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

Fusion Power

Enabling 21st Century American Dominance

Commission on the Scaling of Fusion Energy

February 24, 2025

We write today, as co-chairs of the Commission on the Scaling of Fusion Energy, to underscore the potential for fusion energy to be a cornerstone of America's energy future. Fusion energy, the process that powers the Sun, holds transformative potential to redefine the global energy landscape and cement the United States' leadership in the 21st century. Harnessing fusion to produce electricity and process heat could be a game-changer: it is inherently safe, predictable, and clean, and could contribute to the resilience and reliability of America's energy grid right as domestic power demands are increasing rapidly.

Actions taken today can accelerate fusion commercialization and enable the technology to scale as soon as the next decade. Fusion energy offers a unique opportunity to achieve energy independence and bolster America's techno-economic competitiveness, particularly given advancements like artificial intelligence (AI) and increasing electrification across various sectors are pushing our nation's energy demands to unprecedented levels.

Mastering these revolutionary technologies will not only enhance our energy security but also drive innovation and productivity across leading growth sectors like energy, defense, and supercomputing. With China making massive investments in fusion research and development, the United States must take decisive action to maintain its competitive edge and ensure that we, not our adversaries or international competitors, win the race to set the standards, and capture the massive global market for this transformative technology.

American ingenuity has proven time and again that, particularly when catalyzed by a long-term strategy and public-private partnerships, it can solve seemingly insurmountable problems. We have cured diseases. We put man on the moon. We built hydropower dams that power the West.

Today, we are closer than we have ever been to harnessing the power of the stars on Earth. Achieving the commercialization of fusion energy will require collaboration across sectors to address scientific, regulatory, and logistical challenges. A coordinated national strategy, and unleashing the full power of our free enterprise system, is the way for America to deliver fusion power to the world.

The Commission's work aims to chart a clear path toward achieving large-scale, commercial power generation from fusion in the United States. We appreciate the time and expertise lent by each Commissioner and look forward to seeing the recommendations generated to set the U.S. course for fusion.

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

February 24, 2025

Fusion energy—what promises to be a baseload, dispatchable, carbon-free source of energy—may bring about a decisive shift in how humanity powers its future within the next 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 leads in its research, development, and at-scale deployment. Leadership in this field will not only secure our nation's energy future, but will also reinforce our position as a powerhouse of innovation.

As with other breakthrough technologies, maintaining U.S. leadership in fusion will require bold, coordinated actions that address technological, regulatory, and market barriers. The recommendations outlined in this report provide a roadmap for the U.S. Government to achieve these goals, combining ambitious research and development initiatives with strategic public–private partnerships and forward-thinking policies. It 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 race to commercialize fusion energy.

The imperative to act now cannot be overstated. 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. Without decisive action, the United States risks falling behind in an industry poised to redefine the global energy landscape sooner than we thought possible. 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 convenes at a crucial moment in our nation's history. The coming years will be decisive in shaping the future of fusion energy. By leveraging its technological strengths, fostering innovation, and enacting bold policies, the United States has the opportunity to usher in a new era of clean, abundant, and secure energy. With continued commitment and investment, fusion energy can become a transformative force, ensuring a more 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, CEO of Bohr Quantum Technology
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

Key Deliverables

- *Preliminary Report (February 2025):* A strategy argument for fusion power, emphasizing the role of fusion in ensuring U.S. energy independence, economic stability, and technological leadership, with initial recommendations of immediate steps that should be taken.
- *Final Report (Fall 2025):* A roadmap for scaling fusion energy, including policy recommendations, infrastructure needs, and strategies to unleash American fusion energy leadership at home and abroad.

Scope of Work

The Commission's activities include:

- Quarterly plenary sessions of commissioners and co-chairs.
- Three commissioner working groups focused on:
    - R&D Acceleration: Identifying and closing scientific gaps to accelerate fusion development.
    - Authorities: Creating regulatory and permitting frameworks policies to streamline licensing and enable deployment.
    - Resources: Ensuring necessary capital, supply chains, and skilled workforce for large-scale fusion deployment.

The Commission convened a framing session in September 2024, followed by working group meetings on each topic, with Commissioners receiving informative briefings from government officials, including experts from the Department of Energy, National Laboratories, the Nuclear Regulatory Commission, and the fusion industry, among others. These conversations shaped the preliminary report, and will drive the recommendations presented in the final report later this year.

About the Preliminary Report

This report includes recommendations derived from the Commission's working group meetings and reflects the collective views and expertise of the commissioners, with input from advisors, expert briefers, and commission staff listed below.

In developing this report, all commissioners had the opportunity to review and provide feedback. The majority of commissioners offered substantive input, which has been incorporated into this final version, and concurred with its release to the public.

Commission Co-Chairs Senator Risch and Senator Cantwell provided their guidance for the development of this report, but were not involved in the formulation of the report's specific policy recommendations. As co-chairs, the Senators provided strategic direction and supported the commission's broader mission to advance U.S. leadership in fusion energy and technology competitiveness.

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Executive Summary

This report underscores the urgent need for the United States to prioritize the rapid commercialization of fusion energy as a matter of national security and restoring U.S. 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 reshape geopolitical dynamics. Once commercialized, fusion energy could have a society-level changing impact on human development. Thanks to decades of publicly funded research, recent technological breakthroughs, and an emergent private fusion industry, the dawn of commercial fusion power is close at hand.

The Stakes Are High. The nation that leads in fusion could write the global rules and secure significant economic advantages, ensure its energy independence, and maintain its technological edge in critical areas, including AI, advanced manufacturing, and national defense. The global race for fusion energy is underway. China, in particular, has made substantial strides, outpacing the United States in building critical infrastructure and positioning itself to dominate the future fusion supply chain. America's historical leadership in fusion science is at risk, with profound implications for our economic competitiveness and national security. Failing to act quickly and decisively will result in the United States ceding its technological advantage, becoming reliant on other nations for a critical energy source, and diminishing its global influence.

America Needs a National Fusion Goal. *The United States should establish an explicit National Fusion Goal of starting construction on the world's first commercial fusion power plant this decade. Achieving this goal would solidify the United States as the world's leader in fusion energy, and catalyze a thriving and ultimately self-sustaining commercial fusion industry. The approach to achieving this goal, as outlined in the report recommendations, involves de-risking multiple commercial pathways for building pilot plants, investing in a robust public-sector program and the foundational infrastructure to close remaining R&D gaps, and empowering a leader with the authority and budget to oversee the goal's execution.*

A Critical Moment for Fusion. To achieve this National Fusion Goal and secure America's future energy dominance, this report recommends immediate and concerted action across three key pillars:

1. **Declare Fusion a National Security Priority.** The Federal Government should, in upcoming national security strategy and policy formulation, officially recognize fusion energy as a critical technology essential to national security and energy dominance. We recommend developing a 90-day action plan encompassing the topics set out in this report in furtherance of achieving the National Fusion Goal. This will elevate fusion, and help align policy, funding, and regulatory frameworks to accelerate its development and deployment. It will signal to the world, and particularly to China, that the United States plans to lead in fusion energy and win the fusion race.

