

Fusion Energy Innovation Strategy

Daisuke Baba

Director, International Nuclear and Fusion Energy Affairs Division

**MEXT (Ministry of Education, Culture, Sports, Science and Technology)
& CAO (Cabinet Office)**

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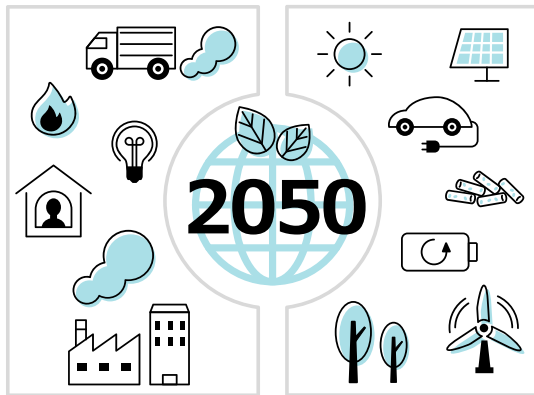
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 - ④ Moonshot R&D Program

Overview of Fusion Energy Innovation Strategy①

- ✓ Seeing fusion energy as a new industry, Japan will not miss the opportunity to enter the burgeoning global fusion supply chain competition.
- ✓ In addition to subsequent approach; the ITER Project/BA Activity, and DEMO development, Japan will accelerate the realization of fusion energy through a multifaceted approach such as commercialization.
- ✓ Japan will establish Fusion Industry Council, support start-up and others' R&D, hold discussions on safety regulations, strengthen its support to emerging technologies, develop educational programs, etc.

Fusion energy as a solution for energy and environmental problems

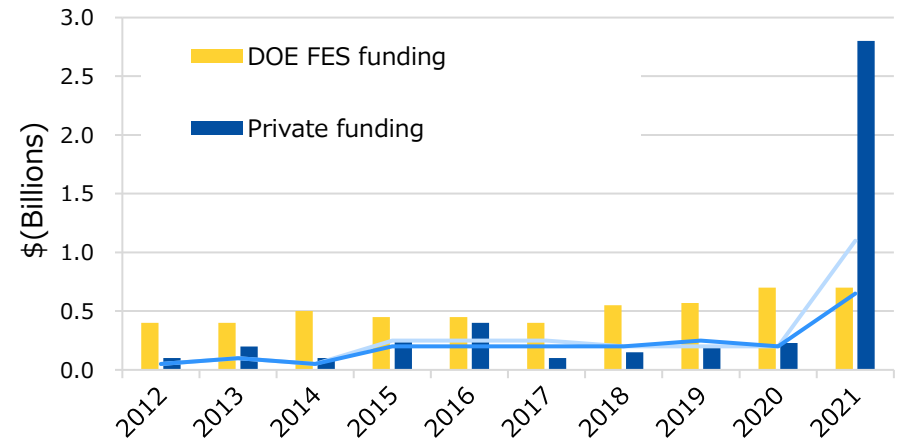
- Carbon neutrality by 2050
- International energy situation greatly impacted by Russia's aggression against Ukraine
- Ensuring energy security



- Benefits of fusion energy:
 - ① carbon neutral
 - ② abundant fuel supply
 - ③ inherent safety
 - ④ environmental protection
- Paradigm shift of energy hegemony from countries with resources to those with technology

