

Japan's Green Transformation (GX) Strategy toward 2050

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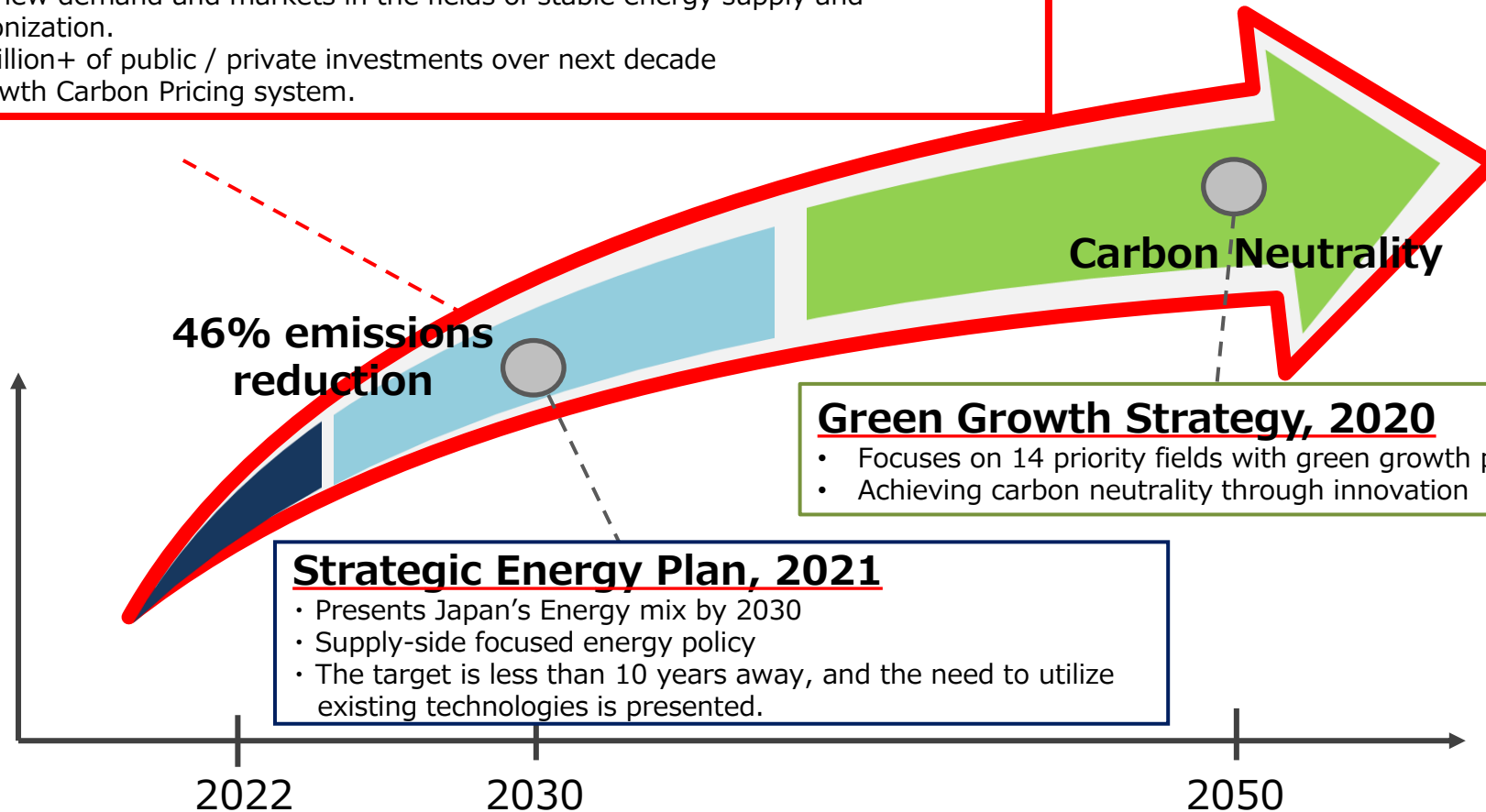
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Japan's Major Energy–Climate Policy packages

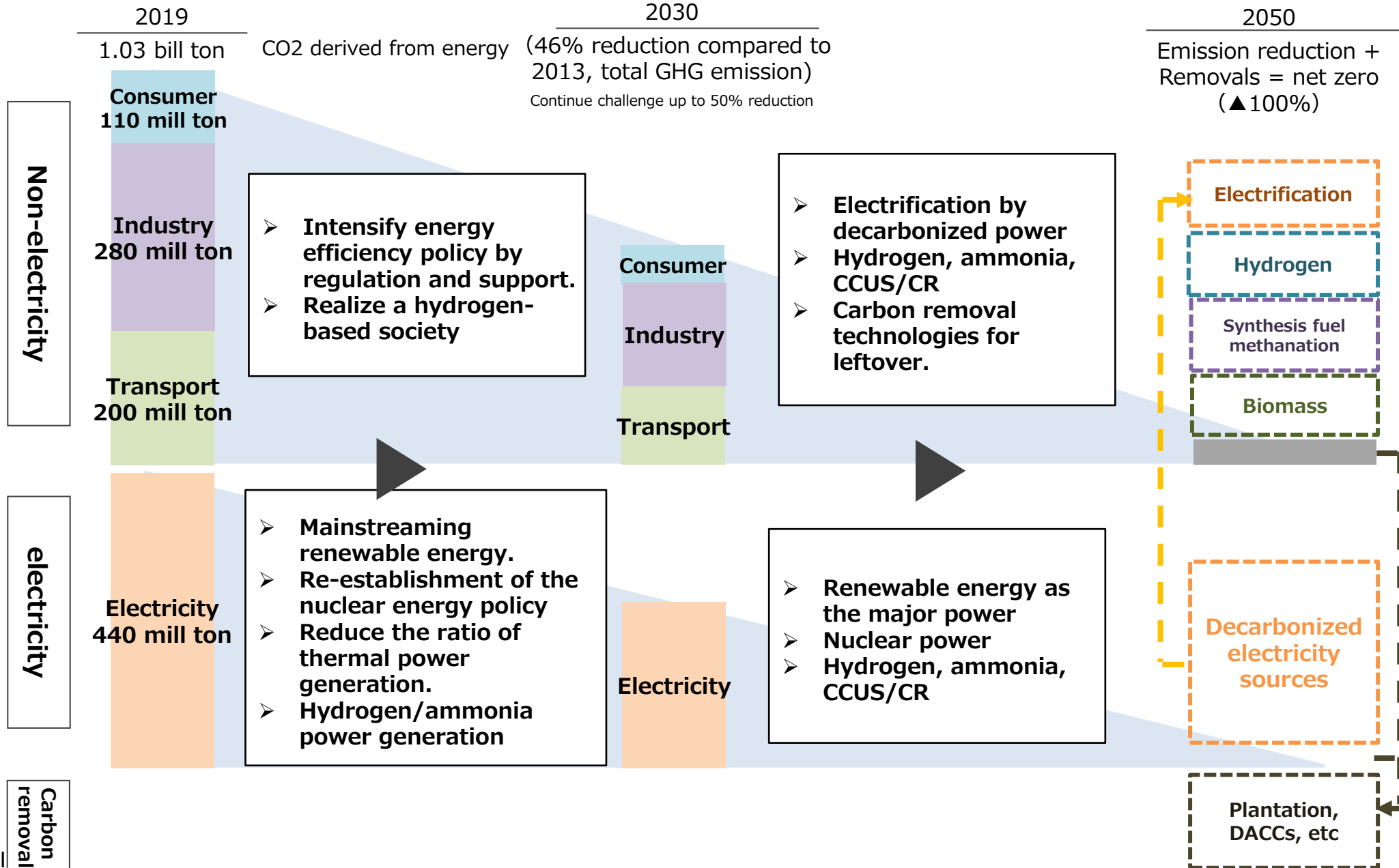
- GoJ announced the Basic Policy for the Realization of GX in February 2023. Relevant bills were approved thereafter by the Diet.
- Green Transformation (GX) delivers both emission reduction and economic growth.

