Commission's (NRC) decision to regulate fusion separately from fission,[89] coupled with the 2024 ADVANCE Act (which effectively codified that separate regulatory treatment),[90] signals a growing recognition that the path to commercial deployment exists and the United States simply needs to execute. The regulation of fusion under 10 CFR Part 30, as particle accelerators, is a step forward for the fusion industry, accurately reflecting the inherent safety of fusion technology. The Agreement State framework will allow fusion machines to be built in and regulated by the states most eager to facilitate their deployment.

These moves represent a strong foundation, but they are just the beginning. Fully unlocking fusion's promise as a clean, firm, domestically produced energy source can be accelerated by proactive, coordinated action across multiple levels of government and jurisdictions. Failing to leverage these opportunities to accelerate fusion's deployment could result in China beating the United States to commercial fusion deployment, adding to a concerning trend of American inventions turning into Chinese products.

This appendix, which includes the *Progress Report on Fusion Authorities* and the *Fusion Authorities Matrix*, identifies pivotal decision points—such as forthcoming NRC rules, updates to state policies, or siting and permitting processes—and spotlights areas where planning has yet to begin for fusion regulatory needs.

These materials should provide a clear picture to agencies, legislators, and stakeholders of where they must take proactive measures today to enable the efficient, at-scale deployment of demonstration and, soon, commercial fusion power plants. When used effectively, these tools can support the development of a regulatory framework that is not only responsive to the fusion industry's needs but also anticipatory, agile, and aligned with broader national priorities.

Why a Coordinated Approach Matters

Much like the nation's electrical grid, the regulatory landscape for energy in the United States is complex and highly distributed. At the federal level, agencies like the NRC, Department of Energy (DOE), and Federal Energy Regulatory Commission (FERC) oversee nuclear safety, uphold international obligations, and manage transmission and wholesale power markets, respectively. Meanwhile, states play a critical role in siting facilities, granting permits, and implementing energy

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[89] Brooke P. Clark, Staff Requirements – SECY-23-0001 – Options for Licensing and Regulating Fusion Energy Systems, Nuclear Regulatory Commission (2023).
[90] Pub. L. 118-67, ADVANCE Act, § 205 (2024).

policies tailored to local needs.[91] International frameworks—such as those governing export controls and nonproliferation—will be another relevant layer down the road, helping to shape the global deployment of fusion energy and ensure American energy dominance.

These layers are interdependent. For example, a fusion developer might receive an NRC or Agreement State license for a fusion power plant, but still face obstacles if state and local permitting processes are misaligned, or if it cannot connect to the power grid under existing FERC rules and changing grid operator interconnection procedures. A coordinated approach can help streamline progress, minimize risk, and position fusion as a central pillar of the nation's energy mix.

Building any new energy infrastructure, like a fusion power plant, can be challenging. Thankfully, because of fusion's attributes, it can avoid some of the same permitting challenges affecting other technologies.[92] Fusion can be sited close to where the demand for power exists (as opposed to where the resource is located, requiring lengthy and challenging transmission buildouts). Because of its inherent safety profile, the radioactive materials licensing process can be successfully navigated in a fraction of the time and costs associated with new fission reactors. Fusion power plants are not expected to trigger the National Environmental Policy Act based on their licensing alone, as this is done at the state level, and should not be subject to it unless they are being built on federal lands or are leveraging substantial federal funding, such as loans, loan guarantees, or demonstration funding.[93]

Meeting rising electricity needs and the increasing demands for 24/7 clean, firm power requires an efficient, predictable permitting process. At the federal level, a number of reforms have been enacted recently to improve this process, such as the establishment of the Federal Permitting Improvement Steering Council (FAST-41)[94] and meaningful reforms to the federal permitting process in the Fiscal Responsibility Act of 2023.[95] As tasked in the ADVANCE Act of 2024, the NRC has begun to explore licensing for mass production of fusion generators, potentially under a design-specific licensing framework.[96] The United States should build on this progress and continue to focus particular attention on the important role states will play in licensing and permitting fusion power.

The Fusion Authorities Matrix as a Tool

[91] *See, e.g.,* States Restrictions on New Nuclear Power Facility Construction, National Conference of State Legislatures (2023); Fusion Industry Workgroup, Initial Report to the Washington State Legislature, WA.gov (2024).