Fusion energy as a new industry

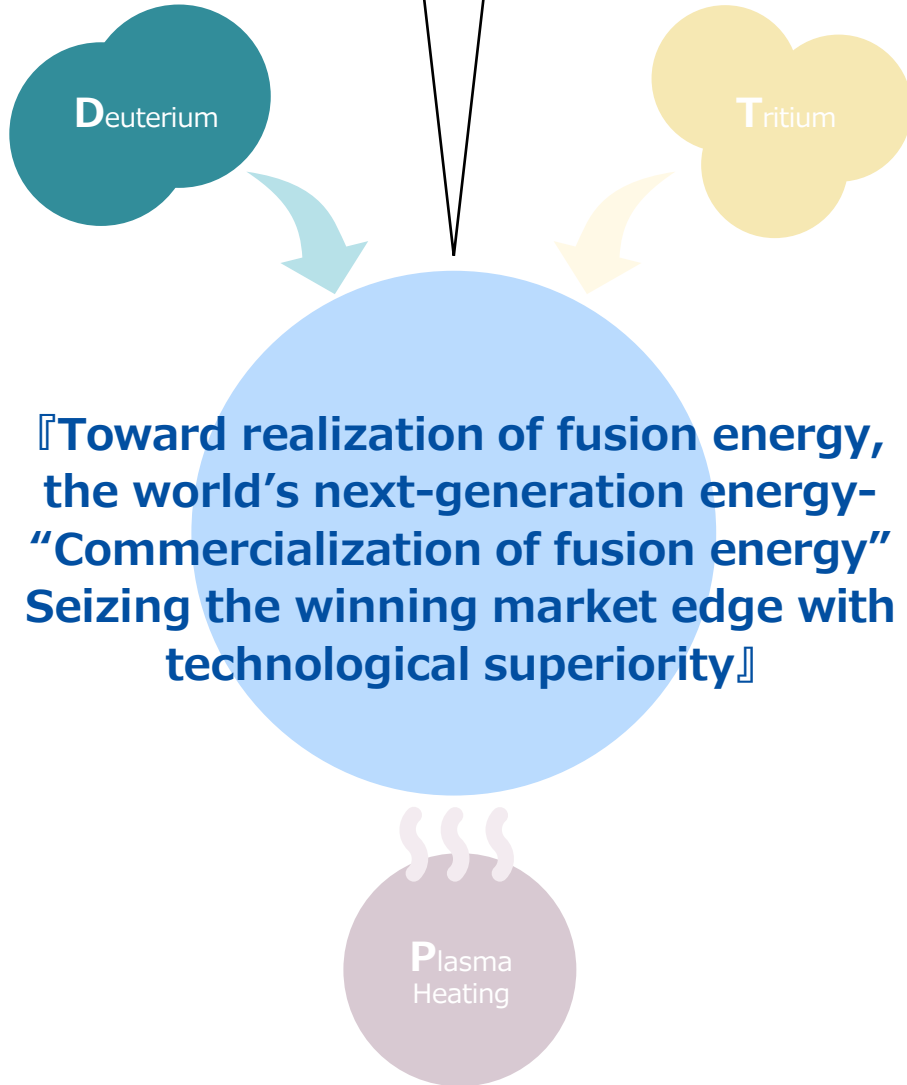
- Increased private-sector investment in fusion energy development in other countries
- US, UK have national strategies aiming at commercialization of fusion energy (starting confining technologies to own countries).
- Japan may win in technology but lose in business, although it has technological advantages and reliability.
- Japan is a strong partner for other countries; good chance to get overseas markets.



Reference : <https://science.osti.gov/-/media/fes/pdf/fes-presentations/2022/Wurzel---PPP-Lighning-round-talk.pdf>

Overview of Fusion Energy Innovation Strategy②

Achieving a national vision by : **D**eveloping industry + **T**echnology strategy × **P**romotion



Developing the Fusion industry

Visualization

- Early realization of DEMO by accelerated R&D
- **Clarification of targets** with technology, market opportunity maps

Connections

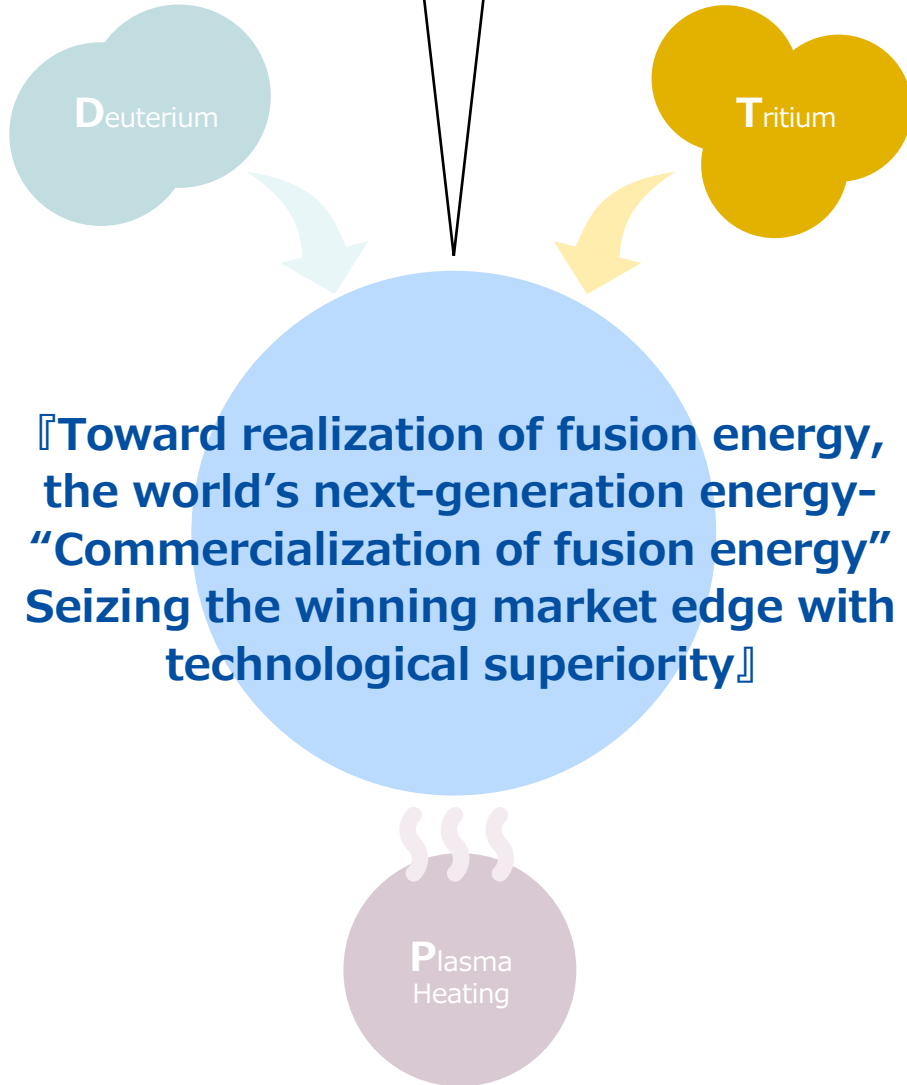
- Matching of companies by **establishment of Fusion Industry Council of Japan** aiming at FY2023

