

Public-Private Investment Roadmap for Fusion Energy under the 17 Strategic Fields

(Adopted by the Headquarters for Japan's Growth Strategy on July 21, 2026)

Tentative Translation

Fusion Energy
Fusion Energy

1. Current Situation and Vision [Objectives]

(1) Current Situation

① Current Situation

- Fusion energy is a next-generation energy source with the potential to address both energy and global environmental challenges. Its key attributes are: (i) carbon neutrality, with no CO₂ emitted during power generation; (ii) abundant fuel, as deuterium is plentiful in seawater and a small amount can produce vast quantities of energy; (iii) inherent safety, as the reaction stops when fuel supply or power is interrupted; and (iv) environmental compatibility, as only low-level radioactive waste is generated and can be managed using established technologies. Power generation has yet to be demonstrated anywhere in the world, and the technology remains at the R&D stage, where scientific and technical feasibility is being established.
- In the United States, numerous startups have emerged. Some have attracted substantial private investment and begun constructing demonstration facilities. These private-sector-led initiatives are advancing rapidly, although their technical feasibility remains to be validated. Many use Japanese products, including superconducting wire.
- The United Kingdom is pursuing the government-led STEP programme toward power-generation demonstration, which remains at the design stage.
- China is constructing the government-led BEST demonstration facility, reportedly comparable in scale to experimental reactors in other countries, with completion targeted for 2027.
- Japan has accumulated decades of R&D through national research institutes and universities, including ITER and JT-60SA. And Japan possesses world-leading technological capabilities and the domestic capacity to develop and manufacture many critical components, including plasma-facing components and heating systems.

② External Environment and Structural Changes

- Since around 2020, particularly in the United States, private companies seeking to commercialize fusion power have mobilized significant private capital, while China and other countries have accelerated R&D.
- In Japan, private-sector initiatives are also expanding, including the establishment of multiple startups building on research outcomes from universities and other institutions.

③ Economic and Strategic Significance

- Strategic significance: Fusion energy is expected to become a major energy source over the long term. Securing technological autonomy is therefore essential, including from the perspective of energy security. Fusion R&D is also expected to generate spillovers into materials, space, defense and other fields.
- Economic significance: According to an IAEA estimate, fusion energy could increase global GDP by more than JPY 700 trillion over the long term.

(2) Objectives

① Target Markets in Japan and Overseas

- Over the medium to long term, capture approximately 30% of the global fusion energy market, including orders won by Japanese companies for fusion power plants overseas.
- Achieve a 100% global share in certain key components.
Potential examples:
superconducting coils, heating systems and divertors.

② Strategic Objective

- Achieve power-generation demonstration in the 2030s, ahead of the rest of the world.

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2. Identifying Japan's Competitive Pathway and the Public-Private Investment Outlook [Roadmap]

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(1) Basic Strategy

① Japan's Competitive Pathway

- Japan currently possesses world-leading technological capabilities, including the domestic capacity to develop and manufacture many critical components such as plasma-facing components, including divertors capable of withstanding ultra-high temperatures, and high-output, highly reliable heating systems. These capabilities are supported by an established supply chain.
- Building on these strengths, Japan will further accelerate technology development and demonstration, resolve outstanding technical challenges ahead of other countries, and establish a competitive, cost-efficient fusion power system ahead of the rest of the world.
- This will contribute to addressing environmental challenges and strengthening energy security, while capturing overseas markets through exports of complete systems and key components.

② Capabilities to be Established in Japan

- Establish in Japan companies capable of designing, constructing and operating competitive fusion power plants, together with resilient supply chains for the components and materials that support them. R&D and related measures will be advanced with due consideration to economic security.
- Develop, in stages and in line with technological progress, scientifically rational safety regulations aligned with international practice, while taking account of technological uncertainty, thereby ensuring both robust safety and rapid development.

(2) Public-Private Investment Outlook

① Scope of Investment

- R&D and demonstration toward the realization of fusion energy.

② Investment Amount

Estimated at JPY 3.1 trillion through FY2040.