2. **Establish Fusion Leadership and Drive Commercialization.** To ensure efficient and effective progress, a "**Fusion Lead**" should be appointed within the highest levels of the Department of Energy (DOE) to drive concrete action towards fusion demonstration and achieve the National Fusion Goal. This high-level official should be empowered and given clear authority to provide the Secretary immediate policy options within prescribed deadlines on each of the topics below and, once finalized, execute the approved actions with executive decision and budget authority.

- **Supply Chain:** Identify the full supply chain of necessary fusion components and materials, and mitigate potential vulnerabilities for fusion pilot plants and functional fusion power plants—including by incentivizing the domestic manufacturing of fusion components at risk of supply disruption or undue market control by adversarial or unstable nations—consistent with the National Fusion Goal.

- **Public–Private Partnerships:** Develop and implement a public–private fusion framework that addresses the current limitations of public–private partnerships (PPPs), clearly articulates the roles and responsibilities of the relevant actors within DOE, National Labs, universities, and private industry, maximizes existing fusion partnerships, and identifies any additional PPP mechanisms needed to achieve the National Fusion Goal.

- **Regulations:** Work within DOE and consult with other appropriate federal and state agencies to develop and implement a roadmap to streamline the regulatory processes for the siting, construction, and operation of fusion power plants. This includes developing an efficient licensing process to enable the full-scale deployment of mass-manufactured fusion machines, fast-tracking federal environmental reviews, directing the Federal Energy Regulatory Commission (FERC) to issue rules expediting the electric grid interconnection process for fusion power, and codifying a pathway for interconnections between fusion power plants and co-located loads, such as data centers and factories.

3. **Strategic Investment to Win the Fusion Race.** Additional federal funding for fusion research and development is imperative to achieve the National Fusion Goal. This report calls for a one-time, $10 billion investment to ensure American energy dominance by building critical research infrastructure first identified in the 2020 Fusion Energy Sciences Advisory Committee's Long-Range Plan developed under the first Trump Administration, accelerating commercialization-focused R&D programs, and supporting the eventual demonstration of fusion pilot plants through cost-share programs and supply chain development. This strategic, one-time investment will catalyze private sector involvement and accelerate innovation. Paired with continued investments in basic science, it will ensure the United States maintains its scientific leadership in the field.

The commercialization of fusion energy represents a transformative moment for the United States to unleash energy abundance at home and abroad. It is an opportunity to secure our energy future, bolster our economic competitiveness, and strengthen our national security. We believe that embracing these recommendations is the best path to American energy dominance. The time for bold action is now. We must seize this moment to ensure that fusion energy powers America's future.

Fusion Power: Enabling 21st Century American Dominance

The Stakes

Fusion energy offers the possibility to engineer and harness the power of the stars on Earth. Fusion entails placing light atoms (typically hydrogen isotopes) under such high temperature and pressure that they combine into new elements, releasing tremendous amounts of energy. Scientists and engineers have for decades pursued a variety of technical approaches to this challenge. Most involve magnets, lasers, or some combination of the two. In 2022, U.S. scientists at Lawrence Livermore National Lab proved the scientific feasibility of fusion, achieving "ignition" by releasing more energy than was put into the reaction.[1]

Powered by an abundant fuel source unconstrained by scarcity or geography,[2] fusion opens the door to a new and safe form of energy generation for the 21st century.[3] When fusion machines are deployed and connected to America's energy grids, fusion power can become a source of national strength. It can fuel an AI-enabled economy, shore up domestic energy security, and reshape energy geopolitics, with significant leverage accruing to first-mover nations. Fusion's vast potential is now propelling a worldwide push to make it a reality. In particular, our rival, China, has made remarkable strides in laying the groundwork for rapid fusion commercialization.[4]

Fusion energy can provide the massive amounts of reliable power needed to support the growth of AI,[5] reshored manufacturing, and other energy-intensive technologies. As AI hyperscale data centers increasingly seek out firm energy generation technologies to power their computing infrastructure,[6] fusion energy could support these growing demands in the next decade, alongside other energy sources like advanced nuclear reactors and geothermal power.

Fusion energy could also yield transformative economic growth and lower energy costs for consumers.[7] The market for fusion alone is projected to exceed $1 trillion by 2050.[8] Combined with AI, fusion could create a powerful flywheel of U.S. techno-economic power. AI has already proven critical in accelerating fusion development, driving breakthroughs in physics, materials science, and laser and magnet technologies that have catalyzed a booming startup ecosystem. As AI capabilities advance, they will continue to expedite fusion R&D. Once online, fusion power plants can fuel the next generation of AI models and adoption, supercharging America's lead in AI. Finally, fusion's enabling technologies[9] promise to unlock jobs across the economy and drive innovation in sectors like aerospace, defense, medicine, and more.[10]

Beyond economic benefits, fusion power could redefine global geopolitics. Countries that rely heavily on their

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[1] H. Abu-Shawareb, et al., Achievement of Target Gain Larger than Unity in an Inertial Fusion Experiment, Physical Review Letters (2024).
[2] The most common fusion targets are made of deuterium (D) and tritium (T), two isotopes of hydrogen. Tritium is derived from commonly found lithium, and deuterium is found in seawater. If everyone on Earth used as much energy as the average American today, D–T fusion could supply energy for 30 million years, and deuterium-only fusion would last over a billion years. For comparison, gas, oil, or coal would each run out within a decade to a century in a similar scenario. See Arthur Turrell, The Star Builders: Nuclear Fusion and the Race to Power the Planet, Scribner at 44 (2022).
[3] Fusion would only inherently produce low-level nuclear waste. Fusion in Brief, Culham Centre for Fusion Energy (2022).
[4] Losing the Race for Nuclear Fusion, Special Competitive Studies Project (2024).
[5] How Bad Will the AI Power Crunch Be?, Special Competitive Studies Project (2024).
[6] Ivan Penn & Karen Weise, Hungry for Energy, Amazon, Google and Microsoft Turn to Nuclear Power, New York Times (2024).
[7] Bob Mumgaard & Vinod Khosla, Is the World Ready for the Transformative Power of Fusion?, World Economic Forum (2025).
[8] Fusion Energy Worldwide Demand Report, Ignition Research (2024).
[9] I.e., technologies that would yield capabilities or processes that fundamentally accelerate all or most technological pathways to commercially viable fusion energy generation. These include high-temperature superconducting tape, laser diodes, structural materials, and plasma-facing components.
[10] Already today, fusion's tech stack includes superconducting magnets, advanced materials, precision engineering, and high-performance computing.

own fusion energy will be resilient to the geopolitical pressures and supply chain issues associated with other energy sources, and exporting fusion would accrue geopolitical leverage. The fuel sources for fusion will likely be derived from widely available resources like seawater and lithium, creating new avenues for energy independence. Finally, fusion could also support advanced defense technologies, driving new innovations in stockpile stewardship,[11] potentially powering military and space installations, and contributing to overall technological superiority.

Thanks to decades of federal investment in basic research, American scientists have now proven that fusion is possible. Growing power demands, recent technological breakthroughs, and the shifting market dynamics of energy create a unique opportunity for fusion to finally see its time in the Sun. A big bet on fusion could secure America's position as a technological superpower for decades to come.