[92] For example, the two nuclear fission reactors recently built at the Vogtle plant in Georgia began commercial operation over 16 years after first applying for an early site permit; geothermal projects often face 6–8 years of permitting delays on federal lands; and large renewable projects like offshore wind and interstate transmission regularly require nearly a decade of environmental review and agency coordination. Fusion, an inherently safer technology, should be positioned to avoid these lengthy lead times. *See* Issued Early Site Permit - Vogtle Site, United States Nuclear Regulatory Commission (last accessed 2025); Plant Vogtle Unit 4 Begins Commercial Operation, U.S. Energy Information Administration (2024); Tracy Alloway & Joe Weisenthal, Fervo CEO Tim Latimer on Ramping Up Advanced Geothermal Energy, Bloomberg (2024); How Would the Environmental Impacts of the Proposed Humboldt Offshore Wind Farm be Evaluated and Mitigated?, North Coast Offshore Wind (2024).

[93] National Environmental Policy Act Review Process, United States Environmental Protection Agency (2025).

[94] FAST-41, U.S. Department of Energy (last accessed 2025).

[95] Pub. L. 118-5, Fiscal Responsibility Act of 2023 (2023).

[96] Study on Risk-Informed, Performance-Based, Design-Specific Regulatory Frameworks to Support Licensing of Mass-Manufactured Fusion Machines, U.S. Nuclear Regulatory Commission (2025).

To help chart a path towards the quick, efficient, and responsible deployment of fusion power plants, the Fusion Authorities Matrix serves as a practical guide to the evolving regulatory landscape. It maps key responsibilities by specific actors—federal, state, or international authorities—and aligns them with the policy levers each can activate. Accompanying the Matrix is a Progress Report graphic that provides a clear visual snapshot of the current regulatory environment and highlights which entities hold the keys to progress and where key gaps have emerged. Together, the Matrix and Progress Report function as both a roadmap and a diagnostic tool, the needs for which were identified in the Commission's preliminary report.[97]

Status of Regulatory Progress by Topic

The Progress Report on Fusion Authorities provides a snapshot of regulatory progress across the fusion ecosystem, color-coded to reflect the resolution status of different authorities items.

Progress Report on Fusion Authorities

Early regulatory decisions have reduced risks by differentiating fusion from fission, though essential licensing, economic, and international frameworks remain under active development. Unresolved issues such as grid interconnection, NRC staff training, environmental reviews, and manufacturing strategies still pose major challenges to timely fusion deployment.

KEY: Actionable Priorities · Resolved · In Progress · Not Started

	PROGRESS	KEY ACTORS
SAFETY		
Uphold the legal separation of fusion from fission.	Resolved	Federal
Incorporate fusion into NRC's byproduct material framework completely.	In Progress	Federal, U.S. States
Augment Agreement State readiness for fusion.	Not Started	Federal, U.S. States
Create an efficient licensing process for mass fusion deployment.	In Progress	Federal, U.S. States
Improve tritium and environmental safety protocols.	In Progress	Federal, U.S. States
Issue decommissioning and waste guidance.	Resolved	Federal, U.S. States
Align regulatory and non-proliferation frameworks internationally.	In Progress	Federal, U.S. States, International
ENVIRONMENTAL REVIEW & LOCAL PERMITTING		
Clarify state and local siting processes, encouraging flexibility.	In Progress	U.S. States
Expedite fusion federal environmental review.	Not Started	Federal, U.S. States
Streamline state and local permitting.	Not Started	Federal, U.S. States
DEPLOYMENT & SUPPLY CHAIN		
Prioritize grid interconnection for clean, firm energy.	Not Started	Federal, U.S. States
Allow behind-the-meter access to fusion.	Not Started	Federal, U.S. States
Maintain and explore new fusion-eligible tax credits.	In Progress	Federal
Secure domestic supply chains.	Not Started	Federal, U.S. States
R&D & INNOVATION		
Protect and share intellectual property (IP).	In Progress	Federal
Fund fusion RD&D programs.	In Progress	Federal

Some foundational issues have already been resolved, which are marked in green on the Progress Report. Most notably, fusion's legal separation from fission has been affirmed by the NRC and

[97] Fusion Power: Enabling 21st Century American Dominance, Commission on the Scaling of Fusion Energy at 16–17 (2025).

codified in the ADVANCE Act.[98] This determination allows fusion machines to be regulated according to their lower risk profiles: that is, they are regulated like particle accelerators instead of fission reactors. This regulatory certainty allows fusion to move quickly and efficiently through the radioactive materials licensing process while also enabling innovation in the fusion sector as technologies mature. Furthermore, it means that fusion byproducts, such as activated materials, can be reused, recycled, or managed via longstanding disposal pathways—thereby avoiding the long-term spent fuel storage question that has challenged the fission industry for decades.