Basic Policy for the Realization of GX, 2023

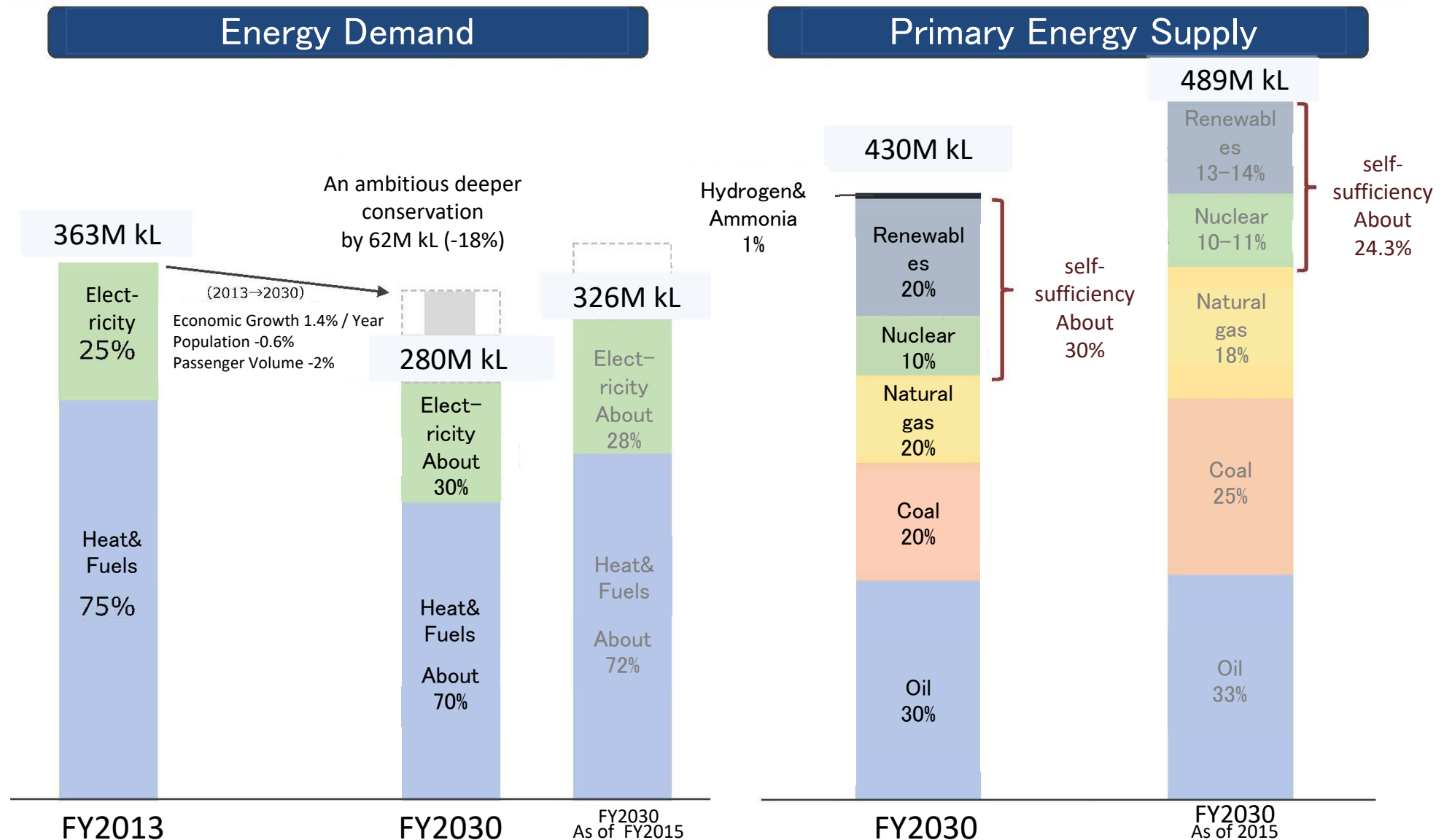
- Create new demand and markets in the fields of stable energy supply and decarbonization.
- ¥150 trillion+ of public / private investments over next decade
- Pro Growth Carbon Pricing system.