The Global Fusion Race

The U.S. Fusion Landscape

America has led the world in fusion energy sciences since the days of the Manhattan Project.[12] U.S. universities have consistently attracted the world's best talent, many of whom created today's leading fusion companies. Our National Labs beat the world in demonstrating fusion's scientific feasibility. Yet despite this legacy of scientific excellence, the United States finds itself underprepared for fusion's transition from experimental science to commercial reality.

Achieving fusion energy on a competition-relevant timeline will require more than just tackling key scientific hurdles. It calls for an entirely different posture than the current U.S. approach, one that prioritizes commercialization and optimizes U.S. spending on fusion. Though progress has been made in strategy, infrastructure, and investment in recent years, it is not sufficient to compete and harness fusion energy's full potential. An assessment of the U.S. fusion landscape reveals:

Strategy: Stemming from the 2022 Bold Decadal Vision, recent U.S. strategic initiatives have laudably sought to push fusion toward commercialization, but have fallen short in translating ambitious goals into urgent, concrete, actionable policies and programs.[13] The Department of Energy's (DOE) 2024 Fusion Energy Strategy focuses on three pillars: bridging technological gaps for a pilot plant, enabling sustainable deployment, and forging external partnerships.[14] The Milestone-Based Fusion Development Program, modeled after NASA's Commercial Orbital Transportation Services (COTS) program, seeks to reduce investment risk by setting discrete technical milestones that unlock government funds. Other programs include the Fusion Innovation Research Engine (FIRE) Collaboratives, which provide testing infrastructure that private firms cannot develop on their own,[15] the Innovation Network for Fusion Energy (INFUSE), which provides access to technical and financial support,[16] and most recently the Private Facilities Research (PFR) program, which will enable public research at private fusion facilities.[17] However, appropriations for these programs have been less than Congressionally authorized levels.[18] The failure to implement many critical recommendations made by strategic documents, such as DOE's Fusion Long-Range Plan, has left an incomplete ecosystem that China is racing to

[11] Fusion breakthroughs at the National Ignition Facility have advanced scientists' understanding of the U.S. nuclear weapons stockpile by deriving knowledge that was once accessible only through nuclear explosive tests. See The US Nuclear Weapons Stockpile, National Nuclear Security Administration (last accessed 2025).
[12] History, U.S. Department of Energy (last accessed 2025).
[13] Readout of the White House Summit on Developing a Bold Decadal Vision for Commercial Fusion Energy, The White House (2022).
[14] Fusion Energy Strategy 2024, U.S. Department of Energy (2024).
[15] DOE Science FY24 Final Appropriation Excerpt, U.S. Department of Energy (2024); Department of Energy Announces $50 Million for a Milestone-Based Fusion Development Program, U.S. Department of Energy (2022).
[16] What is INFUSE?, Oak Ridge National Laboratory (last accessed 2025).
[17] Funding Opportunity Announcement: Private Facilities Research Program (DE-FOA-0003516), U.S. Department of Energy (January 2025).
[18] Fusion Energy: Additional Planning Would Strengthen DOE's Efforts to Facilitate Commercialization, U.S. Government Accountability Office (2025).

complete itself.[19]

Scientific Breakthroughs: In December 2022, after a decade of diligent work, scientists at the U.S. National Ignition Facility (NIF) achieved the long-sought milestone of producing more energy in a fusion reaction than the laser energy used to create it ($Q > 1$).[20] Indeed, the fusion process itself became the primary source of heat for the fusion fuel, signifying true ignition. NIF scientists have reproduced ignition multiple times since, while no other machine has yet to replicate it.[21] The NIF's breakthrough marked the starting gun for the commercial fusion race, but there are a number of scientific and engineering challenges on the road ahead.[22] The scientific community has identified a suite of R&D infrastructure that—with an upfront investment—would help solve these challenges and unlock fusion's economic potential.[23] The key hurdles involve sustaining and stabilizing a burning plasma, increased energy gain, developing components that can handle radiation and extreme heat, and breeding and recycling tritium to fuel the reaction.[24] In addition to hardware and infrastructure, significant progress has been made, largely in the United States, in the computer simulation of plasmas.[25] Simulation has driven the invention of new concepts, such as the Spherical Tokamak NSTX-U at the Princeton Plasma Physics Laboratory (PPPL).[26] The United States is also applying AI across multiple fusion fronts, including PPPL's AI platforms predicting and preventing plasma instabilities in real time.[27] The combination of advanced simulations and AI is poised to further accelerate the development of optimized fusion designs, significantly expediting the path to practical fusion energy.

Supply Chain: Although the U.S. fusion supply chain remains underdeveloped, the main challenges center on limited visibility into long-term purchasing commitments, which will determine the necessary supply chains, and a shortage of specialized skills. Even though fusion machines depend less on raw materials than solar, wind, or battery industries, their reliance on certain specialty components—often sourced from China—still poses risks. Without stronger demand signals and more robust domestic processing and manufacturing capabilities, the United States risks ceding the fusion supply chain to China.[28]

Infrastructure Development: Even before the ignition milestone, DOE published a roadmap with industry input outlining the infrastructure needed for commercial fusion.[29] Yet as the decade unfolds, China is building the very infrastructure plan that America envisioned,[30] while we have so far failed to execute due to a lack of funding, authority structures, and coordinated leadership.[31]

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[19] Troy Carter, et al., Powering the Future: Fusion and Plasmas, Fusion Energy Sciences Advisory Committee (2020).
[20] Kenneth Chang, Scientists Achieve Nuclear Fusion Breakthrough With Blast of 192 Lasers, New York Times (2022).
[21] Jeff Tollefson, US Nuclear-Fusion Lab Enters New Era: Achieving 'Ignition' Over and Over, Nature (2023).
[22] Q, the ratio of energy out to energy in, is a critical measure of the performance of a fusion machine. While the NIF achieved $Q > 1$, a fusion power plant would need a higher number. Approaches involving direct energy recapture (from magnetic fields produced by the plasma, rather than more conventional heat extraction) claim to yield economical results with a Q less than 10, but most ventures will likely seek to have a Q of at least 30 or higher. While going from $Q > 1$ to $Q > 30$ seems like a significant jump, it is worth noting that record gains have always progressed in large leaps. Improvements at NIF, for example, often saw yield increase by factors of five or six. Arthur Turrell, The Star Builders: Nuclear Fusion and the Race to Power the Planet, Scribner at 190 (2021).
[23] Brian Wirth, et al., Report of the FESAC Facilities Construction Projects Subcommittee, Fusion Energy Sciences Advisory Committee at 8–14 (2024).
[24] See Troy Carter, et al., Powering the Future: Fusion and Plasmas, Fusion Energy Sciences Advisory Committee at 6–7 (2020).
[25] Jaemin Seo, et al., Avoiding Fusion Plasma Tearing Instability with Deep Reinforcement Learning, Nature (2024).
[26] 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).
[27] Furthermore, OpenAI's agreement to provide one of its o-series models to Venado, the newest supercomputer at Los Alamos National Laboratory, could enable U.S. scientists to conduct more precise physics simulations, refine fusion machine designs more efficiently, and enhance data analysis, ultimately speeding up the pace of scientific breakthroughs. Strengthening America's AI leadership with the U.S. National Laboratories, OpenAI (2025).
[28] The Fusion Industry Supply Chain: Opportunities and Challenges, Fusion Industry Association (2023).
[29] Troy Carter, et al., Powering the Future: Fusion and Plasmas, Fusion Energy Sciences Advisory Committee (2020).
[30] Joe Manchin, Chairman Manchin's Opening Statement for the Full Committee Hearing to Examine Fusion Energy Technology Development, Senate Committee on Energy and Natural Resources at 5 (2024).
[31] Fusion Energy: Additional Planning Would Strengthen DOE's Efforts to Facilitate Commercialization, U.S. Government Accountability Office (2025).