These early decisions reduce regulatory risk and provide clarity for early movers in the industry. The U.S. Government, through entities like the G7 and International Atomic Energy Agency (IAEA) must also ensure that its allies (and likely first U.S. export customers) implement a regulatory approach for fusion energy based on the same core principles and approach.

Many essential authorities are in active development, as denoted in yellow. The NRC is drafting a risk-informed licensing framework and supporting guidance expected to be proposed this fall, while federal and state agencies are developing protocols for tritium handling and environmental safety tailored to fusion systems.[99] In parallel, fusion's eligibility for tax credits under sections 45Y and 48E of the Inflation Reduction Act was maintained in the One Big Beautiful Bill Act.[100]

Internationally, the United States, over the long run, can work with partners and through organizations like the IAEA to shape appropriate export control and nonproliferation regimes for fusion that likewise recognize fission-centric measures should not apply to fusion. Domestically, federal agencies, companies, and academic institutions are also considering how to structure intellectual property sharing and protect U.S. innovation while enabling collaboration.[101] Although promising, these efforts are not yet complete, and continued coordination will be essential to bring them to maturity.

Several authorities topics have yet to be addressed, marked in white on the Progress Report. Environmental reviews are a particularly important process, whether at the federal or state level, as they can have an outsized effect on the speed of deployment; action must be taken to ensure that newly streamlined pathways for these reviews also apply to fusion energy, where appropriate, while upholding the need for meaningful community engagement.[102] Like other new power generation, grid interconnection stands out as a concern, particularly the need to streamline queue management for 24/7 clean, firm power and enable behind-the-meter connections with data centers and factories.[103]

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[98] Brooke P. Clark, Staff Requirements – SECY-23-0001 – Options for Licensing and Regulating Fusion Energy Systems, Nuclear Regulatory Commission (2023); Pub. L. 118-67, ADVANCE Act, § 205 (2024).

[99] D. White, et al., Program-Specific Guidance about Possession Licenses for Fusion Systems - Preliminary Draft Report, United States Nuclear Regulatory Commission (2025).

[100] Pub. L. 119-21, One Big Beautiful Bill Act (2025).

[101] Troy Carter, et al., Powering the Future: Fusion & Plasmas, Fusion Energy Sciences Advisory Committee at 58 (2020); Richard J. Hawryluk, et al., Bringing Fusion to the U.S. Grid, The National Academies Press at 77, 88 (2021).

[102] Connecting to the Grid FAQs, PJM Learning Center (last accessed 2025); FAST-41, United States Department of Energy (last accessed 2025); Pub. L. 118-5, Fiscal Responsibility Act of 2023 (2023).

[103] For example, a recent bid by PJM to increase behind-the-meter energy production was rejected by FERC. *See* Order Rejecting Amendments to Interconnection Service Agreement re PJM Interconnection, L.L.C., Federal Energy Regulatory Commission (2024); States Restrictions on New Nuclear Power Facility Construction, National Conference of State Legislatures (2023).

Without near-term reforms, fusion projects could be delayed even if they are ready for deployment and have completed radioactive materials licensing. Similarly, although radioactive materials licensing rules specific to fusion are being developed, there is no dedicated funding mechanism to support training and readiness among Agreement States to implement these rules.

Finally, efforts to build a domestic manufacturing base for fusion components remain nascent. While some have suggested using tax incentives (45X or 48C), the Defense Production Act, or loan guarantees to foster a domestic fusion industry, no cohesive supply chain strategy is in place.[104] Clarifying how fusion fits within the broader landscape of federal incentives and supply chain strategy will be important for anticipating deployment challenges and ensuring U.S. competitiveness in this emerging sector.

