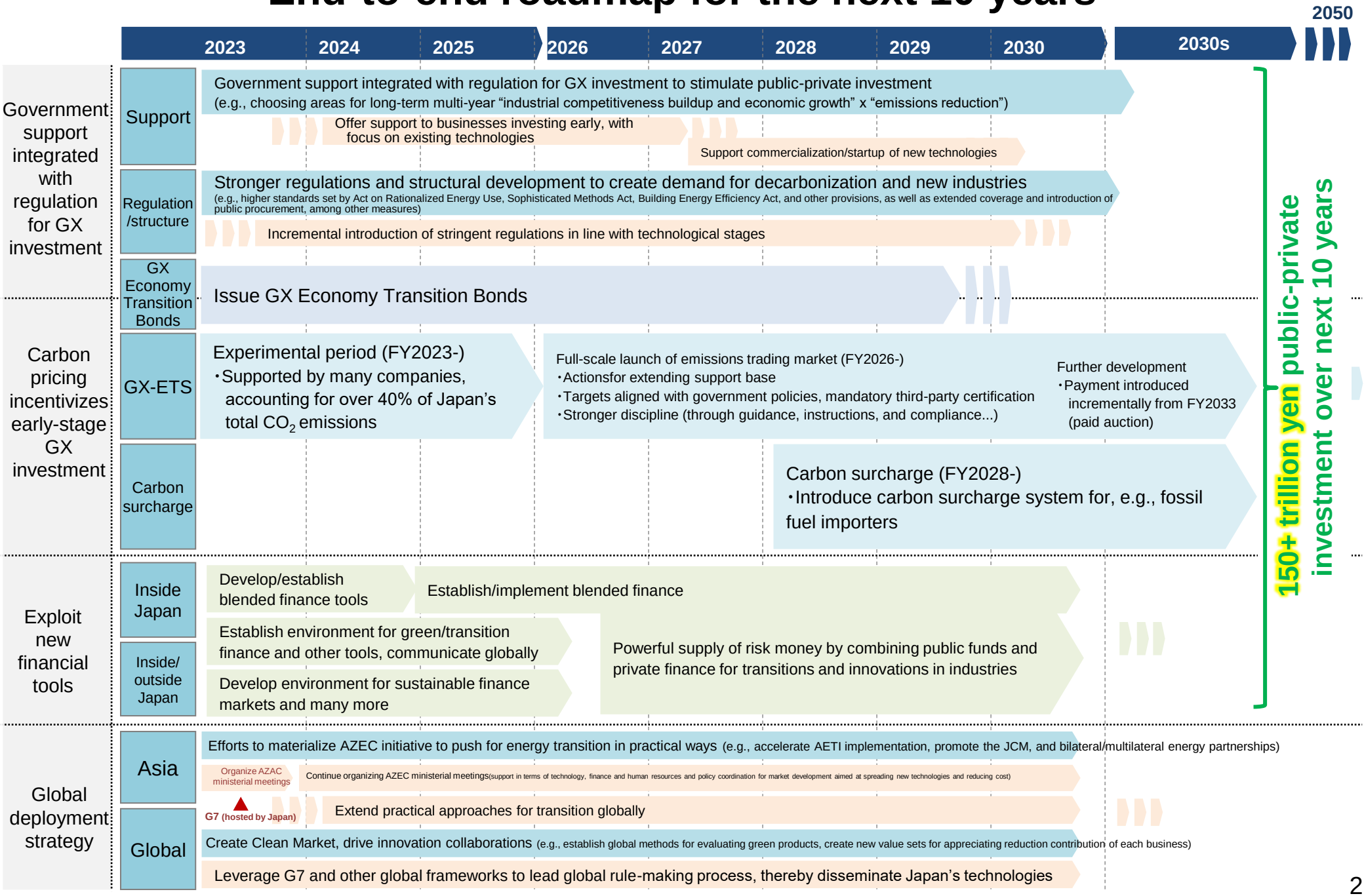
Provisional Translation

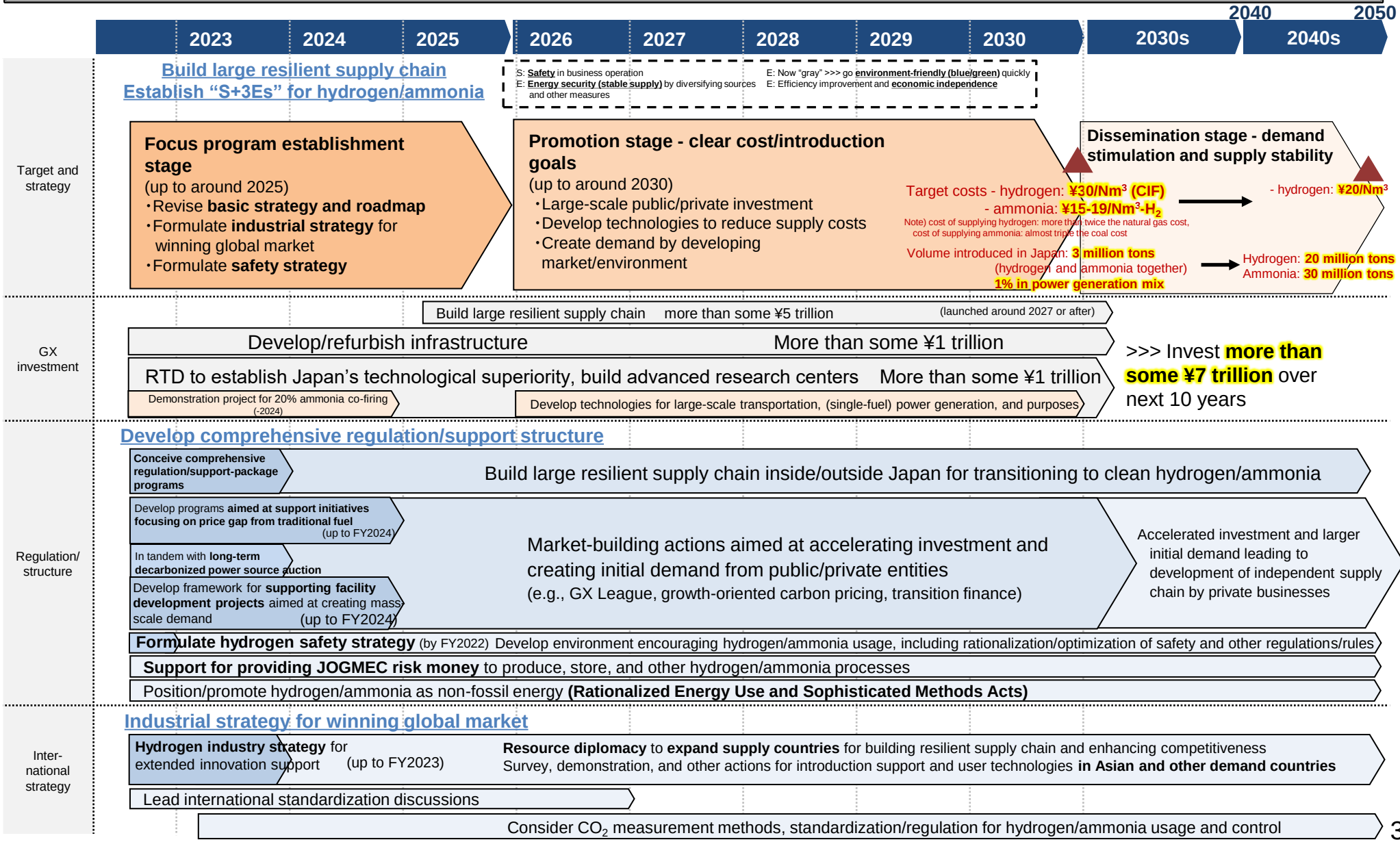
The Basic Policy for the Realization of GX : Reference document