Public–Private Funding: Congress allocated $790 million to DOE's Fusion Energy Sciences (FES) program in 2024,[32] and has averaged $728 million over the last five years,[33] much of which supported legacy projects like the ITER project, an international collaboration to create a large tokamak. DOE supports a handful of programs focused on fusion's commercialization, but they have not been fully appropriated.[34] What is more, domestic fusion energy programs received a total of $230 million in 2024, compared to $240 million in U.S. funding for ITER.[35] The government funding that produced ignition did not actually come from DOE's fusion science mission, but rather was an ancillary benefit of the National Nuclear Security Administration's (NNSA) spending on its nuclear weapons stockpile stewardship mission.[36] Most importantly, the United States has cultivated a first-class private fusion industry, hosting 25 of the world's 45 active fusion companies and attracting more than $6 billion of the over $9 billion in global private investment in the past decade.[37] However, China's public support for fusion commercialization continues to outpace that of the United States.

China's Fusion Landscape

China has emerged as a dominant force in global fusion energy development, out-organizing the United States in several respects.[38] China's fusion approach includes building state-of-the-art infrastructure, fostering scientific breakthroughs, and positioning itself to dominate the global fusion energy supply chain.

Strategy: China's commitment to catching up is evident in the dollars it has spent on fusion R&D and the success of its innovation model in other hardware-intensive technologies.[39] China is already constructing an infrastructure roadmap that spans every stage of fusion development.[40] What is more, much of China's fusion activity today is occurring at the provincial level with only limited top-down coordination from Beijing.[41] Should fusion energy feature more prominently in China's 15th Five-Year Plan, which is due to be released in late 2025, it will translate into a stronger policy mandate for progress, driving advancements in fusion technology.

Scientific Breakthroughs: There is no evidence that China has achieved ignition in the same way that Lawrence Livermore National Laboratory did in 2022 through the inertial confinement (i.e., laser-based) approach, and their fusion ecosystem continues to trail the U.S. lead in laser fusion and plasma physics.[42] However, China is making big bets on magnetic confinement and channeling resources accordingly, even

[32] Congress Increases U.S. Funding for Fusion Energy Sciences Research, Fusion Industry Association (2024).
[33] See Congress Provides Record Funding for Fusion Energy, Fusion Industry Association (2023); Rachel Margraf, A Brief History of US Funding of Fusion Energy, Stanford University (2021); Fusion Energy: Additional Planning Would Strengthen DOE's Efforts to Facilitate Commercialization, U.S. Government Accountability Office (2025). The FIA reports 2022 FES funding as $713M; this is not counting the additional $280M authorized by the Inflation Reduction Act that is counted in the GAO report.
[34] DOE has made available $180 million over the next five years for Fusion Innovative Research Engine (FIRE) Collaboratives. See DOE Announces New Decadal Fusion Energy Strategy, U.S. Department of Energy (2024). Additionally, the Milestone-Based Fusion Development Program was authorized in 2020 but remains underfunded, with only $90 million appropriated of the $415 million allocated by Congress. See Pub. L. 116–260 Consolidated Appropriations Act, 2021 (2021); Pub. L. 117–167 CHIPS Act (2022).
[35] See FY2024 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).
[36] Congress Increases U.S. Funding for Fusion Energy Sciences Research, Fusion Industry Association (2024).
[37] This figure includes recent funding rounds that have occurred since the Fusion Industry Association's latest publication on this subject. Global Fusion Industry Report, Fusion Industry Association at 6 (2024).
[38] China Advances Nuclear Fusion to Strengthen Comprehensive National Power, BGR Group (2024).
[39] Losing the Race for Nuclear Fusion, Special Competitive Studies Project (2024).
[40] See Testimony of Patrick White before the U.S. Senate Committee on Energy and Natural Resources, Full Committee Hearing to Examine Fusion Energy Technology Development (2024).
[41] China's fusion initiatives are guided by the 14th Five-Year Plan, which prioritizes the construction of "comprehensive research facilities for critical systems of fusion reactors." See Outline of the People's Republic of China 14th Five-Year Plan for National Economic and Social Development and Long-Range Objectives for 2035, Center for Security and Emerging Technology at 14 (2021). The establishment of a national fusion consortium, led by the China National Nuclear Corporation (CNNC), aligns state-owned enterprises, utilities, and private companies under a unified framework for scaling fusion technology. See China Seeks Nuclear Fusion Leap Through New R&D Company, Bloomberg News (2024). This consortium is notably composed of infrastructure-heavy state-owned energy companies, reflecting China's infrastructure-first approach to fusion development. See Testimony of Patrick White before the U.S. Senate Committee on Energy and Natural Resources, Full Committee Hearing to Examine Fusion Energy Technology Development at 12–13 (2024).
[42] Angela Dewan & Ella Nilsen, The US Led on Nuclear Fusion for Decades. Now China Is in Position to Win the Race, CNN (2024).

without Beijing's buy-in. In 2025, the EAST tokamak set a significant record, achieving the longest tokamak burn yet.[43] Their next project, the BEST facility, aims to begin operation by 2027.[44] Moreover, China produces ten times more fusion Ph.D. graduates than the United States[45] and filed more fusion patents than the United States in 2023.[46] Although China has yet to make a significant breakthrough in fusion simulation or the application of AI to fusion, this is highly likely to change.[47]

Infrastructure Development: China is building a comprehensive suite of infrastructure for fusion commercialization. Projects include the $700 million Comprehensive Research Facilities for Fusion Technology (CRAFT) campus, to be completed by the end of 2025,[48] and the China Fusion Engineering Test Reactor (CFETR),[49] which aims to produce a gigawatt of fusion power and gain of over 30 by the early 2030s.[50] In late 2023, two state-owned enterprises announced their joint agreement to construct a 100 megawatt fusion–fission reactor in Jiangxi.[51] Furthermore, researchers have stated their goal of using the proposed Z-pinch fusion–fission hybrid reactor to produce a single-shot yield of 100 megajoules by 2030.[52] Most recently, it has been reported that China is building a NIF-style fusion research facility in Mianyang.[53] A NIF-style device with significantly more laser power would likely be capable of achieving ignition with a wide variety of experiments.[54]