The following sections outline "wildcards," or exogenous variables that could positively or negatively disrupt the trajectory for fusion authorities, and "what to watch" in the coming months and years on key authorities issues that could shape their outcome.

Wildcards

- **Prioritized Decision-Making.** The speed and direction of interagency coordination on fusion authorities will depend on the level of priority that the DOE and White House bodies like the National Energy Dominance Council assign to fusion commercialization activities. A fusion Executive Order that identifies fusion as a national security priority, paired with a dedicated Fusion Lead in DOE with sufficient budget and executive authority, would be able to drive alignment on the U.S. Government's fusion activities.[105] States should consider comparable Fusion Leads to help fusion developers expedite state and local permitting processes.

- **Environmental Permitting Reform.** Fusion projects, like other new energy projects, potentially face outdated permitting pathways that create unnecessary uncertainty or delays. Given its unique attributes and potential societal-level change, fusion should be given priority in future permitting reform efforts at the federal and state levels. Fusion's inherent safety and limited environmental impact need to be recognized, sparing the emerging industry from unnecessary and lengthy review processes.

- **Interaction with Financial Incentives.** Beyond regulations, financial incentives like the 45X advanced manufacturing production tax credit—or the absence of such incentives—could either slow or accelerate fusion's commercial trajectory and the timelines for requisite authorities decisions.

- **Trade and Tariff Policies.** As tariffs impact the fusion supply chain, policymakers should begin the process of establishing Harmonized Tariff Schedule codes for fusion components and granting targeted tariff exemptions.

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[104] Some examples of extant government services and credits that could be applied to fusion include: Section 45X Advanced Manufacturing Production Credit, Internal Revenue Service (2025); Qualifying Advanced Energy Project Credit (48C) Program, United States Department of Energy (last accessed 2025).
[105] Fusion Power: Enabling 21st Century American Dominance, Commission on the Scaling of Fusion Energy at 15–17 (2025).

What to Watch

- **Finalization of NRC Part 30 Rulemaking.** This is the foundation for fusion licensing in the United States. The rule must provide clarity, scalability, and public trust, and will be tested as the first industry-led fusion demonstration power plants seek approval. The United States must not re-evaluate the separation of fusion and fission regulations, as this would needlessly delay the deployment of fusion energy at scale.

- **Agreement State Readiness.** As Agreement States begin evaluating fusion projects under the NRC's Part 30 framework, speed and success will depend on adequate levels of funding, trained staff, and shared tools (like registries and best-practice databases). Without this support, implementation may be slow or inconsistent.

- **Grid Interconnection Pathways.** The U.S. electrical grid is experiencing growing strain from increased energy demand associated with electrification, data center expansion, and emerging technologies like AI. These trends have exposed structural constraints in both grid capacity and interconnection processes, which call for evaluating pathways for fusion to collocate and provide electricity directly to large loads, at scale.

- **Nonproliferation and International Norms.** To support U.S. leadership in fusion, it is vital to maintain its clear distinction from fission within international bodies like the IAEA. If the United States does not lead in shaping international fusion governance, others—particularly China—will. The risks associated with fusion are limited, and prematurely mandating new requirements could create uncertainty and delay commercialization. A measured, evidence-based review should be performed at the appropriate time to ensure international norms remain effective while enabling the timely, secure growth of this clean energy source.[106]

- **Planning for Commercial-Scale Deployment.** Prototype and early power plant deployments will yield insights that can inform future licensing and oversight models, including the development of a mass manufacturing licensing regime to be ready for when commercial fusion power plant designs have standardized and the experience of regulators and fusion developers can be leveraged.

[106] Fusion & Nonproliferation, Princeton Plasma Physics Laboratory (last accessed 2025); Fusion Key Elements, International Atomic Energy Agency (2024); NSG Part 1 Guidelines - INFCIRC/254/Rev. 14/Part 1, International Atomic Energy Agency (2019); Sachin S. Desai, et al., Building a Path Toward Global Deployment of Fusion: Nonproliferation and Export Considerations, Atlantic Council (2025).