End-to-end roadmap for the next 10 years



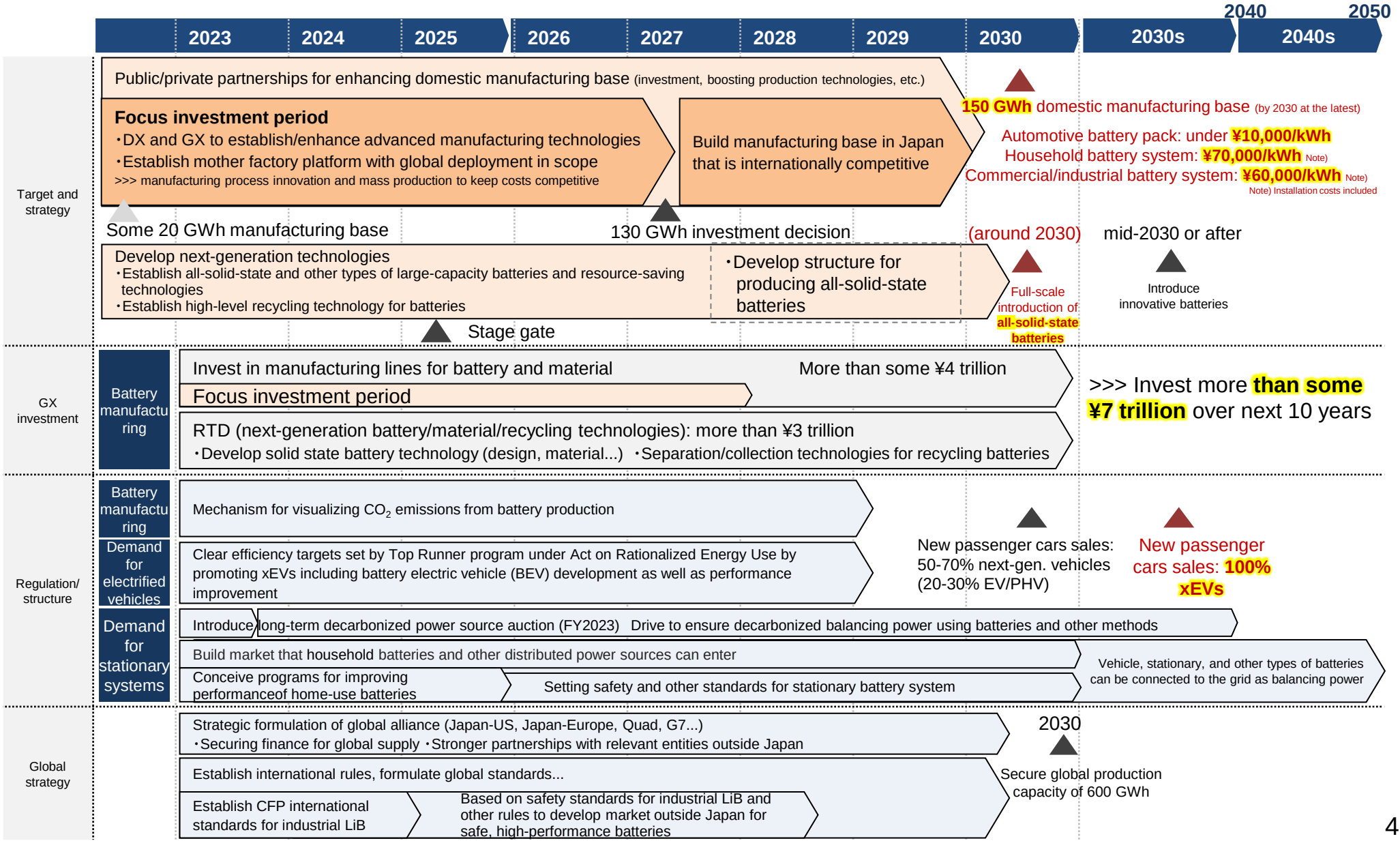
<Future milestones> Case 1: Hydrogen and ammonia

■ Domestic targets for hydrogen/ammonia introduction: 3 million tons (ammonia equivalent) each by 2030, 20 million tons hydrogen and 30 million tons ammonia (ammonia equivalent) by 2050. Exploit support programs for building supply chains and establishing facilities over the next 10 years to create large and resilient supply chain (for production/transportation/utilization).