Supply Chain: China is building the future fusion supply chain. China is drawing on its successful solar panel market strategy and proactively combining sustained government backing, economies of scale, and iterative technological advancement to move towards commercial deployment.[55] China is expanding its influence beyond research advances, positioning it to control portions of the fusion supply chain by way of access to critical materials and components.[56] Some portions of the fusion supply chain could potentially involve Chinese-controlled elements. For example, tungsten is a leading candidate for the material to line the walls of fusion machines. China controls over half of global tungsten reserves and produces 80% of the world's tungsten supply.[57] China also risks taking over the supply chain for high-power semiconductors used for fusion

[43] China Focus: Chinese "Artificial Sun" Sets New Record in Milestone Step Toward Fusion Power Generation, Xinhua (2025). This burn occurred at 100 million degrees Celsius, approximately at the lower limit for ignition of a deuterium–tritium plasma. It is unclear which fuel source was used in this experiment, or what the triple product (the product of temperature, density, and confinement time) was.
[44] See Angela Dewan & Ella Nilsen, The US Led on Nuclear Fusion for Decades. Now China Is In Position to Win the Race, CNN (2024).
[45] Jennifer Hiller & Sha Hua, China Outspends the U.S. on Fusion in the Race for Energy's Holy Grail, Wall Street Journal (2024).
[46] Rimi Inomata, China Tops Nuclear Fusion Patent Ranking, Beating U.S., Nikkei Asia (2023).
[47] EAST has been the beacon of China's plasma confinement AI research, resulting in a functional AI controller system. This research, a collaboration with MIT, shows that Chinese scientists are following closely behind American researchers. 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).
[48] Victoria Bela, China Launches 'Kuafu' Nuclear Fusion Research Facility, Named After Mythical Giant, in Quest to Build 'Artificial Sun', South China Morning Post (2023).
[49] Chinese Fusion Energy Programs Are A Growing Competitor in the Global Race to Fusion Power, Fusion Industry Association (2021).
[50] Losing the Race for Nuclear Fusion, Special Competitive Studies Project (2024).
[51] Jeff Pao, China's Jiangxi to Build a Fusion-Fission Reactor, Asia Times (2023). Note that neither company specified a timeline for the reactor's construction.
[52] Peng Xianjue, et al., Research Trends and Prospects of Fusion Energy (聚变能源研究态势及展望), Chinese Engineering Science (2024). For comparison, the Z machine at Sandia National Laboratories, the most powerful American Z-pinch device, produces about 2 MJ. See Thomas R. Mattsson, The Fundamental Science Program on Sandia's Z Machine, Sandia National Laboratories at 4 (2017).
[53] Gerry Doyle, Exclusive: Images Show China Building Huge Fusion Research Facility, Analysts Say, Reuters (2025).
[54] There appears to be something of a cliff around 2 MJ for indirect drive fusion approaches: anything below will not induce ignition, and energy delivery cleanly above will yield a significant reaction. NIF is a 2 MJ laser, and required significant experimentation and forethought to produce the five ignition experiments it has achieved. A laser on the order of 10 MJ could achieve ignition with a much less delicate approach, as a wide array of target designs would deliver the amount of energy required to initiate a fusion burn. Not only would this be a potential gain to China's fusion energy research, but it could also play a part in the design and simulation of nuclear weapons. See Dan Drollette Jr., Ferreting Out the Truth About Fusion: Interview with Bob Rosner, Bulletin of Atomic Scientists (2024).
[55] 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).
[56] Aaron Larson, U.S. in a Race with China to Develop Commercial Fusion Power Technology, POWER (2024).
[57] Similarly, sourcing Lithium-6 to breed tritium could also be a potential future issue, as China is also a major lithium producer. This has potential to be a less significant issue, as the total mass of lithium required for fusion power plants could be relatively small in comparison to battery usage, and China lags behind Australia and Chile in both lithium reserves and production. See 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); Melissa Pestilli, Top 9 Countries by Lithium Production, Investing News Network (2024).

generators—a major requirement for some fusion companies.[58]

Public–Private Funding: China has created a more integrated funding ecosystem despite U.S. leadership in private investment. Their government reportedly invested approximately $1.5 billion in fusion last year (double U.S. levels),[59] for a total of $2.49 billion in equity investments for Chinese companies.[60]

China is pouring billions into research and development, not just to lead in energy, but to power their aspirations for global dominance in artificial intelligence, advanced manufacturing, and military innovation. As their grip on rare earth minerals tightens and their influence over critical energy supply chains grows, they will be positioned to leapfrog the United States and redefine the global balance of power.

We cannot afford to follow. We must lead. And only America has the entrepreneurial spirit and scientific talent to turn fusion from a scientific breakthrough into a commercial reality.

Other Key Players

America and China are not the only players racing to develop commercial fusion. The following countries have emerged as key players:

- **United Kingdom:** Focuses on developing fusion power plants, exemplified by the Spherical Tokamak for Energy Production (STEP) program,[61] with strong regulatory[62] and financial[63] support for innovation. This strategy is heavily dependent on achieving good fusion performance on the National Spherical Torus Experiment-Upgrade (NSTX-U) at Princeton, as evidenced by U.S.–UK agreements to cooperate closely on the technology. The United Kingdom was also home to the most successful experimental tokamak to date, the Joint European Torus (JET), which ceased operation in December 2023.[64]

- **European Union:** Prioritizes large-scale fusion research and demonstration projects, including major contributions to ITER, which is housed in France, and the planned Demonstration Power Plant (DEMO) initiative.[65] France is also home to the WEST (Tungsten Environment in Steady-state Tokamak) reactor, which beat EAST's record for plasma burn time, albeit at a lower temperature.[66] The largest stellarator (another magnetic confinement approach) in the world is the Wendelstein 7-X reactor at the Max Planck Institute in Germany.[67]

- **Japan:** Concentrates on advanced fusion technology development with projects like JT-60SA[68] and their Fusion by Advanced Superconducting Tokamak (FAST) project, aiming to demonstrate fusion-generated power by the 2030s.[69]

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[58] Scott Krisiloff, Response to Request for Information: Implementation of the CHIPS Incentives Program Regulations.Gov Docket DOC-2022-0001, Helion Energy at 5 (2022).
[59] Jean Paul Allain, Building Bridges: A Bold Vision for the DOE Fusion Energy Sciences, U.S. Department of Energy at 6 (2023).
[60] Sam Wurzel, The Global Fusion Race is On, Fusion Energy Base (2024). Another measure of private funding in Chinese fusion companies is to look at specific companies' funding levels. By this count, three Chinese fusion companies—Energy Singularity, ENN, and Startorus Fusion—have secured $580 million in quasi-private funding. See 2024 Global Fusion Industry Report, Fusion Industry Association (2024).
[61] The planned STEP machine is in the class of DEMO, the intended successor to ITER. It is being planned on a timescale of 2040. STEP, Culham Centre for Fusion Energy (last accessed 2025).
[62] Consultation on a New National Policy Statement for Fusion Energy, UK Department for Energy Security & Net Zero (2024).
[63] Towards Fusion Energy 2023: The Next Stage of the UK's Fusion Energy Strategy, UK Department for Energy Security & Net Zero and Department for Business, Energy & Industrial Strategy (2023).
[64] Breaking New Ground: JET Tokamak's Latest Fusion Energy Record Shows Mastery of Fusion Processes, EUROfusion (2024).
[65] Demonstration Power Plant DEMO, EUROfusion (last accessed 2025).
[66] Nuclear Fusion: WEST Beats the World Record for Plasma Duration, French Alternative Energies and Atomic Energy Commission (2025).
[67] Wendelstein 7-X, Max Planck Institute for Plasma Physics (last accessed 2025).
[68] JT-60SA, JT-60SA Advanced Superconducting Tokamak (last accessed 2025).
[69] Fusion Energy Power Generation Demonstration Project, FAST, Launched in Japan, Kyoto Fusioneering (2024).