Path to 2050 CN through 2030

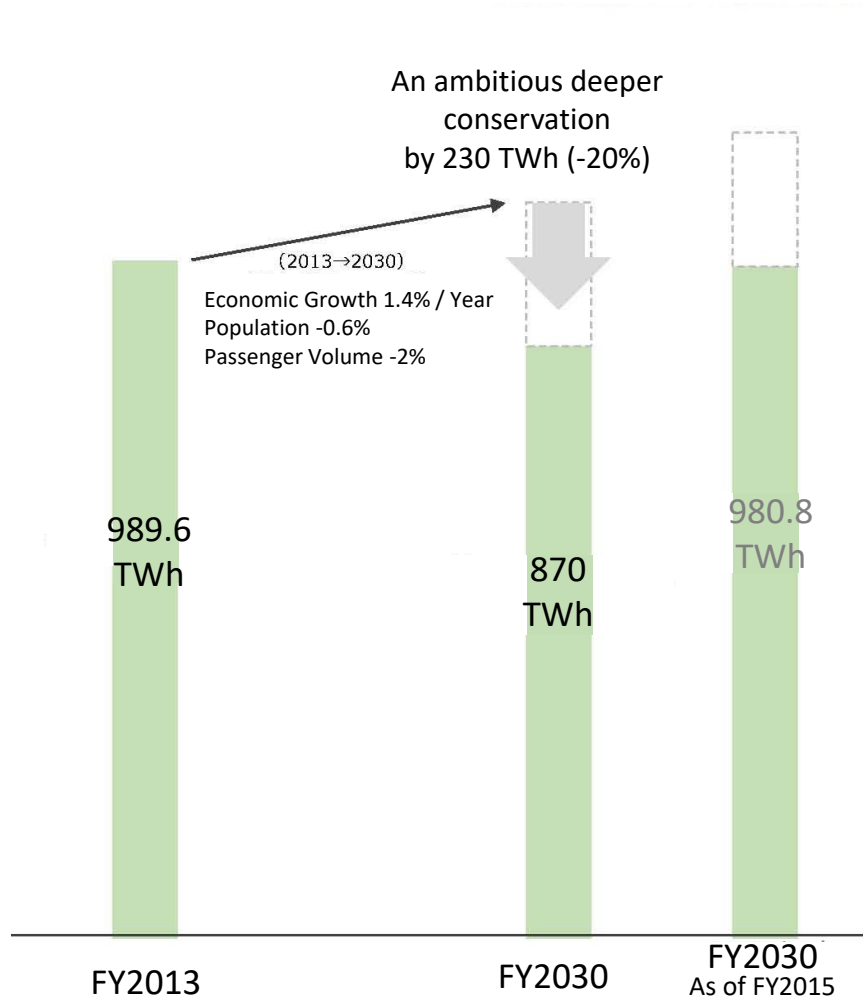


Revised Energy Mix in 2030 : Demand and Primary Energy

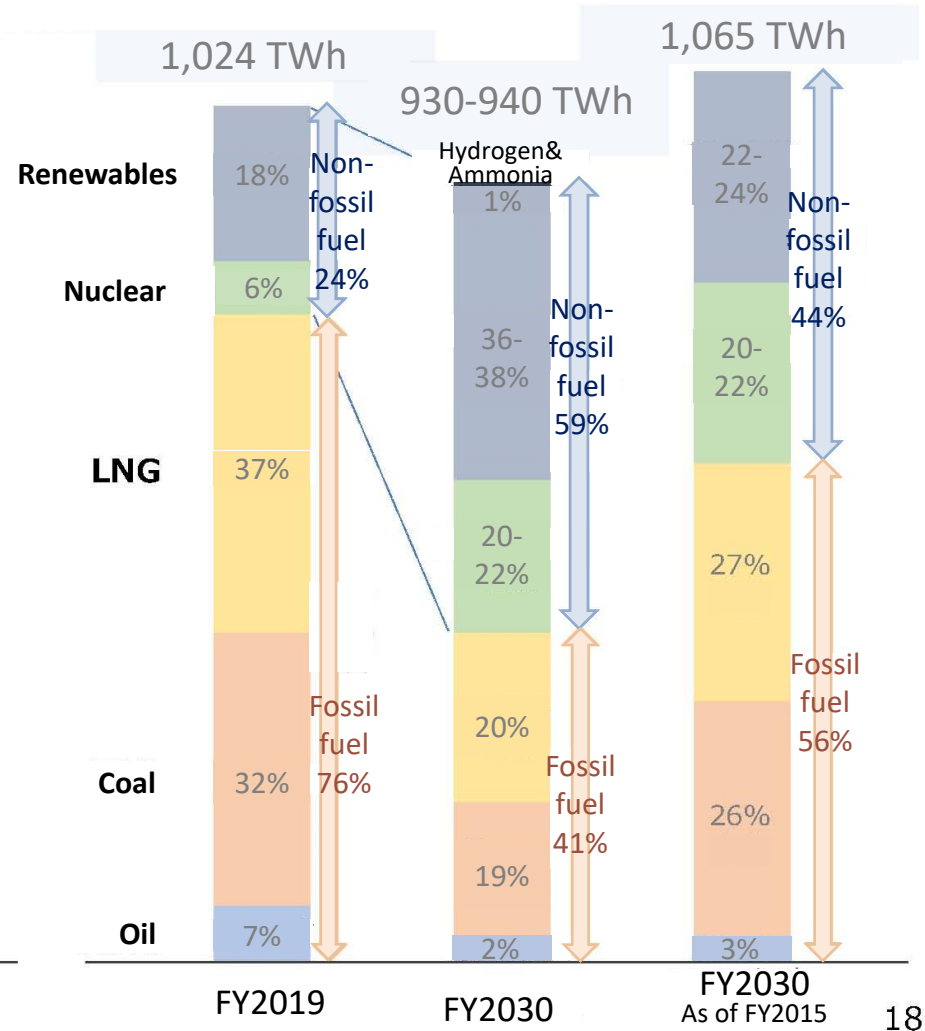


Revised Energy Mix in 2030 : Power Mix

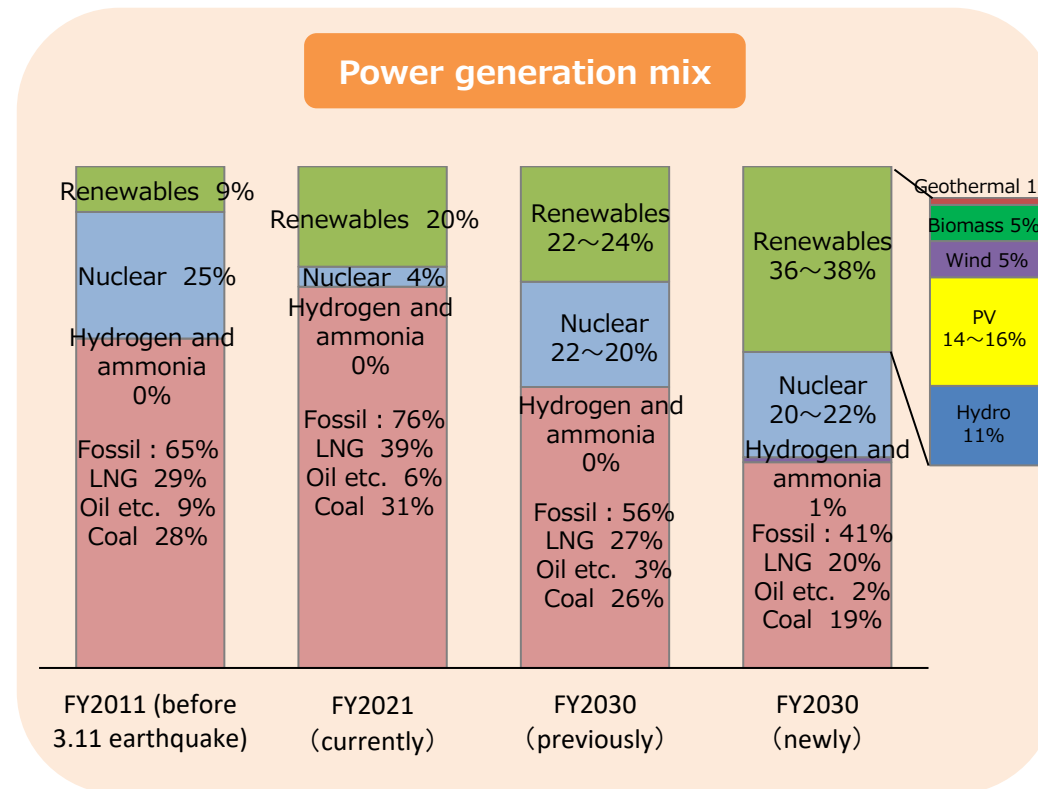
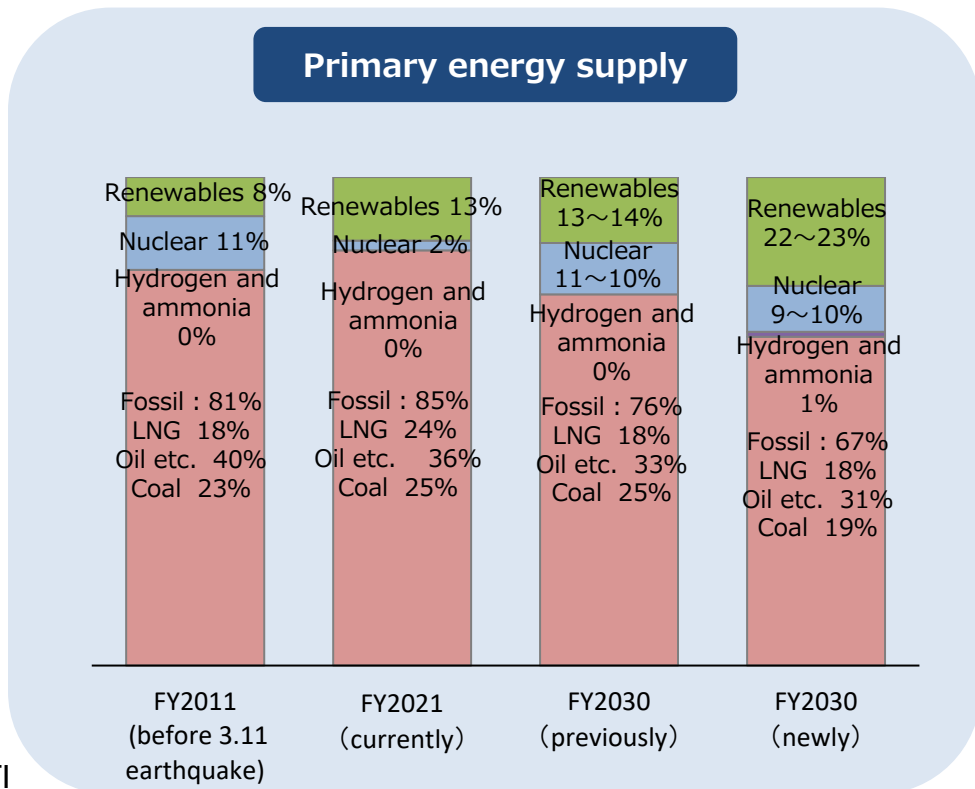
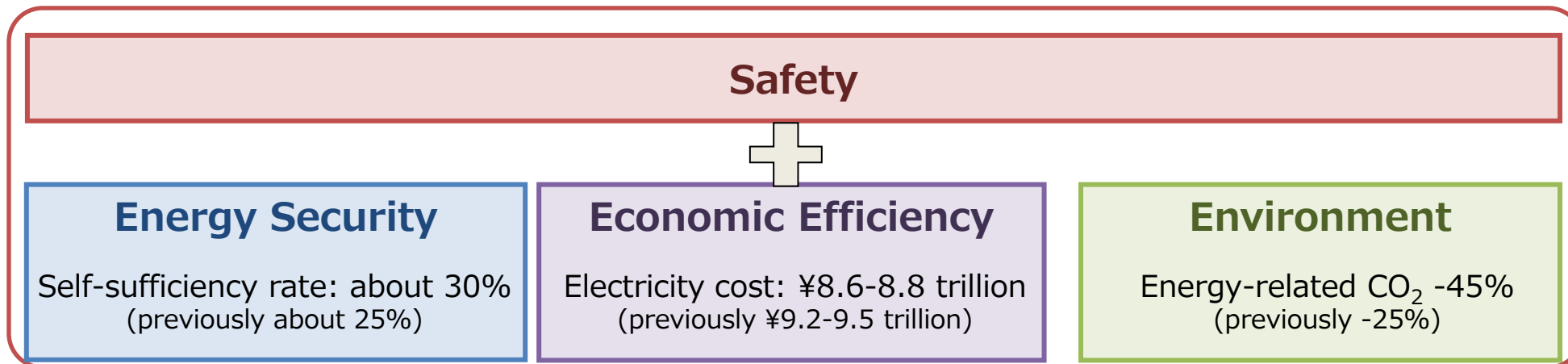
Electricity Demand