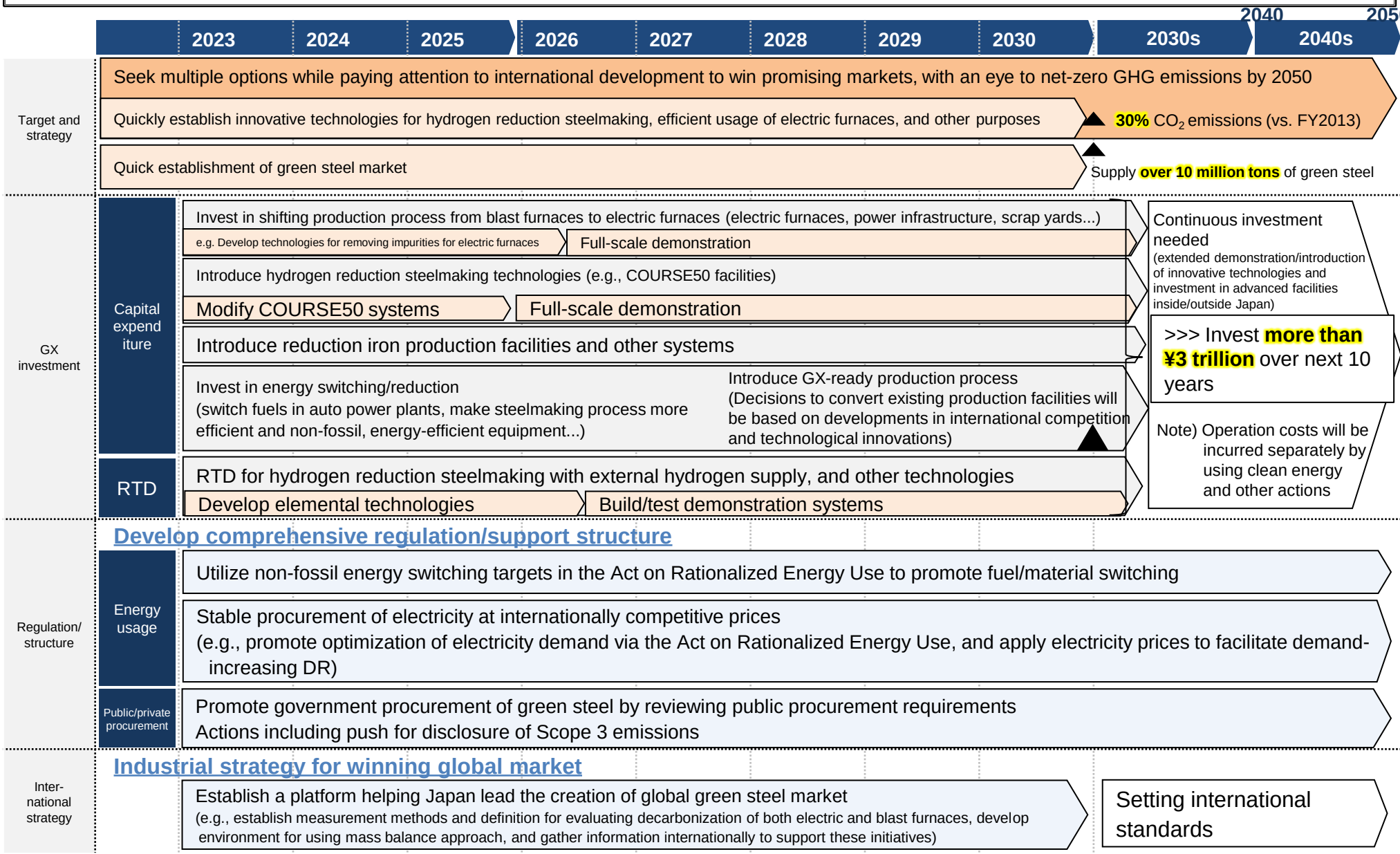
<Future milestones> Case 2: Battery industry

■ Target is to establish a domestic annual manufacturing base of 150 GWh of batteries by 2030. Use Act on Rationalized Energy Use and other tools to approach demand side to create demand over the next 10 years, also focus on investment for battery manufacturing base over the next five years.