Fusion Authorities Matrix

	AUTHORITY	NEED	RESOLUTION STATUS	NOTES	SOURCE
SAFETY	**Federal** NRC	Separation of fusion machine regulation from nuclear fission reactor regulation	Resolved	Resolved through NRC decision to regulate fusion under the NRC's byproduct material framework. Subsequently codified through the ADVANCE Act. Allows fusion-specific regulations without fission-oriented requirements. Attention is required to ensure future government actions do not create any uncertainty with this position.	NRCSRM-SECY-23-0001 ADVANCE Act (§205)
	Federal NRC **State** Agreement States	Establishment of a clear risk-informed, performance-based regulatory framework for fusion machines within 10 CFR Part 30	In Progress	NRC incorporating fusion machines into byproduct material framework (10 CFR Part 30) through rulemaking and developing risk-informed, performance-based licensing guidance under NUREG-1556 series.	NRCSRM-SECY-23-0001 ADVANCE Act (§205)
		Ensuring NRC and Agreement States have the resources and expertise they need to license fusion machines	Not Started	Resources are needed to train staff at the NRC & Agreement States on fusion-specific technical areas as well as supporting licensing fee recovery at Agreement States to help ensure timely consideration of license applications.	Not Applicable
		Efficient licensing process to support at-scale deployment of mass-manufactured fusion machines	In Progress	Current licensing process is bespoke and site-by-site and supports initial deployments but becomes potentially limiting at scale. NRC is performing a study and reporting to Congress as required by the ADVANCE Act. The NRC should consider establishing a "registry" of materials licenses for fusion machines, capturing and sharing best practices across the National Materials Program, to improve licensing efficiencies and accelerate deployment while enabling the fusion industry to continue to innovate.	ADVANCE Act (§205(c)) Preparing for At-Scale Deployment of Fusion Energy: Novel Licensing Pathways
		Tritium control and environmental safety protocols	In Progress	NRC is addressing this through current rule-making, incorporating fusion machines into their byproduct material framework (10 CFR Part 30). State implementation of NRC regulation and guidance may benefit from increased resources and training.	NRC Draft Fusion Machine Guidance
		Decommissioning and byproduct material management protocols for fusion facilities	Resolved	Activated material created by fusion power plants is considered "byproduct material." There are many options for addressing it, including re-use, recycling, disposal at RCRA-permitted facilities, or disposal at low-level waste facilities (although fusion process waste is not considered low-level waste by NRC, it is a pathway for disposal).	NRC Rulemaking: Requirements for Expanded Definition of Byproduct Material
	Federal DOE, State, DOC, NRC **International** IAEA	Recognition that the current international nonproliferation regime addresses the minor risks of fusion at scale & establish export control framework that enables the global deployment of fusion energy	In Progress	The existing fission-based nonproliferation framework does not apply to fusion power plants. IAEA should move fusion to a particle accelerator-based framework, as specified by the NRC. A measured, evidence-based review should be performed at the appropriate time to ensure international norms remain effective while enabling the timely, secure growth of this clean energy source. The Department of Commerce (DOC) should work with the State Department, DOE, DOD, and NRC to ensure the readiness of our export control framework to support the at-scale, global deployment of fusion energy.	DOE Fusion & Nonproliferation workshops IAEA Fusion Key Elements Nuclear Suppliers Group
	State Regulators, Energy Councils, Etc. **Local** City, County	State & local siting and permitting of fusion power plants separate from nuclear fission and ability to leverage any clean energy benefits	In Progress	Fusion should not be associated with nuclear power plants nor be subject to any limitations or restrictions meant for reactors. Further, a level playing field for fusion power plants with other clean energy sources should be established.	State Nuclear Bans WA State: Promoting the Integration of Fusion Technology Within State Clean Energy Policies