Power Mix



Energy Policy Principles : S+3E



14 sectors in the Green Growth Strategy (Dec. 2020, June 2021)

Energy

Offshore wind power

Wind turbines, parts, floating wind turbines

Ammonia fuel

Combustion burner
(as fuel in transition period to hydrogen-powered society)

Hydrogen

Turbines for power generation, hydrogen reduction steel-making, carrier ships, water electrolyzers

Nuclear power

SMR (Small Modular Reactor), nuclear power for hydrogen production

Source: METI

Transport/Manufacturing

Mobility and battery

EV (electric vehicle), FCV (fuel cell vehicle), next generation batteries

Semiconductor and ICT

Data centers, energy-saving semiconductors (demand-side efficiency)

Maritime

Fuel-cell ships, electric propulsion ships, gas-fueled ships

Logistics, people flow and infrastructure

Smart transportation, drones for logistics, fuel-cell construction machinery

Foods, agriculture, forestry and fisheries

Smart-agriculture, wooden skyscrapers, blue carbon

Aviation

Hybrid electric, Hydrogen-powered, Aircraft

Carbon Recycling

Concrete, biofuel, plastic materials

Home/ Office

Housing and building,

Next generation PV

(perovskite solar cell)

Lifestyle-related industry

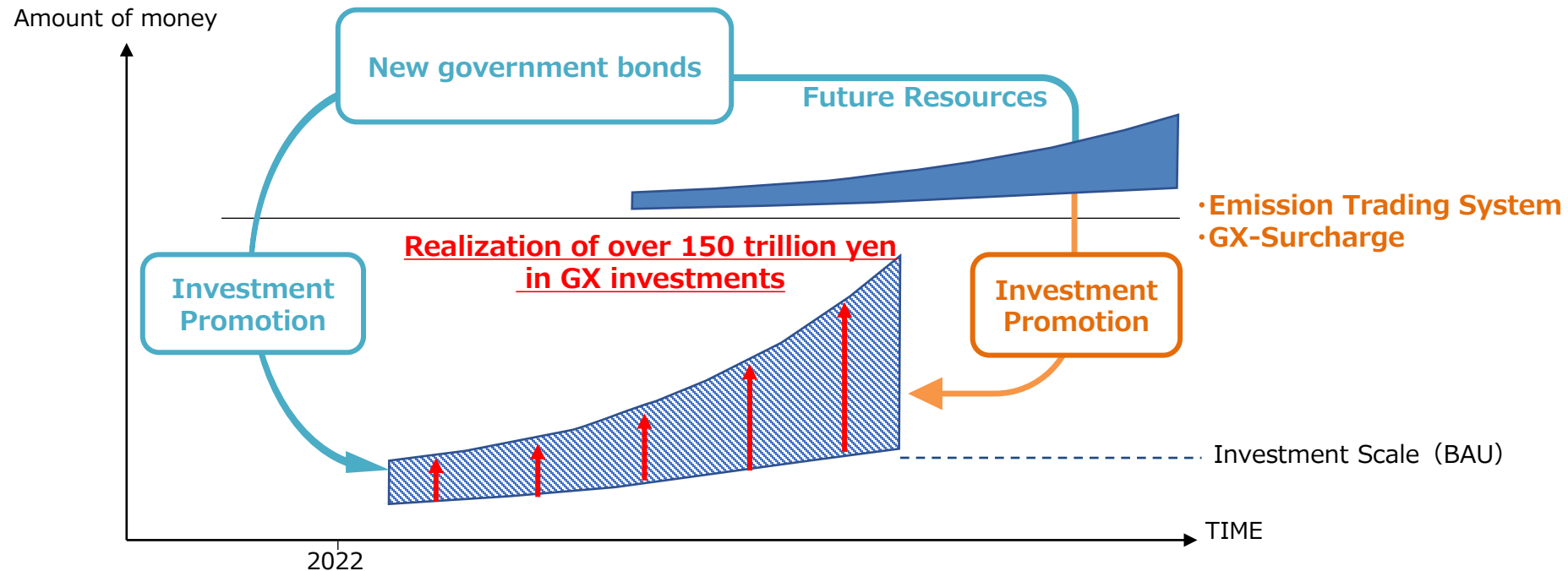
Local decarbonization business

Resource circulation

Biomaterials, recycled materials, waste power generation

Pro-Growth Carbon Pricing System

- ① **Government support for bold upfront investment** by issuing **new government bonds (20 trillion yen over the next 10 years)**
- ② **Introduction of carbon pricing to give incentives for GX investment**
 - (1) Full-scale operation of **emissions trading system** in high emission industries [**from FY2026**].
+ Allowance auctioning to be phased in gradually to **power generation companies** [**from FY2033**]
 - (2) Introduction of a **GX-Surcharge** on fossil fuel supply [**from FY2028**]
- ③ Strengthen financial support through public-private partnership