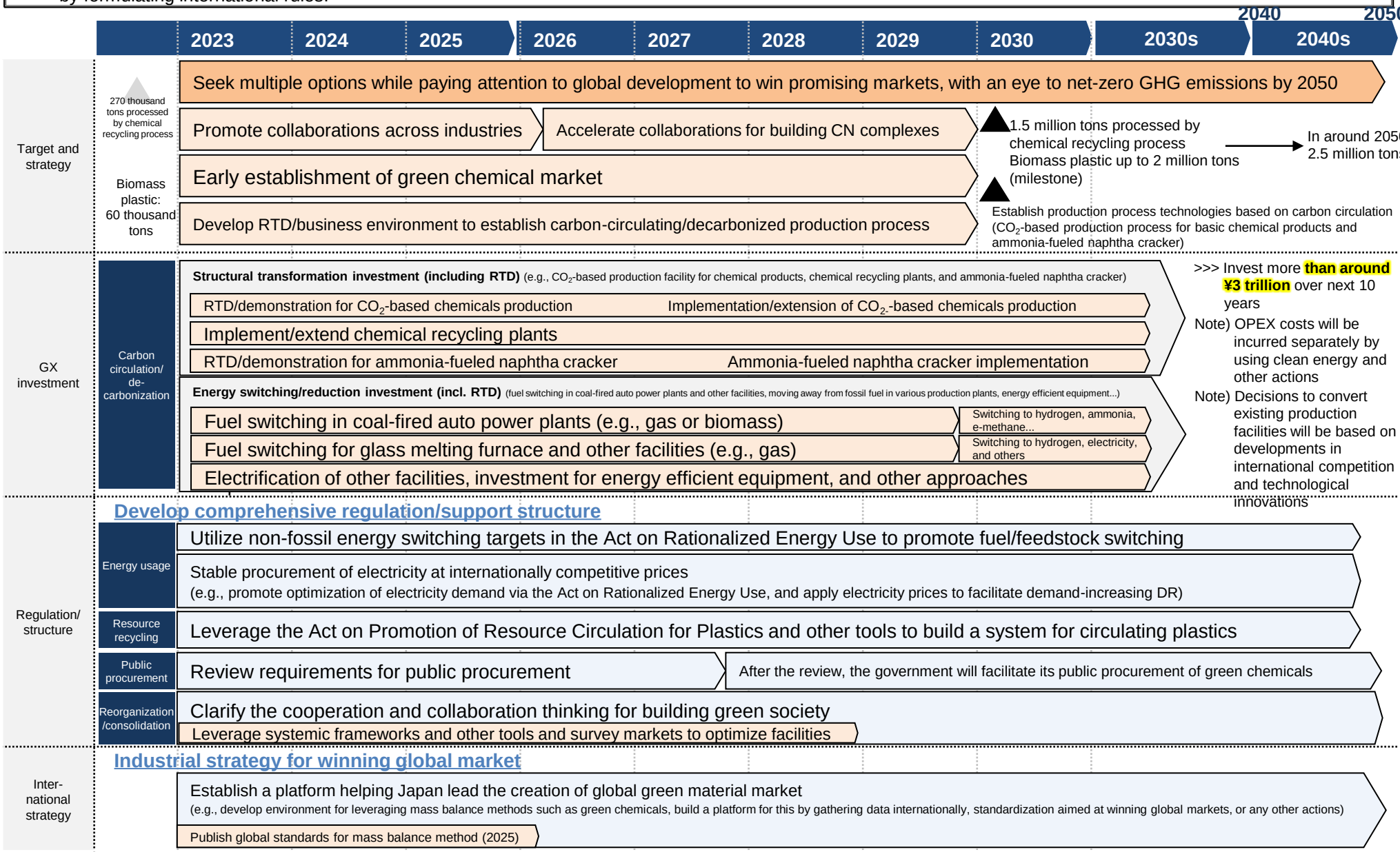
<Future milestones> Case 3: Iron and steel industry

■ Clear the target of supplying 10 million tons of green steel in 2030 by leveraging the Act on Rationalized Energy Use, GX investment in step with structural reforms, and other measures to promote fuel/material switching (e.g., shifting to electric furnaces) while procuring electricity priced at internationally competitive levels and winning global market shares through formulation of international rules.



<Future milestones> Case 4: Chemical industry

■ In order to complete structural transformation to green chemicals (e.g., processing 2.5 million tons in 2050) leverage the Act on Rationalized Energy Use, GX investment support in step with structural reforms, and other tools over the next 10 years to promote fuel/feedstock switching (e.g., carbon cycling by chemical recycling) while building a circulation system for plastic resources using the Act on Promotion of Resource Circulation for Plastics, reaching out to the global market by formulating international rules.



<Future milestones> Case 5: Cement industry

■ In order to complete structural transformation to carbon-recycling cement (e.g., supplying 2 million tons in 2030), leverage the Act on Rationalized Energy Use, GX investment support in step with structural reforms, and other tools over the next 10 years to promote fuel/material switching (e.g., transformation to cement production process using CO_2 capture method) while creating predictable demand through public procurement and other approaches and reaching out to the global market by formulating international rules.

2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2030s (2040) | 2040s (2050)

Target and strategy

Win carbon-recycling cement market

CO_2 emissions: −11.6% vs. 2013

- Seek multiple options while paying attention to global development to win promising markets, with an eye to net-zero GHG emissions by 2050
- Stronger competitiveness by collaborations across industries to build CN society → CO_2 emissions: -15% vs. 2013
- Carbon-recycling cement market established quickly → Carbon recycled cement 2 million tons → In around 2050 18 million tons
- Develop RTD/business environment to establish carbon-circulating/decarbonized production process → Social implementation of CO_2-capturing cement production technologies

GX investment

Carbon circulation/ decarbonization

Structural transformation investment (including RTD) (e.g., CO_2-capturing cement production facilities)

- Develop/demonstrate CO_2-capturing cement production process
  - Social implantation/extension of CO_2-capturing cement production process
  - Other CCU facilities (e.g., methanation)

>>> **Invest more than around ¥1 trillion** over next 10 years

Energy switching/reduction investment (incl. RTD) (fuel switching in coal-fired auto power plants and other facilities, moving away from fossil fuel in various production plants, energy efficient equipment...)

- Fuel switching in coal-fired auto power plants (e.g., gas or biomass) → Switching to e-methane, ammonia...
- Electrification of other facilities, investment for energy efficient equipment, and other approaches

Note) Operation costs will be incurred separately by using clean energy and other actions

Regulation/ structure

Develop comprehensive regulation/support structure

Energy usage
- Utilize non-fossil energy switching targets in the Act on Rationalized Energy Use to promote fuel/material switching
- Stable procurement of electricity at internationally competitive prices (Promote optimization of electricity demand leveraging the Act on Rationalized Energy Use and other actions)

Resource recycling
- Build raw material and fuel system for cement by waste recycling

Public procurement
- Review requirements for public procurement — Push for government procurement of carbon-recycling cement and CO_2 reduction concrete

Inter-national strategy

Industrial strategy for winning global market

- Establish a platform helping Japan lead the creation of global market for carbon-recycling cement (Examples: standardize volumes for capturing/storing CO_2, develop environment for promoting the use of green cement and concrete with eco-friendly additives, and gather information internationally to support these initiatives as well as standardize for winning global market)
- Build upon the success of Japanese NSP kiln models, aim to sell technological licenses and standardize volume of captured CO_2

<Future milestones> Case 6: Pulp/paper industry

■ In order to complete structural transformation of pulp/paper industry (e.g., switch to bio-refineries), leverage the Act on Rationalized Energy Use, GX investment support in step with structural reforms, and other tools over the next 10 years to promote fuel/material switching while creating predictable demand through public procurement and other approaches and reaching out to the global market by formulating international rules.