Note: This estimate assumes one fusion power demonstration plant. Following power-generation demonstration in the 2030s, investment is expected to increase as progress through the R&D phases improves predictability for industry.

③ Quantitative Impact: Broader Economic Effects

Estimated at JPY 9.4 trillion through FY2040.

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3. Challenges and Policy Package to Mobilize Public-Private Investment [Policy Measures]

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(1) Challenges to Investment Mobilization

<R&D Phase to Establish Enabling Technologies, over the Next Five Years>

○Factors of Uncertainty

- Technological uncertainty is the principal challenge.
Many required technologies remain to be established, including plasma control, reactor materials, the fuel cycle, reliability and maintainability.
- R&D requires substantial funding, while expected returns remain difficult to assess at present.
- Certain challenges, including tritium handling, are difficult for private companies to address independently.

<Power-Generation Demonstration Phase, in the 2030s>

①Resource Constraints

- Substantial funding and a large pool of highly skilled personnel will be required.
- Suitable sites and fuel materials must be secured.

②Factors of Uncertainty

- Technological uncertainty.
- High costs and limited predictability of returns.
- Social acceptance and understanding within host communities.
- Technical and cost uncertainty concerning safety measures and the management of activated materials.

(2) Policy Package

<R&D Phase to Establish Enabling Technologies, over the Next Five Years>

- The Government will take the lead in strongly advancing R&D on enabling technologies required to realize fusion energy, while broadly supporting the development of fusion power systems with credible prospects of success. This will include technology development led by QST based on established approaches, and ambitious concepts pursued by startups and others, and the development, establishment* and infrastructure needed for common enabling technologies.
- * Japan will seek to resolve, ahead of other countries, technical challenges that remain unsolved globally, reduce technological uncertainty and secure a competitive advantage. With reference to the SBIR framework, the Government will also consider expanding support for technology demonstrations by startups seeking to commercialize critical components and materials.
- In several years, based on progress in technology development, the readiness of public- and private-sector organizational arrangements, and international trends, the Government will decide the fusion power system to support as Japan's priority pathway toward early power-generation demonstration and concentrate R&D resources on its realization. Support for other systems will continue, and additional promising pathways may also receive support toward demonstration.
- To promote these initiatives, the Government will consider strengthening NEDO's funding functions.
- In parallel, scientifically rational safety regulations aligned with international practice will be developed in stages, updated as necessary, and calibrated to technological progress and uncertainty, thereby ensuring both robust safety and rapid development.
- Through R&D projects and strategic participation in ITER, Japan will develop, from a long-term perspective, the human resources required for subsequent demonstration and commercialization. Measures will include promoting women's participation across companies, national research institutes and universities; supporting reskilling through continuing-education programmes at universities and other institutions; and increasing the number of Japanese personnel engaged in ITER.
- Japan will also lead international standardization with a view to capturing future markets.

<Power-Generation Demonstration Phase, in the 2030s>

- For the priority fusion power system with government support, a public-private partnership will implement a power-generation demonstration project. By concentrating talent and capital, Japan will achieve demonstration of a competitive fusion power system in the 2030s.
- The Government will work with local governments and regional businesses, including through workforce development, so that the project also contributes to regional economic growth.
- In parallel, technology development for commercialization will continue, enabling demonstration outcomes to be translated swiftly into competitive power systems, including through improvements in reliability and maintainability.

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Strategic Direction

- Leveraging Japan's world-leading technological capabilities in helical and laser systems, as well as in tokamak systems **developed through decades of R&D under ITER and related programmes**, Japan will rapidly develop and establish all required enabling technologies. By establishing a competitive fusion power system ahead of the rest of the world, Japan will address environmental challenges, strengthen energy security, and **capture overseas markets through exports of complete systems and key components**.
- In the near term, the Government will advance both technology development based on established approaches and ambitious fusion power concepts pursued by startups and others. In several years, taking account of technological progress and international developments, the Government will select the priority fusion power system to support toward early demonstration, concentrate R&D resources on its realization, and **achieve power-generation demonstration in the 2030s**.

International Thermonuclear Experimental Reactor (ITER)