Fostering

- **Greater support to private companies** from FY2023 for **reducing gap between industry needs and technology seeds possessed**
- Participation in discussion between like-minded countries on safety regulations and standardization
- **Formulation of basic ideas on ensuring safety** based on inherent safety of fusion energy

Overview of Fusion Energy Innovation Strategy③

Achieving a national vision by : **D**eveloping industry + **T**echnology strategy × **P**romotion

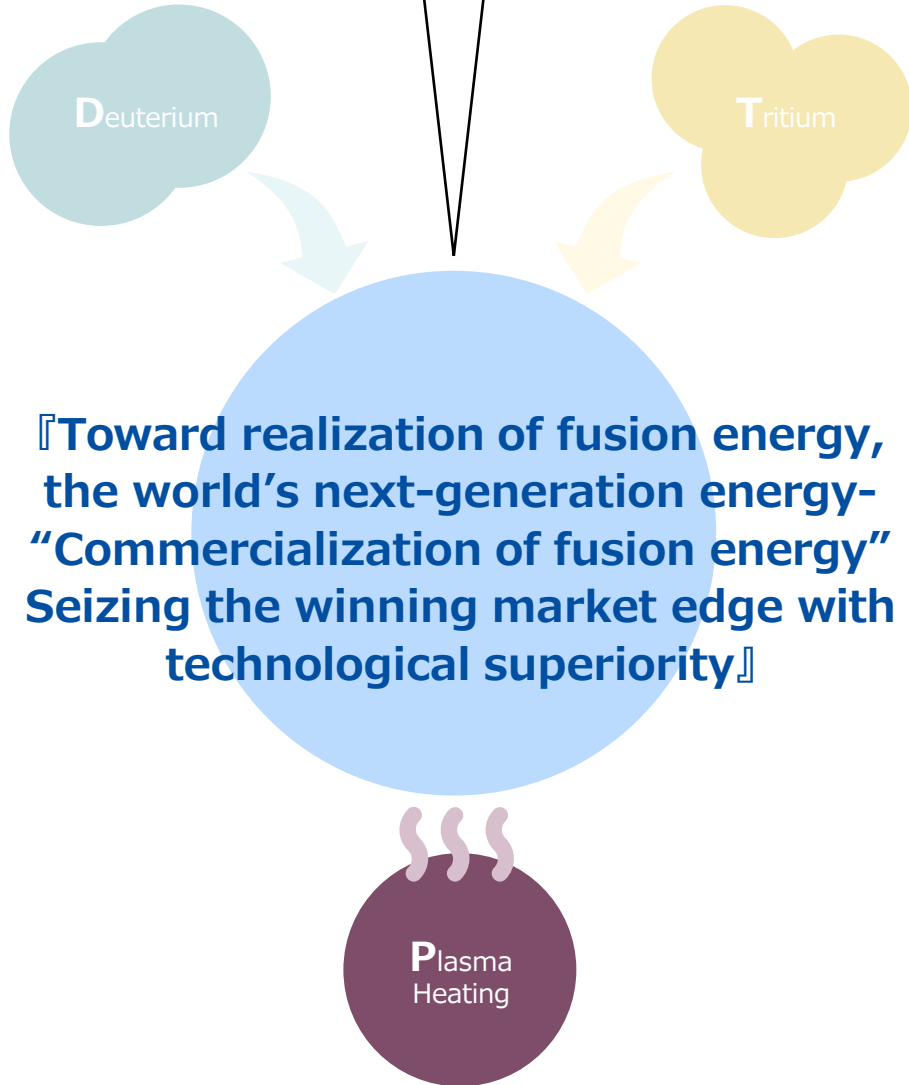


Developing Fusion Technology

- Enhanced support measures for emerging technologies such as **miniaturization and high-performance technologies** as a game-changer
- **Acquisition of key technologies** through ITER Project/BA Activity
- **Acceleration of R&D anticipating future development of DEMO**
- Promotion of academic research on fusion energy
- **Promotion of Action Plan** for DEMO development by incorporating new technologies