2023 2024 2025 2026 2027 2028 2029 2030 2030s 2040 2040s 2050

Target and strategy

CO_2 emissions: −15.9% vs.2013

Seek multiple options while paying attention to global development to win promising markets, with an eye to net-zero GHG emissions by 2050

Stronger competitiveness by new collaborations across industries to build CN society

Early establishment of green material market

Develop RTD/business environment to establish bio-refineries in production process

▲ CO_2 emissions: 38% reduction from 2013

▲ CNF composite material Market size ¥2 trillion → 2050 ¥6 trillion

GX investment

Carbon circulation/ de-carbonization

Structural transformation investment (including RTD)
(e.g., investment for bio-refinery transformation, investment for CNF production facilities helping reduce fossil-based resin usage)

RTD/demonstration aimed at bio-refinery transformation → Implement/extend bio-refinery facilities

Social implementation and extension of CNF production facilities helping reduce fossil-based resin usage

Energy switching/reduction investment (incl. RTD) (fuel switching in private power stations and other facilities, building advanced energy supply/demand structure by renewing recovery boilers...)

Fuel switching in coal-fired auto power plants (e.g., gas or biomass) — Switching to hydrogen, ammonia, e-methane...

Building advanced energy supply/demand structure by renewing black liquor recovery boilers

Electrification of other facilities, investment for energy efficient equipment, and other approaches

>>> Invest more **than around ¥1 trillion** over next 10 years

Note) OPEX costs will be incurred separately by using clean energy and other actions

Note) Decisions to convert existing production facilities will be based on developments in international competition and technological innovations

Regulation/ structure

Develop comprehensive regulation/support structure

Energy usage

Utilize non-fossil energy switching targets in the Act on Rationalized Energy Use to promote fuel/material switching

Stable procurement of electricity at internationally competitive prices
(Promote optimization of electricity demand leveraging the Act on Rationalized Energy Use and other actions)

Public procurement

Review requirements for public procurement — Based on the result, push for introducing green material to government procurement

Inter-national strategy

Industrial strategy for winning global market

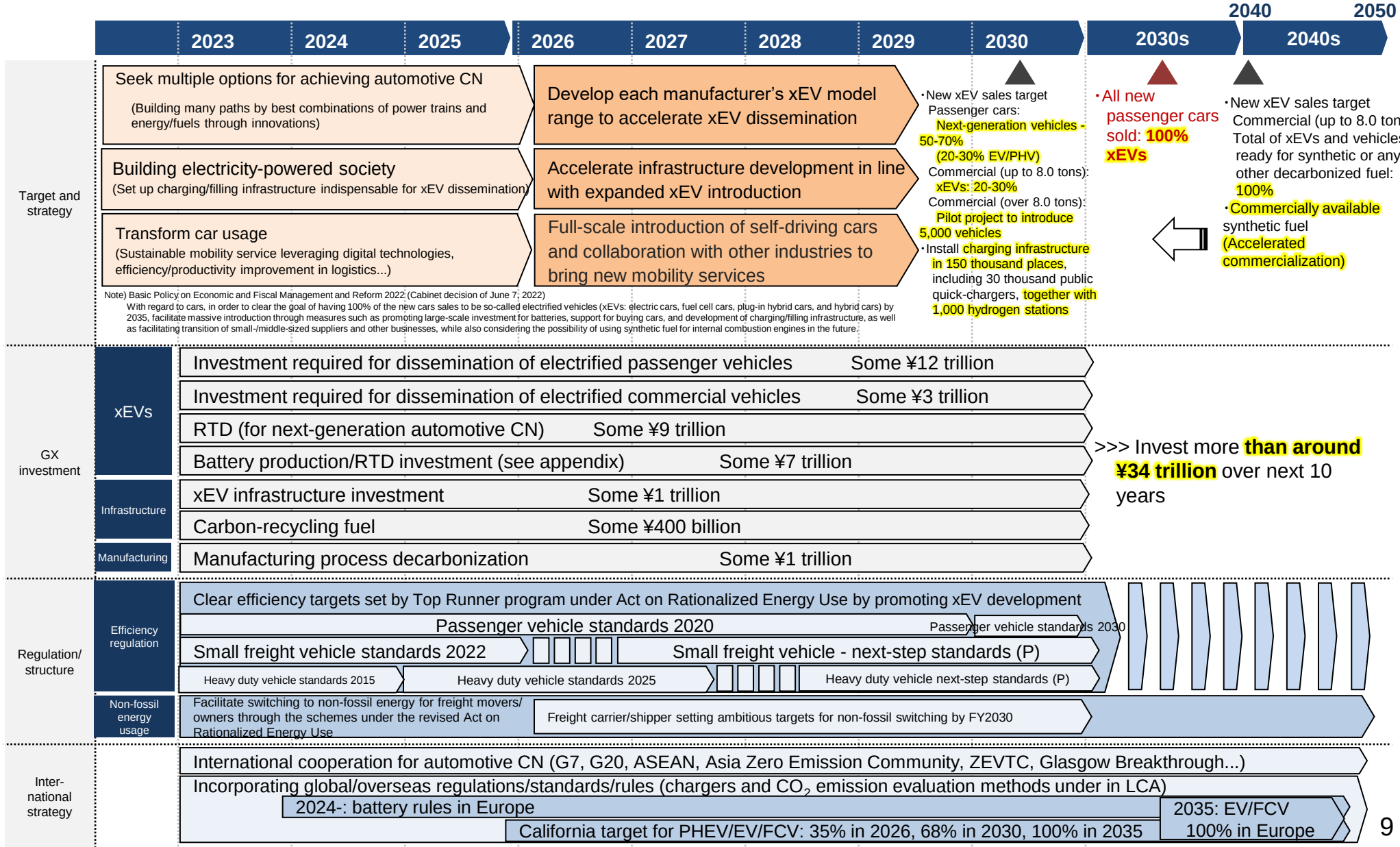
Establish a platform helping Japan lead the creation of global green material market
(examples: develop environment for leveraging bio-refineries, and gather information internationally to support these initiatives as well as standardize for winning global market)