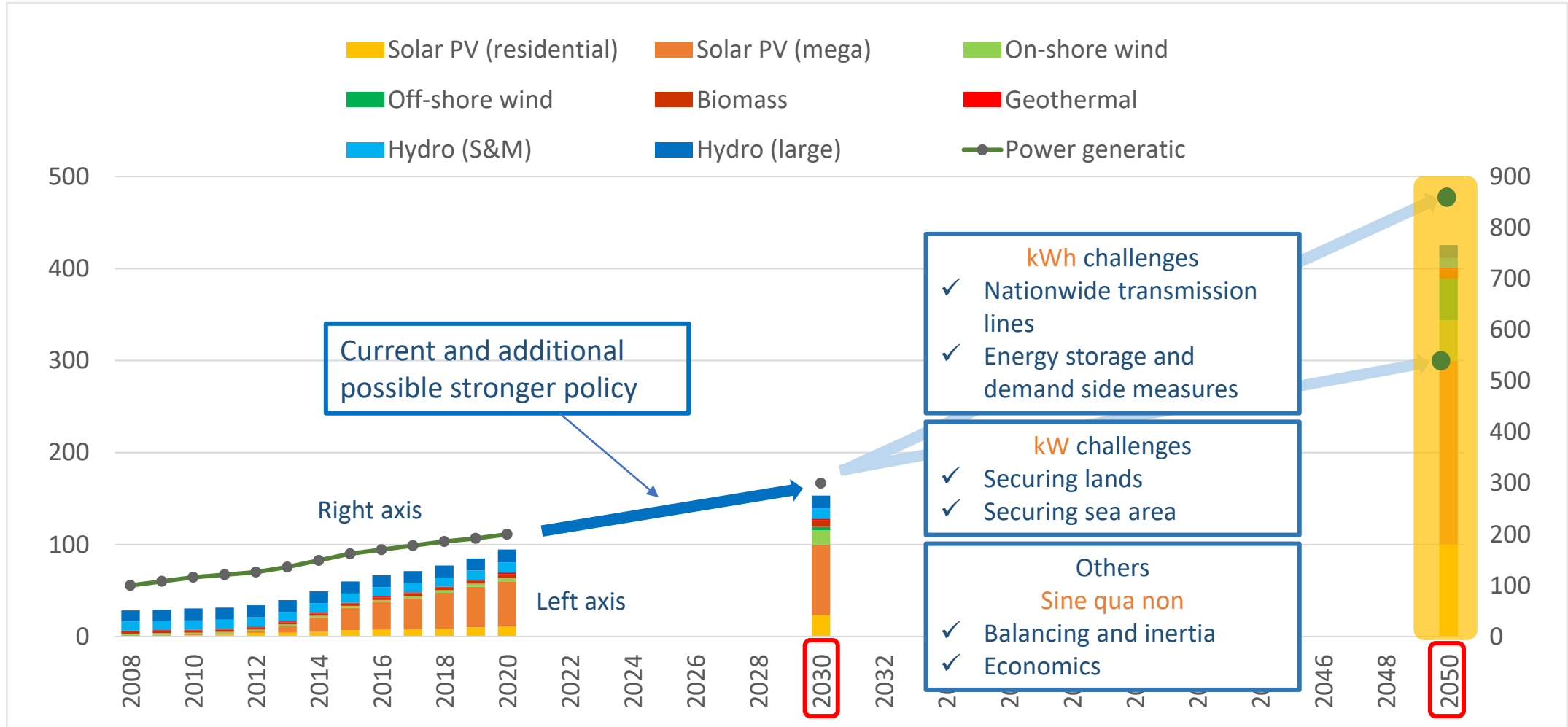


Examples of JPY150 trillion investment

Approximate amounts of investments over the next decade	
Renewable energy	JPY 20 trillion ~
Electricity grid • Balancing Capacity	JPY 11 trillion ~
Nuclear energy (R&D of innovative reactors, etc.)	JPY 1 trillion ~
Hydrogen and Ammonia	JPY 7 trillion ~
Steels	JPY 3 trillion ~
Chemicals	JPY 3 trillion ~
Cements	JPY 1 trillion ~
Paper/pulp	JPY 1 trillion ~
Automotive	JPY 34 trillion ~ (JPY 7 trillion ~ for Battery)
Circular	JPY 2 trillion ~
Zero-emission Housing and Buildings	JPY 14 trillion ~
Digital investment for decarbonization	JPY 12 trillion ~
Aircraft industries	JPY 5 trillion ~
Maritime industries	JPY 3 trillion ~
Bio manufacturing	JPY 3 trillion ~
Carbon recycling fuel	JPY 3 trillion ~
CCS	JPY 4 trillion ~

Challenge & Opportunity: Renewables

- 330-350TWh in 2030 by the current and the additional stronger policies
- Toward 2050 is unknown horizon. A variety of challenges face, kW and kWh.

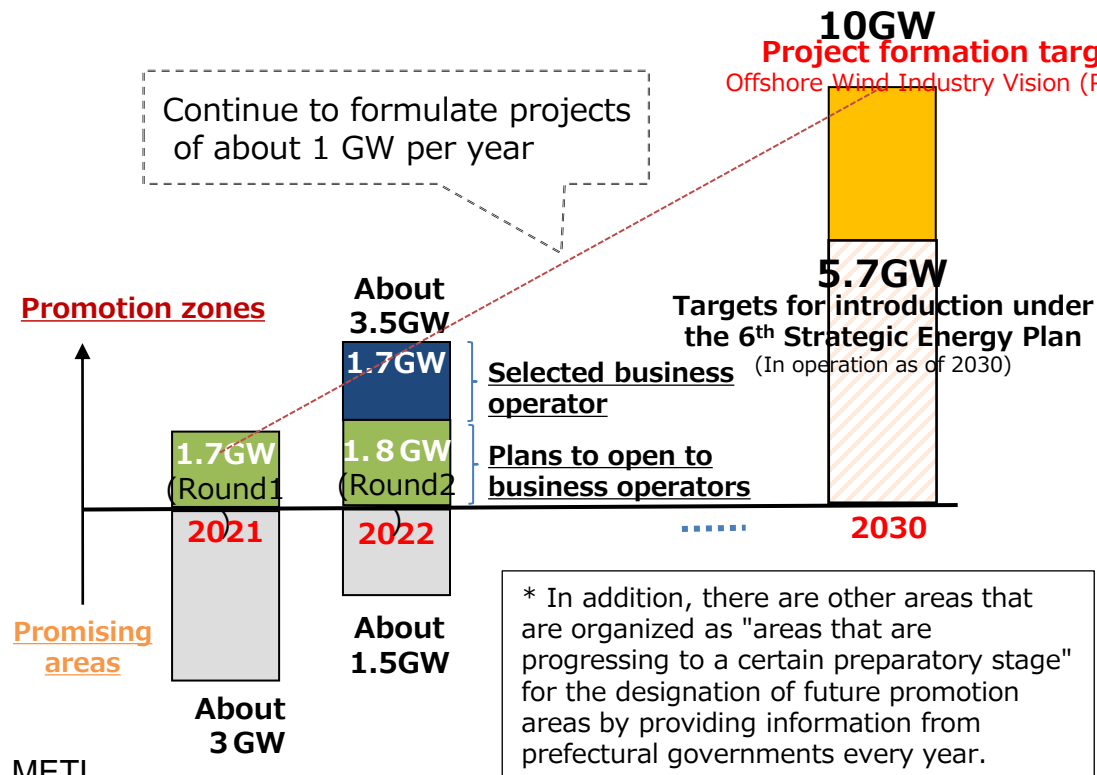


Source: IEEJ

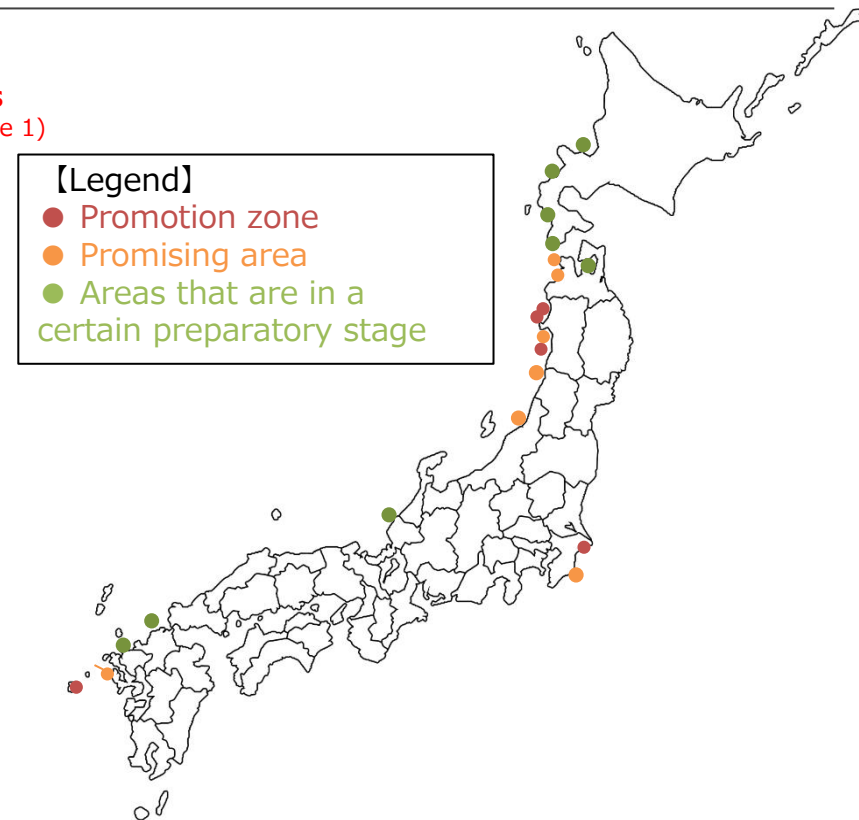
Offshore wind power

- The Act on Promoting the Utilization of Sea Areas for the Development of Marine Renewable Energy Power Generation Facilities to license sea areas for 30 years (enforced on April 1, 2019).
- The "Offshore Wind Industry Vision (Phase 1)" (December 2020) set targets of appr. 1 GW/year of projects, total 10 GW by 2030 and 30~45 GW by 2040.