Overview of Fusion Energy Innovation Strategy④

Achieving a national vision by : **D**eveloping industry + **T**echnology strategy × **P**romotion



Framework for Promoting Fusion Energy Innovation Strategy

- With Cabinet Office as “control tower,” advancing strategy together with relevant ministries, agencies
- Establishing framework for conducting R&D by bringing together, centering on QST, academia and private companies for DEMO development (**establishment of fusion technology innovation hub**)
- Clarifying future career paths, systematically fostering by industry-academia-government HR engaged in fusion energy
- Strengthening HR development at universities, acquiring excellent HR from other fields, countries (**provision of fusion energy educational programs**)
- Conducting outreach activities to deepen understanding of citizens

Remarks by Prime Minister Kishida

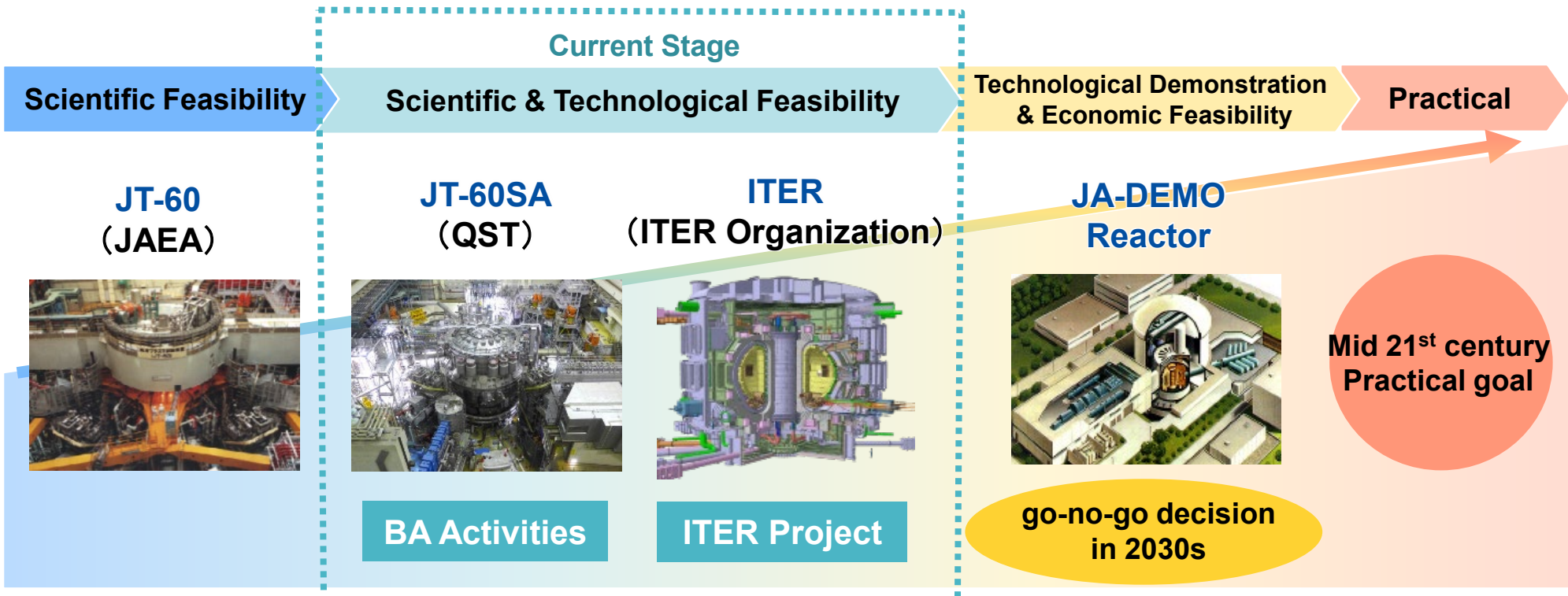


As for investment, we have enacted relevant legislation in anticipation of 150 trillion yen in public and private investment in environmental fields over the next decade. To accelerate public and private investment beyond the environment to cutting-edge fields such as AI, semiconductors,

bio, and fusion energy, we will formulate and then implement an investment assistance package that can compete with the rest of the world on every front, including budgetary, tax, and regulatory considerations.

at the Economic Club of New York on 9/21, 2023

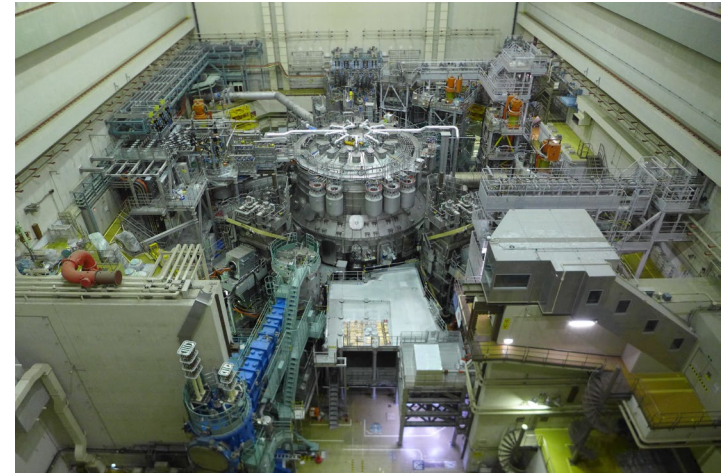
Toward the Realization of Fusion Energy



JT-60SA First Plasma

- **JT-60SA is currently the world's largest tokamak superconducting plasma experimental device** at the Naka Fusion Institute in Ibaraki, Japan, which was jointly constructed by Japan and Europe.