Develop methods to evaluate CNF products' performance

For example, CNF market is expected to grow by being accepted as automotive parts, especially in advanced environment-friendly countries (in Europe and elsewhere) - seize this opportunity

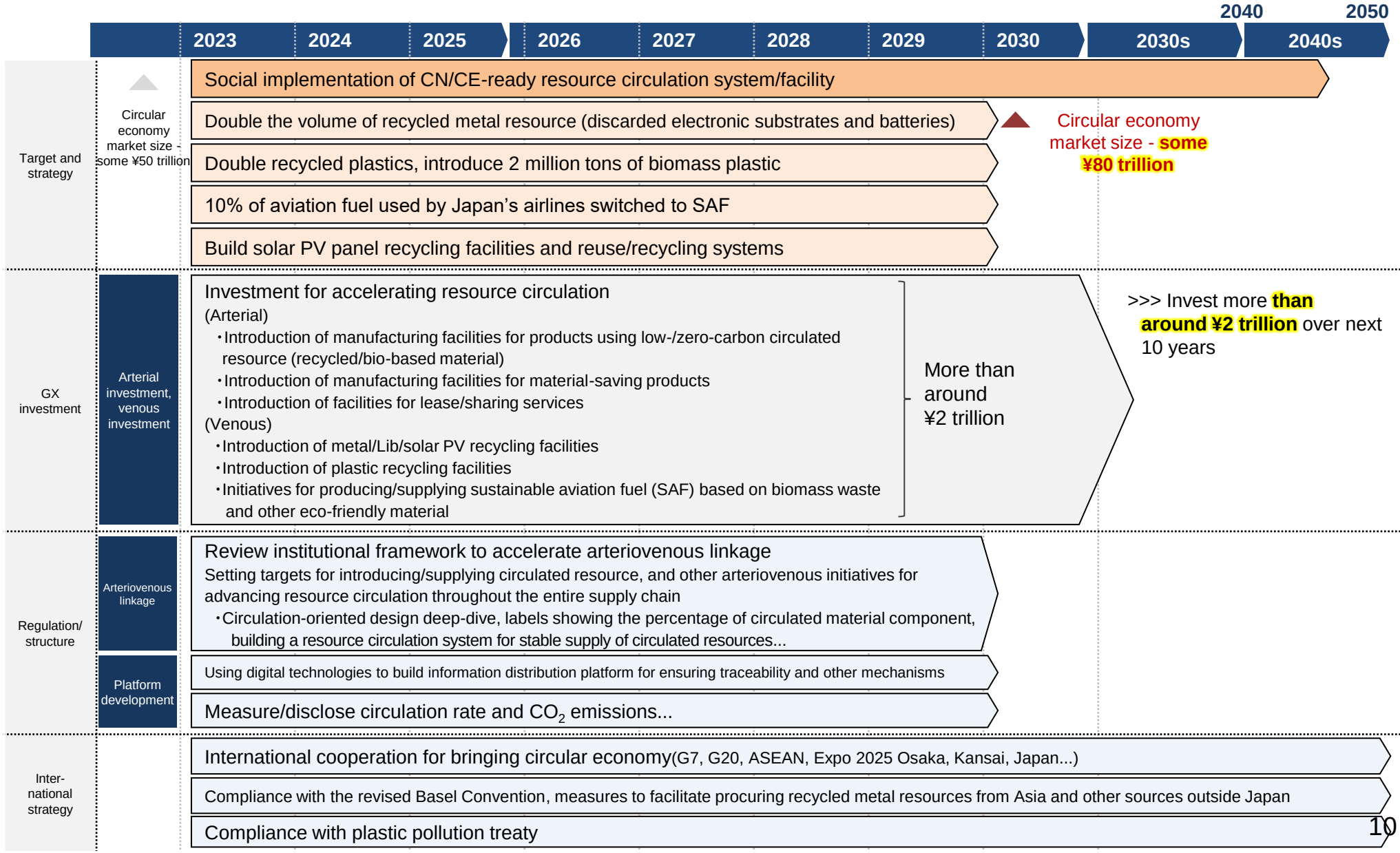
<Future milestones> Case 7: Automotive industry

■ Make automotive industry carbon neutral (example: new passenger cars sold in 2035 - 100% xEVs) by leveraging Act on Rationalized Energy Use and other tools over the next 10 years to facilitate investment in develop, improve performance, and introduce xEVs, while steadily adapting to international rules to reach out to the global market.