- **South Korea:** Excels in high-temperature plasma research and long confinement times, showcased by KSTAR[70] and significant investments[71] in its fusion roadmap.[72]

- **Russia:** Emphasizes fusion–fission hybrid technologies[73] and experimental plasma research with the T-15MD tokamak,[74] though with limited global collaboration.

Spotlight: International Mechanisms

Several mechanisms have shaped international fusion collaboration to date:

- ***Multilateral Scientific Partnerships:*** ITER is the cornerstone of international fusion science collaboration, bringing together 35 nations to construct the world's largest tokamak and supporting infrastructure.[75] The International Atomic Energy Agency (IAEA) complements this work by providing technical assistance, safety standards, and information-sharing platforms for nuclear energy overall, including fusion.[76]

- ***Bilateral Partnerships:*** Recent U.S. partnerships with the United Kingdom[77] and Japan[78] focus on sharing facilities, harmonizing regulations, and bolstering supply chain resilience. These collaborations could accelerate progress, reduce costs, and offset China's integrated approach.

- ***Public–Private Partnerships:*** Partnerships like Kyoto Fusioneering's deal with In-Q-Tel[79] and the £40.5 million ($51.4 million) U.S.–UK project with Tokamak Energy[80] highlight the increasing role of the private sector in driving international collaborations. These moves are poised to foster knowledge exchange, offset substantial development costs, and shape standards and safety protocols.

While many nations contribute to the fusion ecosystem, the United States and China will mold the future of this transformative technology. To maintain its edge, the United States must develop a strategy that bolsters domestic capabilities and crafts strategic partnerships with like-minded nations to lead the fusion race.

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[70] Oceane Duboust, Korea's 'Artificial Sun' Achieves a Record 48 Seconds at 100 Million Degrees. Why Does It Matter?, Euronews (2024).
[71] MSIT to Present Policy Direction to Lead Fusion Energy Development, Korean Ministry of Science and ICT (2021).
[72] Shin Ha-Nee, Gov't to Chase 'Artificial Sun' with $866 Million Investment in Nuclear Fusion Reactor Development, Korea JoongAng Daily (2024).
[73] Caroline Peachey, Russia Develops a Fission-Fusion Hybrid Reactor, Nuclear Engineering International (2018).
[74] Tracey Honney, Russia's T-15MD Tokamak Achieves First Stable Plasma, Nuclear Engineering International (2023).
[75] History, ITER (last accessed 2025).
[76] Fusion, International Atomic Energy Agency (last accessed 2025).
[77] Joint Statement Between DOE and the UK Department for Energy Security and Net Zero Concerning a Strategic Partnership to Accelerate Fusion, U.S. Department of Energy (2023).
[78] Joint Statement between DOE and the Japan Ministry of Education, Sports, Science and Technology Concerning a Strategic Partnership to Accelerate Fusion Energy Demonstration and Commercialization, U.S. Department of Energy (2024).
[79] Kyoto Fusioneering Closes 2nd Round of 1.1 Billion Yen Series C Extension Led by In-Q-Tel (IQT), Marubeni and Nichicon, Kyoto Fusioneering (2024).
[80] UK and US Announce First Joint Project in Fusion Energy Innovation , UK Government (2024).

Achieving Fusion Power

The United States has consistently led in scientific innovation, but it can no longer allow China to exploit our breakthroughs for commercial dominance. This has happened in too many other strategic sectors, including lithium batteries, solar cells, and EV manufacturing.[81] America must lead not only in the invention but also in the production and trade of fusion energy at scale. The United States must mobilize its resources and coordinate its efforts to effectively compete with China.

The National Fusion Goal: The United States should establish an explicit National Fusion Goal of starting construction on the world's first commercial fusion power plant this decade. Achieving this goal would solidify the United States as the world's leader in fusion energy, and catalyze a thriving and ultimately self-sustaining commercial fusion industry. The approach to achieving this goal, as outlined in the report recommendations, involves de-risking multiple commercial pathways for building pilot plants, investing in a robust public-sector program and the foundational infrastructure to close remaining R&D gaps, and empowering a leader with the authority and budget to oversee the goal's execution.

1. **National Security Imperative:** Formally declare fusion energy a national security priority. This recognizes its transformative potential for energy independence, economic competitiveness, and military advantage in the face of growing global power competition.

2. **Empower a Fusion Lead to Drive Commercialization:** Appoint a dedicated "Fusion Lead" within the Office of the Secretary of Energy. This high-level official will drive strategy, policy, and the necessary bureaucratic changes to move fusion faster from lab to grid and beyond, including through supply chain incentives, regulatory, and other reforms.

3. **Strategic Investment:** Invest $10 billion towards fusion commercialization by 2030. This funding will fuel the foundation for U.S. leadership in this game-changing technology.

A detailed examination of these three recommendations follows.

1. Declare Fusion a National Security Priority

Fusion energy has the ability to revolutionize how we power the world, and the United States must lead the way both at home and abroad to ensure our energy dominance. The Federal Government should make fusion a top national security priority in upcoming national security strategies and policies. We recommend the President issue an executive order (Fusion EO) establishing a National Fusion Goal and directing and empowering DOE to take the lead on developing a step-down national fusion strategy while working closely with the White House and other appropriate agencies to coordinate and facilitate its execution. We recommend that the Fusion EO direct DOE to develop a 90-day action plan process to identify and prioritize the necessary resources, streamline regulations, break down silos between agencies, and clear a path for companies to quickly and efficiently build fusion power plants in order to achieve the National Fusion Goal.

A unified, government-wide push will signal to American businesses and the public that the United States is all in on fusion, encouraging private investment, fueling innovation, and attracting top talent. And, crucially, it will send a powerful message to China and other global competitors: the United States is determined to win the fusion race. This race is about more than energy; it is about technological supremacy, economic dominance, and shaping the 21st century. Securing American leadership in fusion is a matter of ensuring our nation's prosperity and security for generations.

[81] You Xiaoying, The 'New Three': How China Came to Lead Solar Cell, Lithium Battery and EV Manufacturing, Dialogue Earth (2023).