Image of project formation to achieve goals



Promotion Zones



Next-generation solar PV : Perovskite solar cell

- Includes a perovskite (calcium titanate)-structured compound, most commonly a hybrid organic-inorganic material
- Developed in Japan
- Conversion efficiency doubled in 7 years (2014→2021)
- Lightweight, flexible and printable (applicable to various buildings)

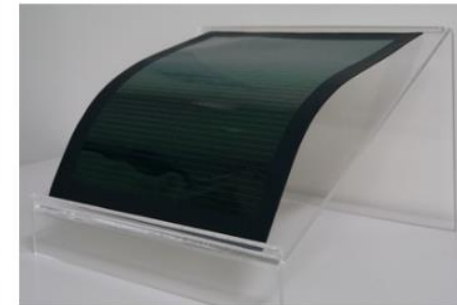
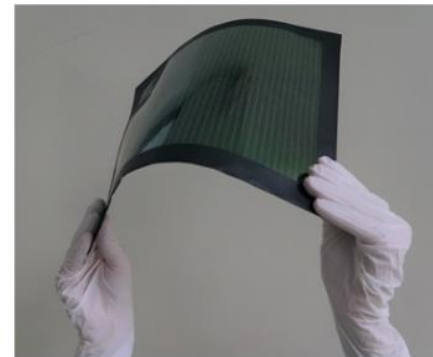
Perovskite solar cell module

(804cm², conversion efficiency: 17.9%)



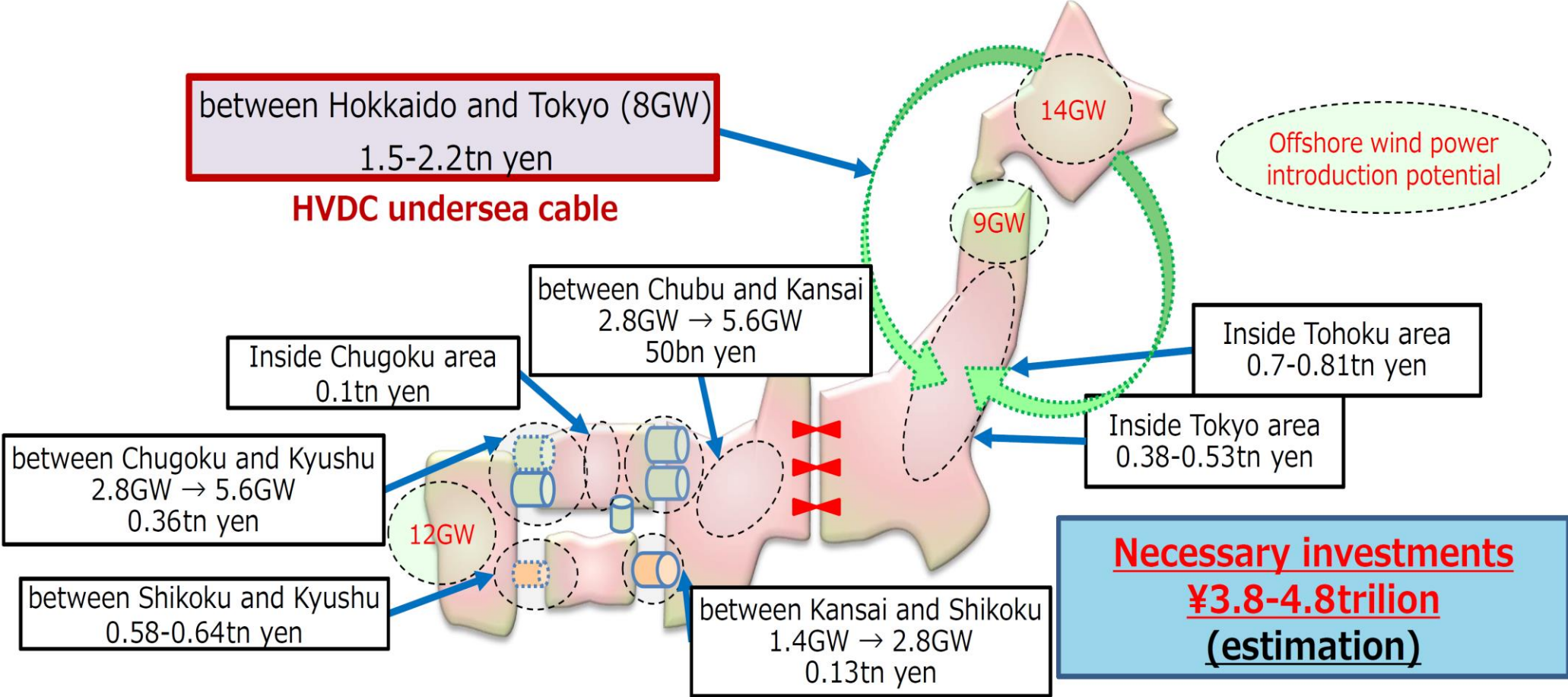
Film-based perovskite photovoltaic module

(703cm², conversion efficiency: 16.6%)



Challenge & Opportunity: Upgrading grids

Outline of the first draft of the Master-plan

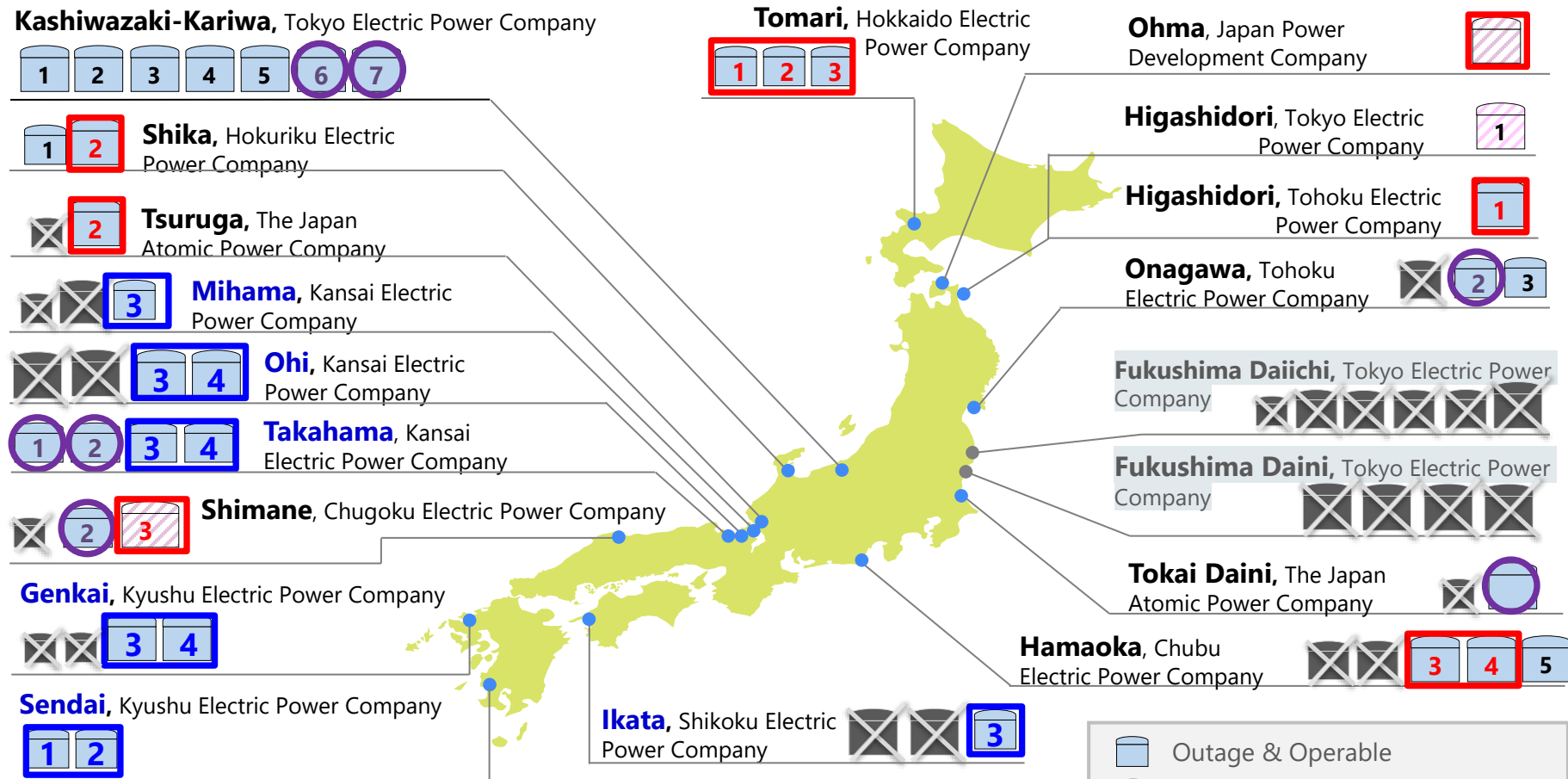


Source: IEEJ

Challenge & Opportunity: Nuclear Power in Japan

(As of May 26, 2023)