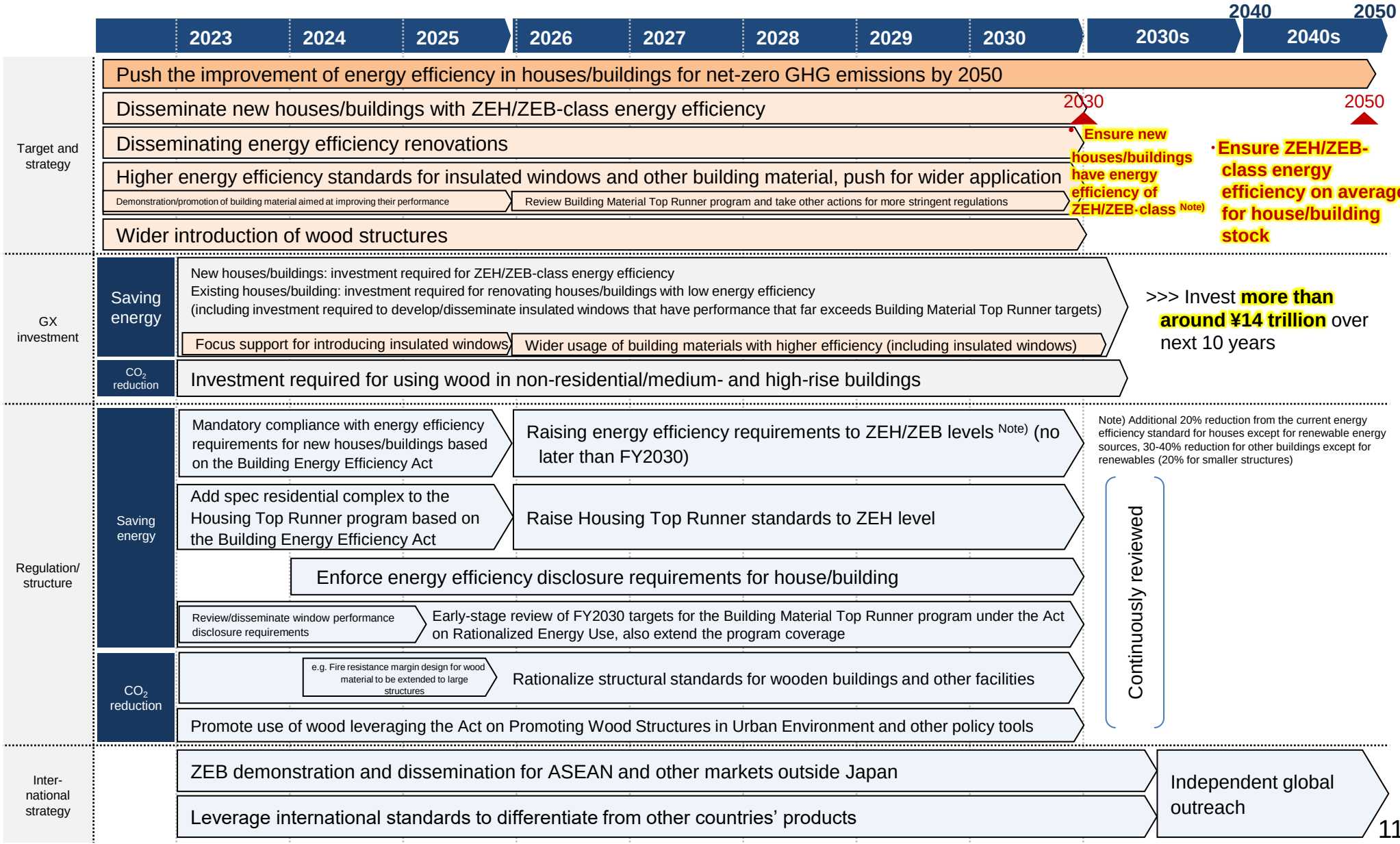
<Future milestones> Case 8: Resource circulation industry

■ To accelerate resource circulation by arteriovenous collaboration and establish an independent and resilient resource circulation system, build an information distribution platform and other mechanisms using digital technologies over the next 10 years, leading to the creation of resource circulating markets by reviewing institutional frameworks to accelerate arteriovenous collaboration and supporting GX investment in step with structural reforms.



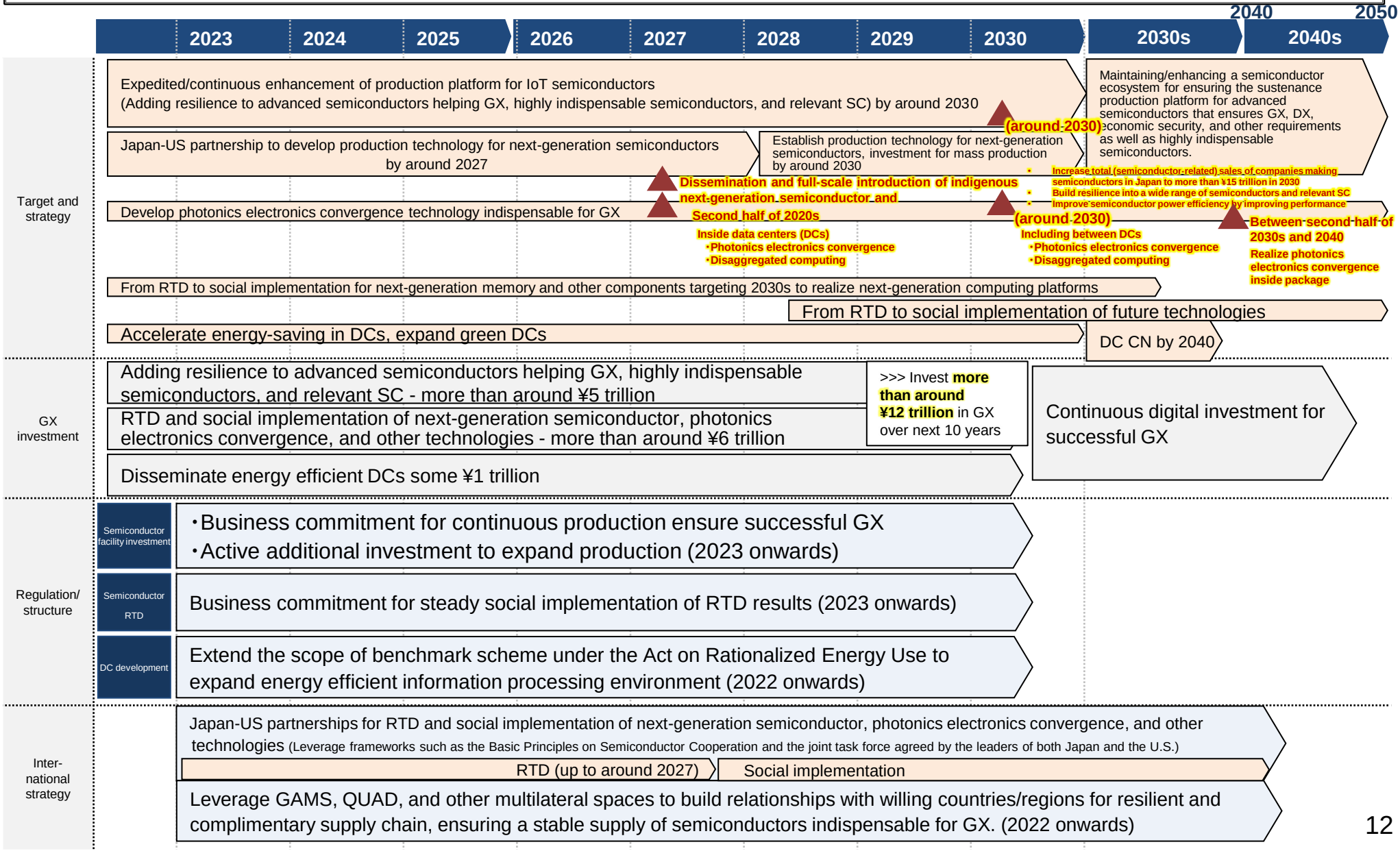
<Future milestones> Case 9: Houses/buildings