2. Establish Fusion Leadership and Drive Commercialization

We recommend the establishment of a dedicated "Fusion Lead" political appointee at DOE reporting directly to the Secretary and empowered to drive the commercialization of fusion energy, implement the Fusion EO, and achieve the National Fusion Goal. This senior leader, residing within the Office of the Secretary, should be responsible for recommending to the Secretary the necessary policies, allocating resources, and restructuring the Department to effectively support the burgeoning commercial fusion market, consistent with the Fusion EO and the National Fusion Goal. The Fusion Lead should assume oversight of all existing DOE fusion commercialization programs and be empowered with a budget and the personnel to develop the EO's step-down 90-day action plan with specific actions due within 30, 60, or 90 days of the EO's issuance. This clear and focused authority is essential to swiftly identify and dismantle bureaucratic obstacles hindering the path to full fusion commercialization, and realizing the National Fusion Goal. The Fusion Lead's actions and recommendations to the Secretary, as well as other agency actions, should address the following areas:

2.1. Securing a Robust Supply Chain

2.1.1. Supply Chain Mapping and Vulnerability Mitigation: The Department of Commerce (in consultation with the Fusion Lead, intelligence agencies, and other relevant agencies) should within 30 days comprehensively map the fusion component and material supply chain, identifying potential vulnerabilities for fuel supply, construction metals, and other essential materials, considering application in fusion pilot plants, commercial-scale power plant deployment, and other fusion energy machines. Based on the supply chain map, the Department of Commerce, in consultation with DOE and the Department of the Treasury, should establish onshoring priorities for key fusion materials and component technologies. This mapping exercise will be crucial for understanding dependencies and mitigating risks.

2.1.2. Incentives Assessment: DOE, in consultation with the Department of Commerce, the Department of the Treasury, and other appropriate departments and agencies, should within 60 days lead an assessment of incentives, such as the Section 45X tax credit,[82] loans and loan guarantees, and grants, to drive domestic production and attract foreign direct investment in these critical areas, and evaluate near-term tariff exclusions for components that are being actively onshored.[83]

2.1.3. Cybersecurity Support for Fusion Companies: Within 90 days, the Fusion Lead should consult with appropriate agencies to develop and provide voluntary cybersecurity training and relevant resources to U.S. fusion companies. This support is essential to protect intellectual property and prevent technology transfer, particularly from state-sponsored actors seeking to gain an unfair advantage, such as China attempting to copy machine designs.[84]

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[82] In particular, expanding §45X, the advanced manufacturing tax credit under the Inflation Reduction Act (IRA), to fusion components is essential to counter China's dominance in energy supply chains and secure U.S. leadership in fusion deployment in addition to development. Furthermore, the clean electricity production credit under §45Y and the clean electricity investment credit under §48E of the Internal Revenue Code enacted in the IRA are financial incentives that fusion recently became eligible for to encourage deployment in the United States after a fusion company's first power plant. Pub. L. 117–169 Inflation Reduction Act of 2022 (2022).

[83] These moves could be part of a larger national strategy to lead in advanced manufacturing. See National Action Plan for United States Leadership in Advanced Manufacturing, Special Competitive Studies Project (2024).

[84] See, e.g., Angela Dewan & Ella Nielsen, The US Led on Nuclear Fusion for Decades. Now China Is in Position to Win the Race, CNN (2024); Testimony of Jackie Siebens before the U.S. Senate Committee on Energy and Natural Resources, Full Committee Hearing to Examine Fusion Energy Technology Development at 3 (2024).

2.2. Leveraging Public–Private Partnerships

2.2.1. Feedback and Barrier Removal: Within 30 days, the Fusion Lead should solicit feedback from fusion companies and National Labs regarding limitations of current public–private partnership mechanisms. Based on this feedback, the Fusion Lead should move decisively to eliminate or amend policy and regulatory barriers that are impeding commercialization progress.

2.2.2. Maximize Existing Public–Private Partnerships: Within 60 days, the Fusion Lead should develop and begin implementing a public–private fusion framework within DOE that clearly articulates the roles and responsibilities of the relevant actors in DOE, National Labs, universities, and private industry to achieve the National Fusion Goal. The framework should encompass existing programs that could help finalize fusion power plant designs and identify the appropriate PPP mechanisms to cost-share the deployment of multiple technologically diverse commercial pilot plant deployments, consistent with achieving the National Fusion Goal.

2.2.3. Coordination Mechanism: Within 90 days, the Fusion Lead should establish a voluntary information sharing mechanism among public and private actors contributing to the National Fusion Goal.[85] This will help ensure that the Fusion Lead stays apprised of progress and can move expeditiously to address any obstacles that arise.

2.3. Clearing a Regulatory Path for Commercial Fusion

2.3.1. Nuclear Regulatory Commission (NRC) Clarification: The NRC should continue its implementation of the ADVANCE Act's codification of fusion machines as particle accelerators in 10 CFR Part 30, including the development of a process to replace duplicative site-by-site licensing reviews with an efficient licensing process for mass-manufactured power plant designs.[86] This provides crucial clarity for the fusion industry and its suppliers, while also offering certainty for currently licensed facilities. This clear regulatory framework will foster investment and accelerate development.

2.3.2. Fast-Track Environmental Reviews: Recognizing fusion's potential to power long-term U.S. leadership in critical sectors like AI and manufacturing, the Fusion Lead should within 30 days propose a mechanism for making fusion projects eligible for fast-track federal environmental reviews when appropriate. This expedited process will help avoid unnecessary delays and encourage rapid deployment of this vital technology.

2.3.3. Expedited Grid Interconnection: The Federal Energy Regulatory Commission should be directed to issue rules within 60 days that expedite the electric grid interconnection process for fusion power plants. These rules should also codify a clear pathway for interconnections between fusion plants and co-located loads, such as data centers and factories, enabling efficient and innovative energy utilization.[87]

2.3.4. Streamlined Regulatory Roadmap: Within 90 days, the Fusion Lead should, as appropriate, consult with regulatory authorities (Nuclear Regulatory Commission, Federal Energy Regulatory Commission, and Agreement State authorities), White House offices (National Energy Dominance Council,[88] Office of Management and Budget, National Security Council, Office of

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[85] This should include U.S. AI companies and state governments that are pursuing various investment models in fusion, including power purchase agreements, consortium models, and other targeted investments in fusion R&D, infrastructure, and critical supply chain elements. 89 Fed. Reg. 48605, Fusion Energy Public-Private Consortium Framework, U.S. Department of Energy (2024).
[86] Pub. L. 118–67, ADVANCE Act, § 205 (2024).
[87] Executive Order No. 14156, Declaring a National Energy Emergency, 90 Fed. Reg. 8433 (2025).
[88] Establishing the National Energy Dominance Council, The White House, (2025).

Science and Technology Policy, and the Federal Permitting Improvement Steering Council), and relevant departments and agencies (DOE, Department of the Interior, Department of Commerce, and Department of the Treasury) to develop a roadmap outlining specific actions to streamline the siting, construction, and operation of fusion power plants in the United States by the early 2030s and to support the export of U.S.-made fusion power to the global marketplace. This roadmap should identify key regulatory hurdles and propose solutions to expedite the process while maintaining safety and environmental standards.

3. Strategic Investment to Win the Fusion Race

The United States will not be able to achieve fusion power unless it invests in the fundamental building blocks of commercial fusion: infrastructure, supply chain, and talent. To outpace China, the United States should make a one-time investment towards these strategic assets while continuing to invest in the next generation of science.