Restarted **10** Passed review **7** Under review by NRA **10** Not applied for review **9** To be decommissioned **24**

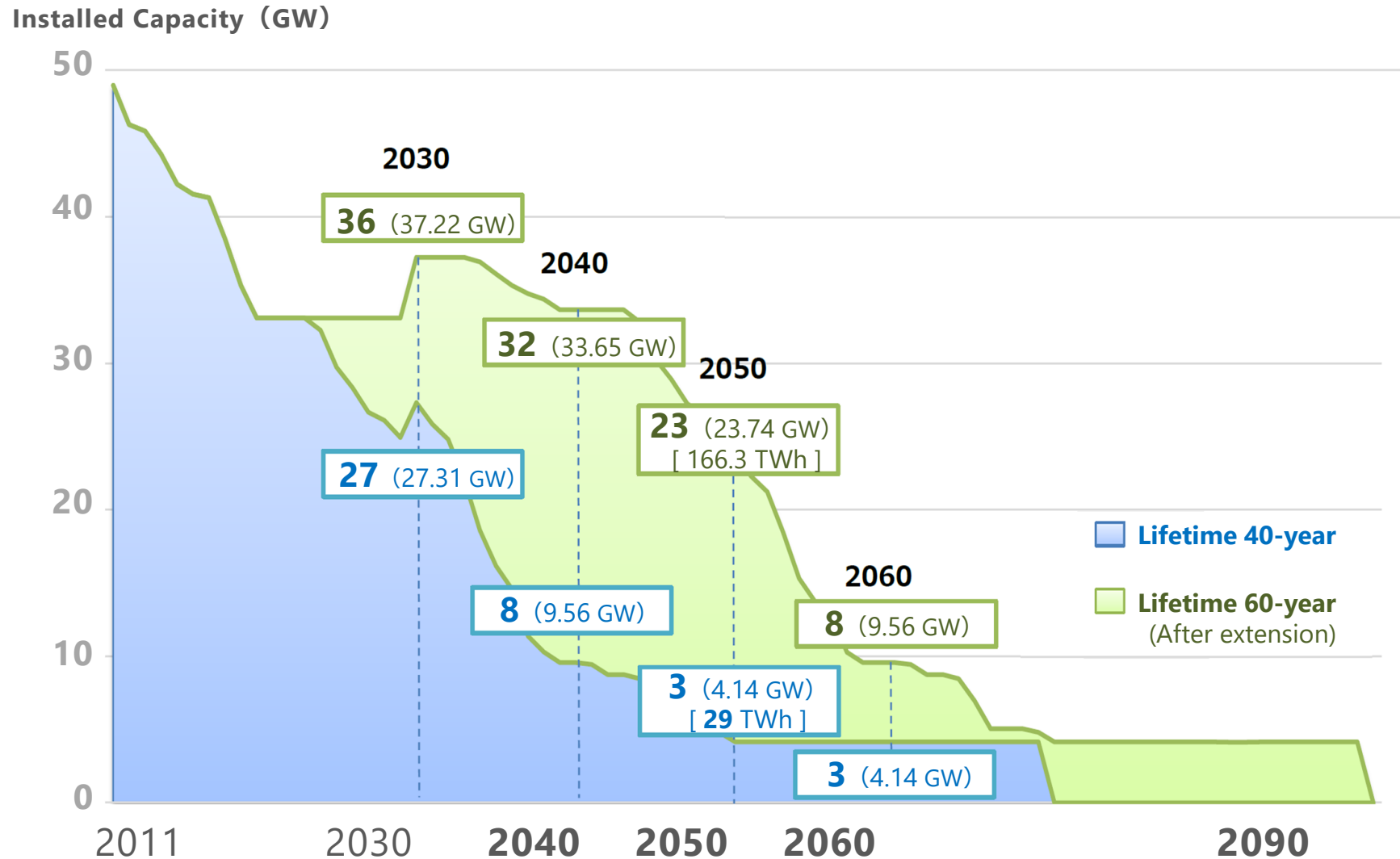


Source: Compiled by IEEJ, based on "Current status of nuclear power plants" The Agency for Natural Resource and Energy (ANRE), May 26th, 2023

- Outage & Operable
- Under construction
- Decided to be decommissioned

Operation outlook of Japan's nuclear reactors

(Lifetime of 40 years/ Lifetime of 60 years)

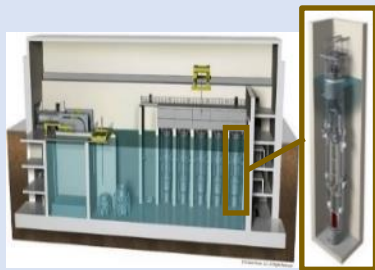


Nuclear Innovation

- Through **NEXIP** and other programs, METI supports various types of nuclear reactor technologies including **international cooperation projects**.
- The Japan Atomic Energy Agency (JAEA) possess **important test facilities**.

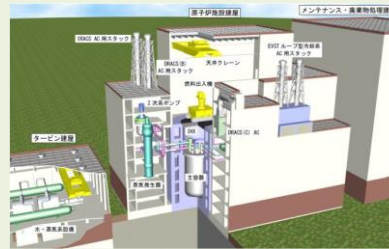
Small Modular LWR

- Smaller size, modular type
- Passive safety
- ➔ ✓ Affordable capital cost
- ✓ Smaller EPZ



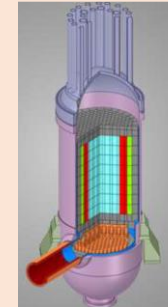
Fast Reactor

- Sodium-cooled reactor
- Fast neutrons
- ➔ ✓ Effective use of resources
- ✓ HLW management



High Temperature Gas-cooled Reactor

- Helium gas-cooled reactor (chemically stable)
- Coated particle fuel
- Very high temperature
- ➔ ✓ Heat/hydrogen use
- ✓ Smaller EPZ



France



Fast reactor R&D cooperation based on simulations and experiment

U.K.



High-temperature Gas-cooled Reactor

U.S.



Versatile Test Reactor (VTR) cooperation

International Cooperation

Joyo:
Experimental Fast Reactor

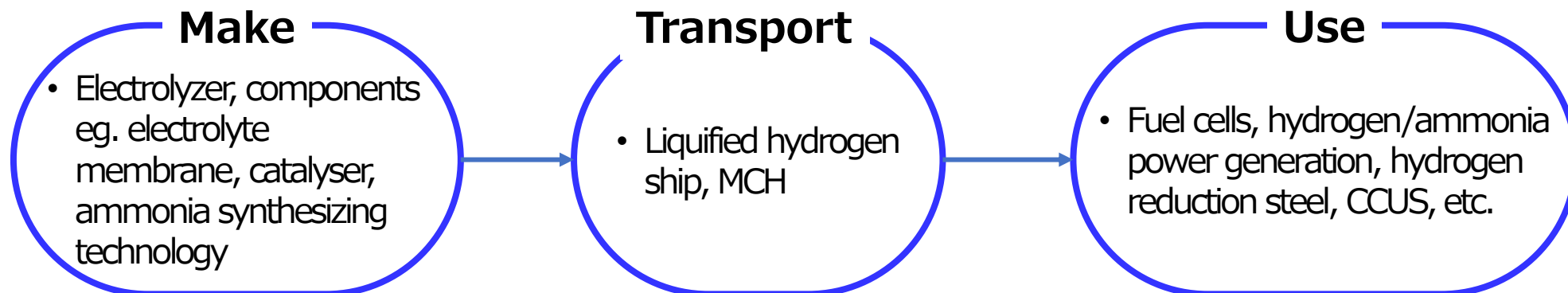
HTTR:
Experimental HTGR

JAEA's Facilities

Hydrogen & Ammonia

● Revised Basic Hydrogen Strategy (June, 2023)

- ✓ **Supply: 3 Mt in 2030, 12 Mt in 2040, 20 Mt in 2050 (currently 2 Mt)**
- ✓ **Cost: 30 yen/Nm³ in 2030, 20 yen/Nm³ in 2050 (currently 100 yen/Nm³)**
- ✓ **Japanese electrolyzer capacity (in and out Japan): 15 GW by 2030**
- ✓ **Support on supply-chain build up and supply infrastructure development**
- ✓ **Transition to low carbon hydrogen based on G7 agreed carbon intensity (regardless of the colors)**