- The purpose of JT-60SA is to support research to achieve the technical goals of ITER, to conduct complementary research to ITER toward DEMO, and to develop human resources.

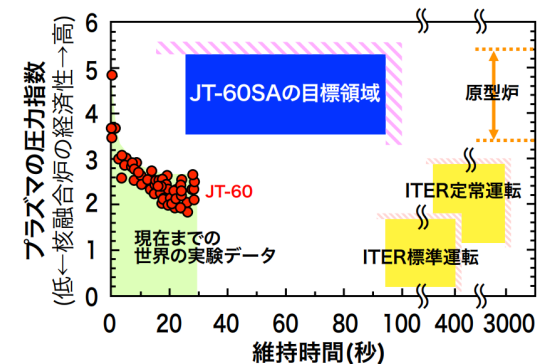


Panoramic view of JT-60SA

- **It contributes to the demonstration of reliability and economics of fusion reactors (reactor downsizing, higher power, etc.)**, such as long sustainment of plasma at high pressure (over 100 seconds).

- Assembly of the reactor started in 2013, and integrated test operation started in 2020. **On October 23, 2023, the first plasma was produced.**

- On **December 1, 2023**, a ceremony to commemorate the start of JT-60SA operation was held jointly by Japan and Europe at the Naka Fusion Institute.



Joint Press Statement on Fusion Energy between MEXT Minister and EU Commissioner for Energy



MEXT and the European Commission have long been promoting joint research ... through the ITER project and Broader Approach activities since 2007. These activities culminate today with the start of operation of JT-60SA..., the biggest and most advanced tokamak-type fusion reactor in the world.

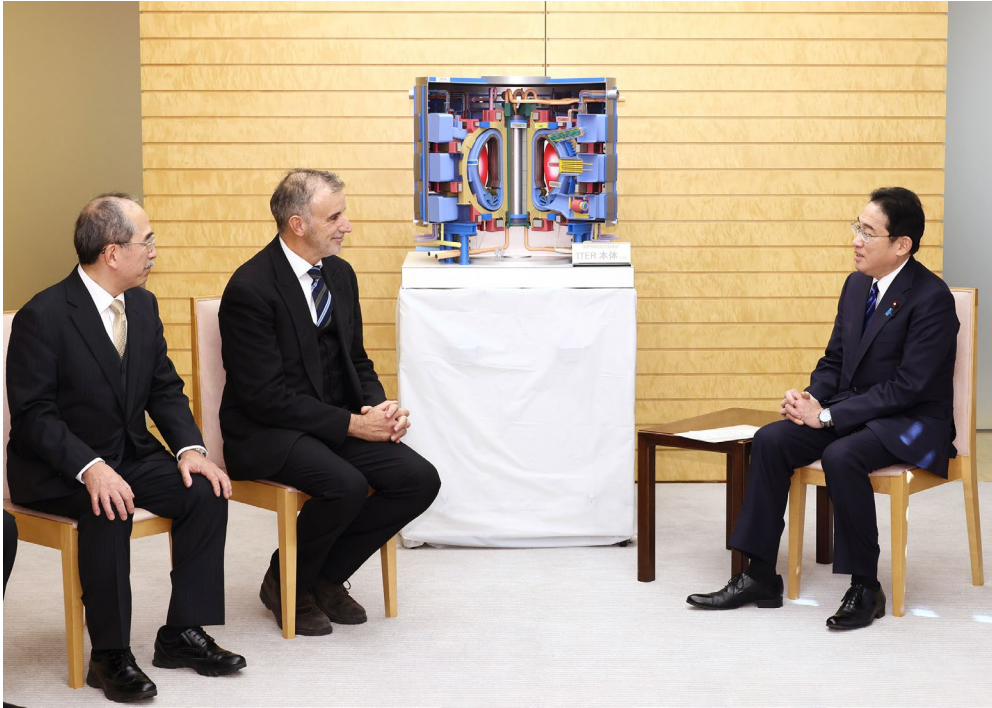
... the Minister of Education, Culture, Sports, Science and Technology of Japan and the EU Commissioner for Energy have **reaffirmed their commitment to promote the Broader Approach activities** to ensure the realization of fusion energy ...