3.1. <u>Areas for Strategic Investment</u>

A $10 billion investment in fusion is crucial to achieve the National Fusion Goal and establish a thriving U.S. commercial fusion ecosystem. This investment could be amplified by attracting additional private funding and utilizing mechanisms like Other Transaction Authorities.[89] The fusion lead should be granted the authority to strategically allocate these funds across the following areas:

3.1.1. R&D Facilities: The Fusion Lead should organize DOE fusion R&D efforts around implementing recommendations stemming from the 2020 Fusion Energy Sciences Advisory Committee (FESAC) Long-Range Plan that are critical to achieving the National Fusion Goal, including:

3.1.1.1. Within 30 days, specify the budgetary requirements and prioritize investments in key R&D facilities and testbeds that "best serve fusion" as determined by the U.S. fusion community.[90] Additionally, explore integrating advanced AI, modeling, and simulation capabilities to optimize and enhance fusion R&D.

3.1.1.2. Within 60 days, evaluate existing or planned government facilities to determine if they can be augmented to meet R&D needs and prioritize these upgrades over new construction wherever possible.

3.1.1.3. Within 90 days, identify opportunities for partnerships with industry, state/local governments, and relevant international actors on R&D facilities, maximizing resource utilization and fostering global collaboration.

3.1.2. Commercialization Programs and Partnerships: Fully fund and execute existing domestic and international R&D programs and partnerships with demonstrated commercialization

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[89] For example, NASA's Commercial Orbital Transportation Services (COTS) program, which served as a model for the Milestone Program, catalyzed what has become a thriving commercial space ecosystem. The U.S. government's $788 million in funding for the development and demonstration of two COT systems was matched by more than double those funds from private sector partners. The program resulted in COTS participants like SpaceX dominating a space economy valued at $630 billion in 2023 and projected to be worth $1.8 trillion by 2035. See Commercial Orbital Transportation Services, National Aeronautics and Space Administration at 95 (2014); Alizée Acket-Goemaere, et al., Space: The $1.8 Trillion Opportunity for Global Economic Growth, McKinsey (2024).

[90] Brian Wirth, et al., Report of the FESAC Facilities Construction Projects Subcommittee, Fusion Energy Sciences Advisory Committee at 8–14 (2024).

potential that advance U.S. fusion goals.[91] Within 60 days, DOE should evaluate new solicitation rounds for domestic milestone-based programs to attract qualified participants and ensure accountability. Additionally, within 90 days, DOE and the State Department should identify the most advantageous opportunities for bilateral fusion agreements with like-minded countries to exchange commercialization-relevant expertise, data, and infrastructure.

3.1.3. **Fusion Pilot Plant Demonstration and Supply Chain:** Accelerate fusion commercialization by de-risking multiple technologically diverse commercial pilot plant deployments and supporting critical supply chain development.[92] Consider expanding the Milestone-Based Fusion Development Program to a scale similar to those used for advanced nuclear fission to further bridge the gap between research and functional fusion power plant construction, in furtherance of the National Fusion Goal.[93]

3.2. Sustained Investment in Basic Science and Workforce Development

Sustain investment in basic science and workforce development to cultivate the next generation of scientific talent and foster technological breakthroughs. The Department of Energy should continue to invest in fundamental fusion science. Additionally, DOE Labs should be funded to support 100 additional graduate students and 100 post-doctorates annually through 2030. The U.S. should maintain fusion's inclusion on National Interest Waiver immigration priorities.

Conclusion

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

Our initial recommendations demand bold investment and unwavering resolve—far less costly than the catastrophic price of inaction. Fusion energy will transform military capabilities, economic competitiveness, and geopolitical relationships. 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 and technological capabilities remain formidable. Our private sector is the most innovative in the world and our national laboratories and universities lead in many critical research areas. But these advantages alone are not enough. We need a coordinated national strategy, sustained investment, and focused execution to ensure continued U.S. energy dominance.

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.

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[91] The Milestone-Based Fusion Development Program, only funded in May 2023, has already led to quantifiable breakthroughs in modeling, HTS magnet coils, and ion-beam focusing. US Department of Energy Announces Selectees for $107 Million Fusion Innovation Research Engine Collaboratives, and Progress in Milestone Program Inspired by NASA, Department of Energy (2025).

[92] For example, inclusion of fusion components in the Inflation Reduction Act's 45X would have a transformational impact on the ability to rapidly scale a domestic fusion supply chain to counter the work China is already pursuing in earnest.

[93] Such programs include DOE's Advanced Reactor Demonstration Program (ARDP) and Gateway for Advanced Innovation in Nuclear (GAIN).

Appendix: A Short Fusion Primer

Fusion is the process that powers the Sun and stars. It involves combining light atomic nuclei, such as isotopes of hydrogen (deuterium (D) and tritium (T)), to form a heavier nucleus (like helium in the case of D–T fusion).[94] This process releases over ten million times as much energy as coal per pound of fuel.[95]

In stars, fusion is powered by intense gravity. To achieve fusion on Earth, scientists must use different approaches, listed below.

Magnetic confinement uses powerful magnetic fields to contain and control a superheated gas (i.e., plasma), where fusion reactions occur. The most common type of magnetic confinement device is a donut-shaped device called a tokamak. Stellarators are another approach in which the magnetic fields take a twisted shape. Magnetic confinement fusion could operate continuously, and will rely on high-temperature superconducting magnets.

Inertial confinement uses high-powered lasers, particle beams, or pulsed currents to compress and heat a small pellet of fuel, causing it to implode and ignite a fusion reaction.

Magneto-inertial fusion uses magnetic confinement (to contain the plasma) and inertial confinement (to smash plasmas together or compress the plasma) to achieve fusion.

These approaches require overcoming significant technological challenges, including:

- **Plasma confinement and stability:** Sustaining a fusion reaction will require stabilizing plasma at extremely high temperatures and managing the instabilities that cause it to whip out at the machine's walls and damage them.[96]

- **Heat management and component resilience:** Managing the heat of a fusion reaction (over a hundred million degrees) is a technical challenge in its own right. Innovative solutions are being pursued for various device configurations, including advanced cooling systems, high-performance plasma-facing materials, and robust component designs.

- **Materials science and durability:** More testing is required to develop materials that can endure the extreme conditions of a fusion reaction and the long-term effects on those materials of heat and radiation.

- **Fuel cycle management:** Technological advances are needed to determine the best ways to breed (or produce), recycle, and retain tritium, the fuel used for most fusion reactions. Optimizing the fuel cycle will be essential to manage the supply chain, ensure operational safety, and scale the deployment of fusion systems.

Despite these challenges, significant progress has been made in the past few years of fusion research, including the first net-positive energy fusion reactions. The prospect of commercial fusion power is quickly becoming a reality.

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[94] Matteo Barbarino, What is Nuclear Fusion?, International Atomic Energy Agency (2023).
[95] Fuel Comparison, European Nuclear Society (2024).
[96] Advancements in confinement technologies, predictive simulation models, and core–edge integration approaches are essential for achieving the necessary energy gain and long-term operational stability.