Section	AUTHORITY	NEED	RESOLUTION STATUS	NOTES	SOURCE
ENVIRONMENTAL REVIEW & LOCAL PERMITTING	**Federal** FPISC, NRC, DOE, CEQ	Expedite federal environmental review for fusion power plants when federal review is required	Not Started	Congress has enacted several reforms to expedite federal decision-making for environmental reviews (FAST-41, Fiscal Responsibility Act), including setting clear deadlines for agencies to complete environmental reviews, requiring a lead agency and setting deadlines and page limits for reviews, and creating a unified and coordinated federal review process. As additional steps are taken to expedite energy project delivery in the United States, fusion energy should be included in those efforts as appropriate. Fusion power plants are not expected to trigger the National Environmental Policy Act based on their licensing alone, as this is done at the state level, and should not be subject to it unless they are being built on federal lands or are leveraging substantial federal funding. Moreover, fusion's inherent safety and limited environmental impact should be recognized, ensuring a right-sized review process. The federal government should make this clear in its regulatory reform efforts and provide guidance to states.	FAST 41 Fiscal Responsibility Act Permitting Reforms
	Local City, County **State** Regulators, Ecology, Energy Councils, Etc.	Streamlined environmental review for fusion power plants leveraging zoning/land use decisions, prior state/federal project reviews, or generic assessments	Not Started	As an efficient safety review process is implemented, environmental review and permitting will become a critical path to deploying fusion power plants. Leveraging prior work or assessments must be enabled to unlock efficient deployment at scale.	WA RCW 36.70B: LOCAL PROJECT REVIEW WA RCW 43.21C.150: State Environmental Policy
	Federal NRC, DOE, CEQ				PJM Interconnect Process
DEPLOYMENT & SUPPLY CHAIN	**Federal** FERC **State** PUCs, Interconnect Entities (e.g., PJM)	Accelerated grid interconnection pathways prioritizing clean, firm energy sources (including fusion)	Not Started	Grid interconnection timelines are currently many years long and clogged with insufficient applications and projects that do not provide firm energy. Clean, firm power like fusion and new nuclear must be enabled to skip the queue to ensure the future reliable operation of our grid and the scaled deployment of fusion energy. AI could be employed to identify locations for expedited interconnection.	FERC Amazon Data Center Rejection
		Codified pathway to provide behind-the-meter energy to large loads (e.g., data centers, industrial sites)	Not Started	The current grid is facing unprecedented challenges to meet the expected future energy demand. Evaluating pathways to enable fusion to co-locate and provide electricity directly to large loads—behind the meter and not borne solely by rate payers—will address this significant issue while enabling rapid scaling potential.	State Nuclear Bans WA State: Promoting the Integration of Fusion Technology Within State Clean Energy Policies.
	Federal Treasury	Maintain "tech-neutral" tax credits to support commercial fusion's deployment in the United States. Provide additional incentives for clean, firm resources, like fusion.	In Progress	The One Big Beautiful Bill Act has maintained 45Y and 48E tax credits for fusion.	One Big Beautiful Bill Act

	AUTHORITY	NEED	RESOLUTION STATUS	NOTES	SOURCE
RESEARCH & DEVELOPMENT	**Federal** DOC, Treasury, DOE, OMB **State** State Equivalents	A secure domestic supply chain for critical fusion energy materials & components	Not Started	DOC, Treasury, and DOE LPO must apply an aggressive application of existing and new programs (e.g., CHIPS), financial support through grants, loans and loan guarantees, and tax incentives to enable the establishment of a secure, robust domestic supply chain for fusion. The Federal Government should consider methods for inclusion of fusion manufacturing and supply chain in federal energy initiatives and incentive programs, such as 45X and 48C tax credits.	DOE Loan Programs Office IRS 45X IRS 48C
	Federal DOE	Robust intellectual property regime for fusion, which enables domestic and international information sharing	In Progress	FESAC and NASEM emphasize the need for frameworks that optimize information sharing and address intellectual property concerns, but expediting the foreign influence review process is largely outstanding.	FESAC (p.58) NASEM (p.77, 88)
	Federal DOE	Fund commercially relevant research and development focusing on an applied materials project, facilities/test stands to close science and technology gaps important to deploying and scaling fusion power, and a robust milestone program for first power plants.	In Progress	$10 billion will unlock fusion, the last frontier of energy. This is the level of investment required for the United States to win globally, not only in fusion development but also in fusion deployment. Examples include: 1. Building high-priority FESAC facilities and test stands. 2. Expanding and fully funding existing programs and partnerships that support commercialization. 3. Adding a demonstration tier to the Milestone-Based Fusion Development Program to support the the demonstration of more than one competitively awarded, technologically diverse demonstration fusion power plant. 4. Strengthening and securing domestic supply chains for key fusion components. 5. Sustaining investment in existing basic science programs to address remaining technological gaps.	FESAC (p.7, 13, 55-61) NASEM (p.28-31, 74-76) DOE Milestone Program

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