... have reasserted their willingness to **support the technical upgrades and operation of JT-60SA** to produce groundbreaking research results, useful for ITER and for designing and constructing the fusion reactors of the future.

... have expressed their intention to jointly **strengthen the JT-60SA International Fusion School (JIFS)** ... to train young scientists and engineers and develop human resources necessary to achieve fusion energy in the future.

at the Naka Fusion Institute on 12/1, 2023 9

Remarks by Prime Minister Kishida at the meeting with ITER Organization DG Barabaschi



I would like to extend my sincere congratulations on the achievement of the first plasma at the experimental fusion reactor JT-60SA.

In Japan, we are promoting the industrialization of fusion energy based on the "Fusion Energy Strategy" formulated in April. We intend to accelerate our efforts toward the early

realization of fusion energy by making maximum use of the technologies and human resources we have cultivated through the ITER Project, in collaboration with industry, and considering safety regulations.

at the Prime Minister's Office of Japan on 11/30, 2023

Overview of the Fusion Industry Council

● Name

Fusion Energy Forum (tentative)

● Objective

Create fusion industries and businesses

● Membership

- Be aware of the expansion of fusion as an assembly of diverse technologies.
- Involve start-ups, supplier companies, academia, as well as energy users.

● Major efforts

- Survey trends in the fusion industry and share information with member companies.
- Activities for standardization of fusion technology and policy proposals to the government, including safety regulations.
- Events focusing on local universities and their local companies.
- Exchange of opinions between industry and students.
- Matching events between industry needs and university seeds, and between fusion-related companies to match needs and seeds.

● Schedule

- The Council will be established by the end of March.



Moonshot Research and Development Program



Goal 1 Overcoming limitations of body, brain, space and time

Illustration for Goal 1: A person in a space suit floating in space, a person in a futuristic car, and a person in a futuristic house.

Goal 2 Ultra-early disease prediction and intervention

Illustration for Goal 2: A person in a futuristic car, a person in a futuristic house, and a person in a futuristic office.

Goal 3 Coevolution of AI and robots

Illustration for Goal 3: A person in a futuristic car, a person in a futuristic house, and a person in a futuristic office.

Goal 4 Cool Earth & Clean Earth

Illustration for Goal 4: A factory emitting CO2, a person in a futuristic car, and a person in a futuristic house.

Goal 5 Sustainable food supply and consumption

Illustration for Goal 5: A person in a futuristic car, a person in a futuristic house, and a person in a futuristic office.

Goal 6 Fault-tolerant universal quantum computer

Illustration for Goal 6: A person in a futuristic car, a person in a futuristic house, and a person in a futuristic office.

Goal 7 To Age 100 without Health Concerns

Illustration for Goal 7: A person in a futuristic car, a person in a futuristic house, and a person in a futuristic office.

Goal 8 Controlling and modifying the weather

Illustration for Goal 8: A sun, clouds, rain, and a person in a futuristic car.

Goal 9 Increasing peace of mind and vitality

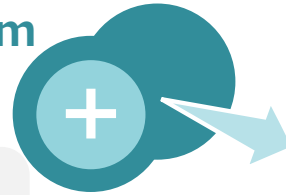
Illustration for Goal 9: A person in a futuristic car, a person in a futuristic house, and a person in a futuristic office.

- The government sets ambitious goals and concepts as Moonshot Goals.
- Opens call for domestic and foreign top-class researchers as Project Managers.
- The Japanese government has decided to add another Moonshot Goal regarding Fusion Energy in 2023 and the open call will start early next year. 12

The new goal of Moonshot R&D Program for Fusion Energy

By 2050, we hope to realize a vibrant society that is in harmony with the global environment and free from constraints on resources through multifaceted utilization of fusion energy.

Deuterium



Tritium



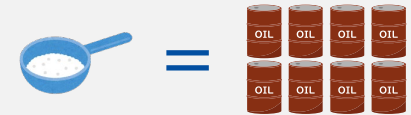
Fusion Energy

Fusion energy is generated by the fusion process!

Fusion Energy

Energy released when light nuclei (deuterium and tritium) fuse into another nucleus (helium). It is also the energy that makes the sun and stars shine.

Fuel for fusion is abundant in seawater!



1 gram of fuel = 8 tons of oil

Overcome resource constraints

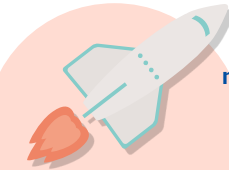
Enables long distance travel with a small amount of fuel



Small Power Source

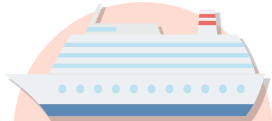
Fusion Energy

Challenges to new and unknown areas become possible



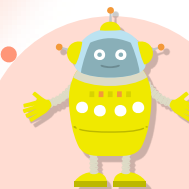
Space Propulsion

Marine Propulsion Systems



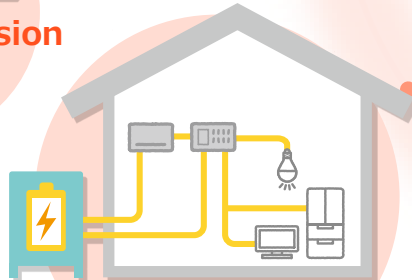
Hydrogen Production/
Synthetic Fuel Production