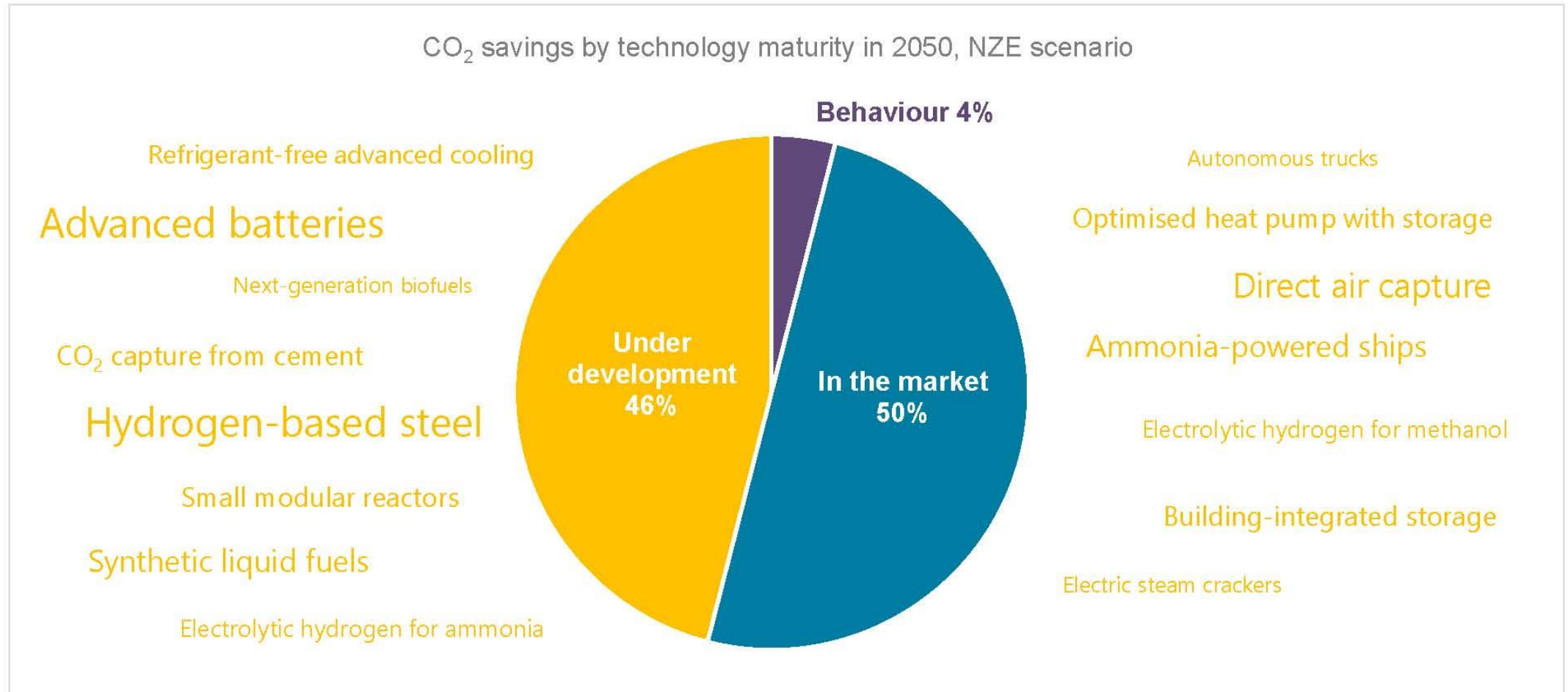


Hydrogen's roles in non-power sectors

Sector	Hydrogen utilization
Steel	Hydrogen direct reduction; Hydrogen -based fuel (such as synthetic methane)
Chemical	Hydrogen -based feedstock; Hydrogen -based fuel (such as synthetic methane)
Aviation	Hydrogen -based fuel (Sustainable Aviation Fuel: SAF)
Maritime Transportation	Clean ammonia or clean methanol produced from hydrogen
Land transportation	Fuel-cell vehicles (FCV); FC Truck/Bus; E-fuel based on Fischer-Tropsch synthesis with clean hydrogen

Technology & Innovation

It is important to accelerate innovation and prepare for the next generation of further actions.



In order to realize the practical use of next-generation low-carbon technologies, it is important to accelerate technology development and promote demonstration facts on the scale of **90 billion dollars by 2030**. To achieve this, more international cooperation is essential.

International Cooperation: G7

G7 Climate, Energy, and Environment Ministerial, 15-16 April, Sapporo



G7 Leaders' Summit, 19-21 May, Hiroshima



2023 Hiroshima G7 Leaders Communique (Para 19)

(Various and Practical pathways)

We will engage with developing and emerging countries to accelerate emission reduction, including by supporting their transitions to climate resilient, circular, and nature positive economies and net-zero GHG emissions through various and practical pathways taking into account national circumstances.

(Green transformation)

Noting the importance of increasing the pace and scale of action on climate change, biodiversity loss and clean energy transitions, we will globally advance and promote a green transformation, working together to realize transformation of our economies to reach net-zero GHG emissions by 2050 at the latest.

(Asia Zero Emission Community (AZEC) Initiative)

We take note of initiatives that are intended to support clean energy transition in countries around the world, such as Asia Zero Emission Community (AZEC) initiative, the Powering Past Coal Alliance (PPCA), 2050 Pathways Platform, Net Zero World (NZW), and the Global Carbon Pricing Challenge and underscore the importance of actions taken through such initiatives being aligned with a 1.5°C pathway.

International Cooperation: Asia Zero Emission Community (AZEC)

- PM Kishida announced an “Asia Zero Emission Community” (AZEC) idea in January 2022. The first Ministerial meeting was held in March 2023.
- AZEC aims for **energy transitions tailored to circumstances of each Asian country** actively pursuing carbon neutrality.
- AZEC is a **platform consisting of Asian countries promoting decarbonization**. Japan intends to contribute to AZEC by **providing support on technology, finance, and human resources** through AETI, JCM, etc., and by **policy coordination** with partner countries. AZEC aims to support new technologies and reduce costs through market expansion.

Examples of supports

- **Financial support by JBIC, NEXI, JICA, etc.**
- **Assistance in developing roadmap** and long-term strategy for CN
- Establishment and dissemination of **Asia Transition Finance**
- **Development, demonstration, and deployment of decarbonization technologies** such as renewable energy, energy saving, hydrogen, ammonia, biomass, and CCUS

Examples of policy coordination

- Share information on **maximizing deployment renewable energies**
- **Establish standards** for energy conservation, energy management, and other decarbonization technologies
- **Share the direction** of utilization of bio-energy, hydrogen, ammonia, etc. in the field of thermal power generation.
- Consider of **effective utilization of power grids**

International Cooperation: JUCEP

- **JUCEP** was established under the two partnerships of the “Japan-U.S. Competitiveness and Resilience (CoRe) Partnership” and the “Japan-U.S. Climate Partnership on Ambition, Decarbonization, and Clean Energy” announced at the Japan-U.S. summit meeting in April, 2021.
- JUCEP is a framework to help Indo-Pacific countries utilize **clean, affordable and secure energy technologies to accelerate decarbonization while promoting a stable energy supply and sustainable growth**. It aims to contribute to the realization of the “Free and Open Indo-Pacific (FOIP)” through an open, competitive and transparent energy markets.

<Key Cooperation Areas>

1. **Renewable Energy**: Geothermal, wind, solar, hydropower, and critical minerals
2. **Power Grid Modernization**: Grid stability, energy management technology including battery storage, and transmission
3. **Nuclear Energy**: Advanced technologies such as small modular reactors and light water reactors.
4. **Decarbonization technologies**: CCUS/Carbon Recycling and other abatement technologies, as well as advanced fuels like ammonia, hydrogen, and others

Conclusion

- Japan's goals of Carbon Neutrality by 2050 and 46% reduction by 2030 are extremely tough, but must challenge and make opportunity
- Toward 2030, existing technologies have to be deployed with utmost political, industrial and the public efforts
- Toward 2050, Japan, as a technology leader, has to contribute to the world with new technology development
- International cooperation is key for both global emission reduction on cost-effective basis and technology development
- Japan is committed to “Asia Zero Emission Community”