Applications in various everyday situations



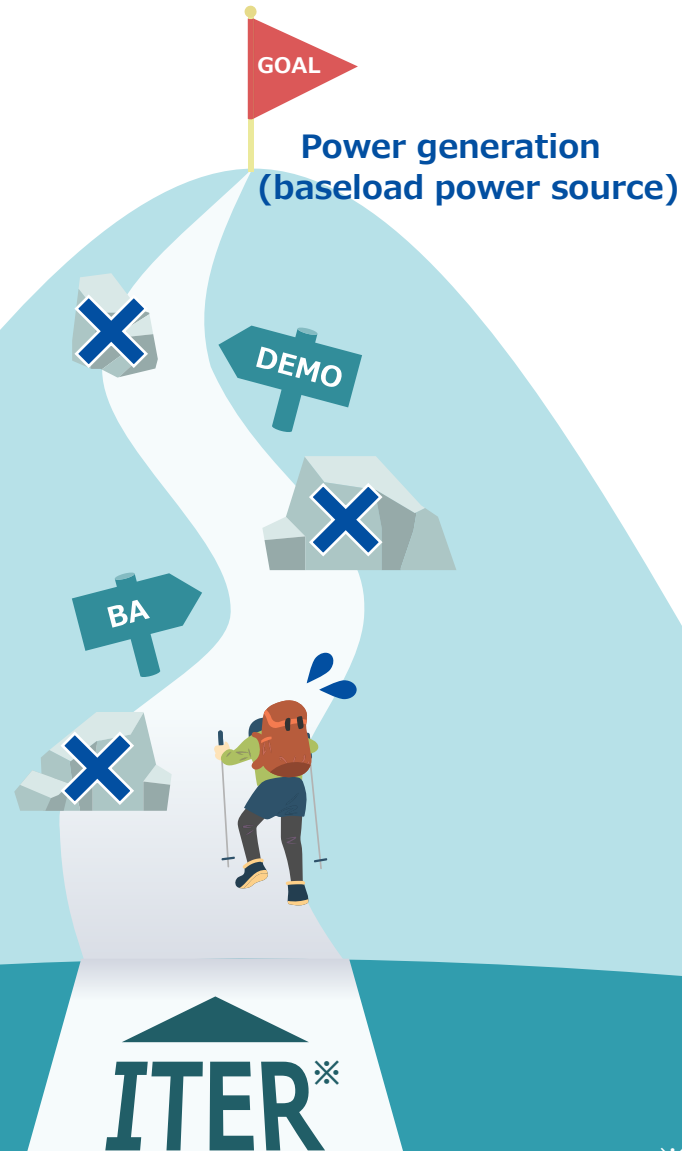
Robots

Off-grid



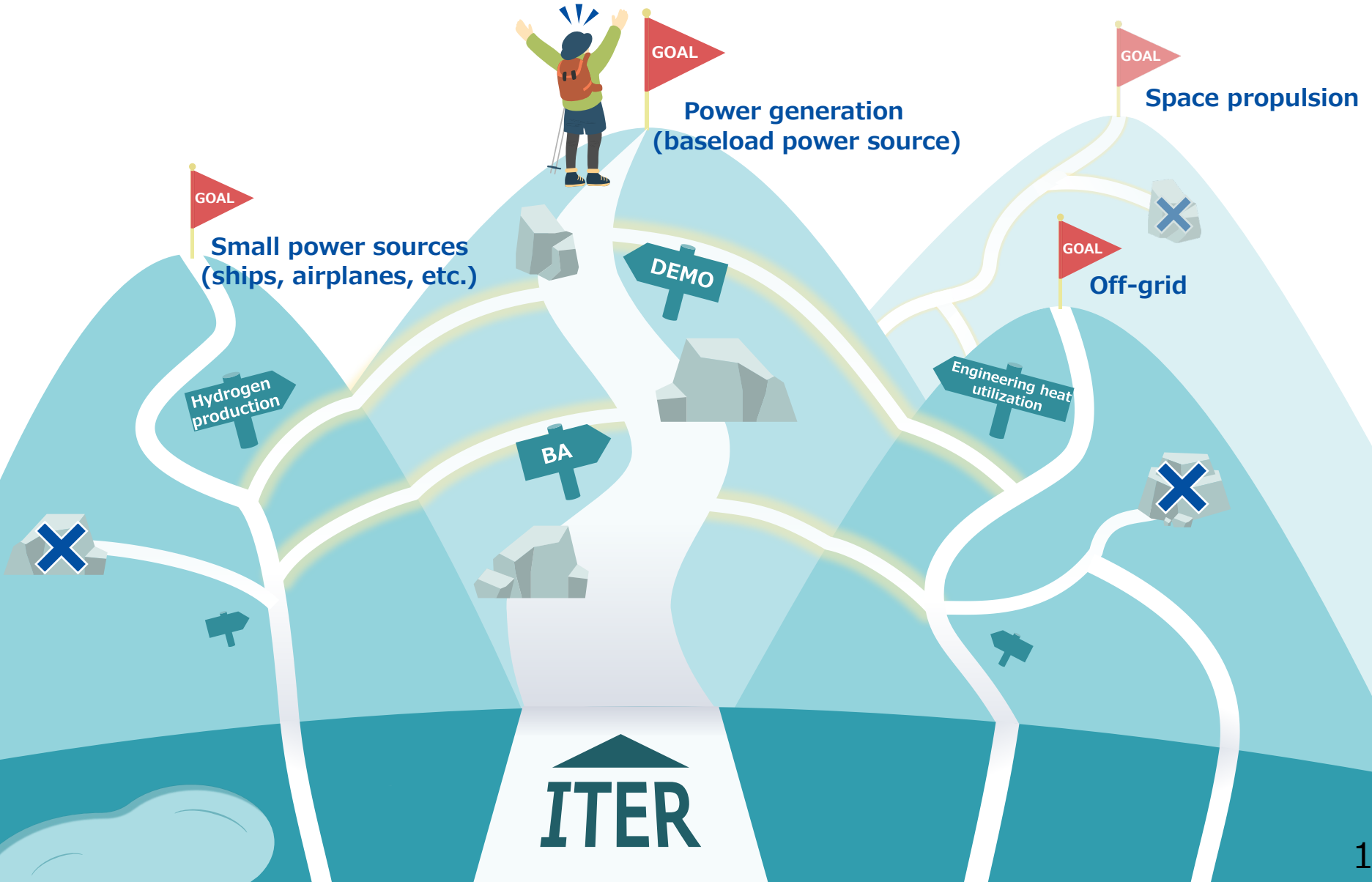
Without Cooperation with the Moonshot R&D Program

When difficulties arise along the path from ITER[※]/BA/DEMO to power generation, social implementation will be delayed due to lack of alternatives.



When Collaborating with Moonshot R&D Program

Research aimed at innovative social implementation can create results ahead of time to better secure the path from ITER/BA/DEMO to power generation.



Summary

Achieving a national vision by : **D**eveloping industry + **T**echnology strategy × **P**romotion

1 Establishment of the Fusion Industry Council of Japan

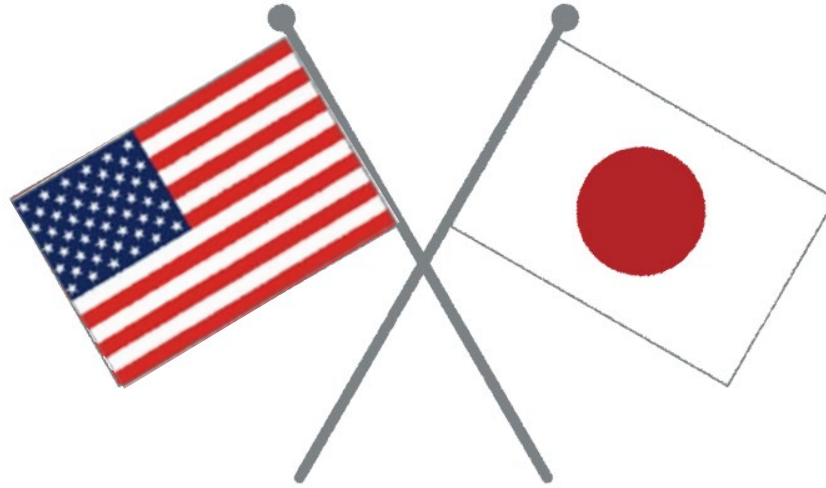
- ✓ The Fusion Energy Forum (tentative) will be established soon.
- ✓ This Forum would become a counterpart for industry groups in other countries.

2 Potential of Moonshot R&D Program

- ✓ This program has great potential to contribute to the realization of fusion energy.
- ✓ It can also be a trigger for promoting international collaboration.

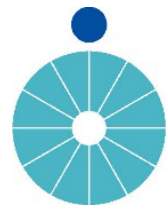
3 The Importance of International Collaboration

- ✓ Japan and US have collaborated on fusion, such as the Japan-US Coordinating Committee for Fusion Energy, the ITER project and High Energy Density Science.
- ✓ Japan and US are discussing our new fusion partnership, taking the opportunity of “International Partnerships in a New Era of Fusion Energy Development”.



Thank you for your kind attention.

Daisuke Baba
d-baba@mext.go.jp



MEXT

MINISTRY OF EDUCATION,
CULTURE, SPORTS,
SCIENCE AND TECHNOLOGY-JAPAN