■ To realize houses/buildings fundamentally designed to use energy efficiently (e.g., new houses/buildings built in 2030 to have energy efficiency on par with ZEH/ZEB levels), extend/enhance regulation coverage over the next 10 years by leveraging the Building Energy Efficiency Act and other policy tools.



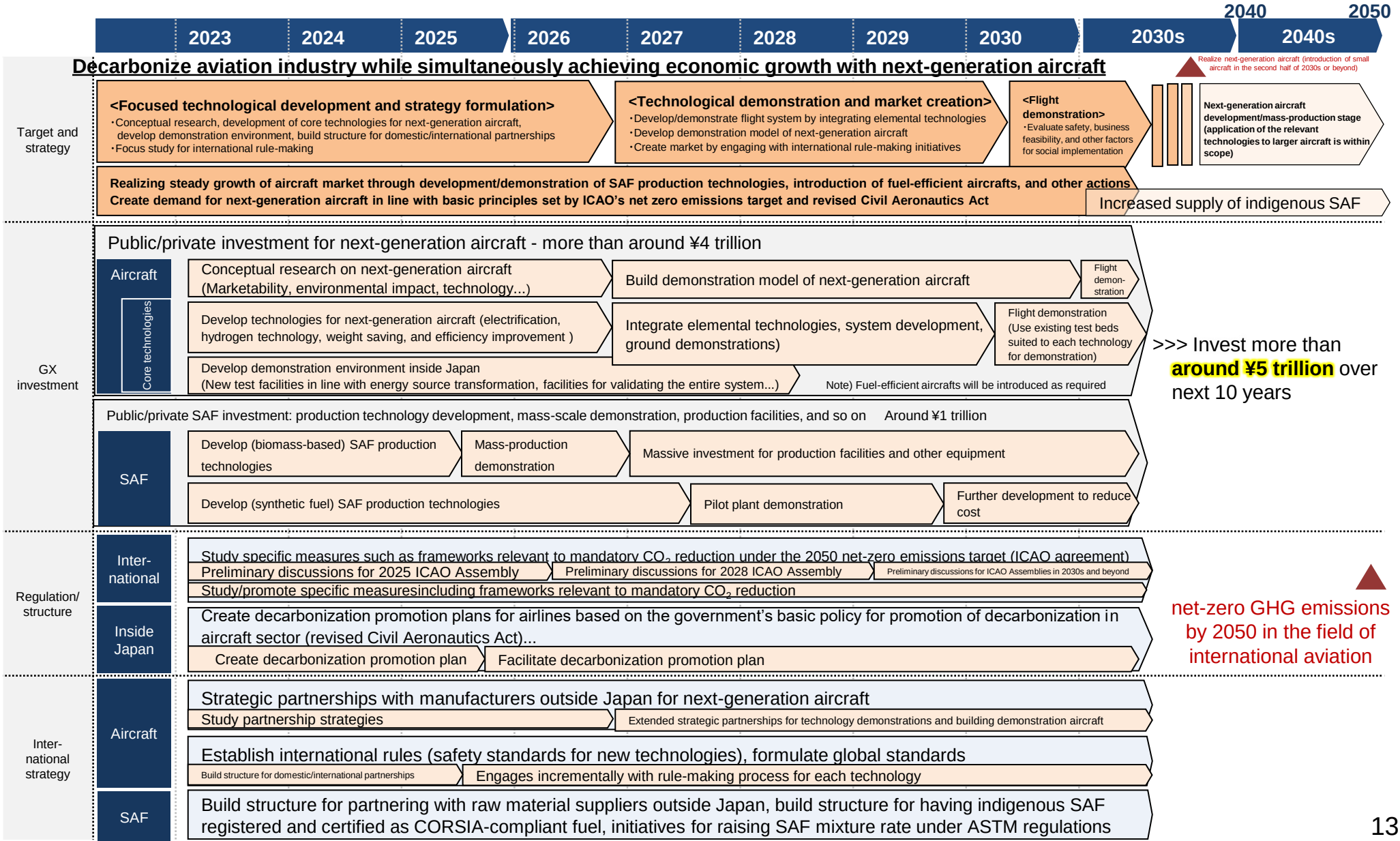
<Future milestones> Case 10: Digital investment aimed at decarbonization

■ In order to develop semiconductor industry, continuously invest in semiconductor business and relevant supply chains into 2030s for successful GX, and push for social implementation of next-generation semiconductor, photonics electronics convergence, and other future technologies. Furthermore, leverage these technologies to promote CN in data centers (DCs).



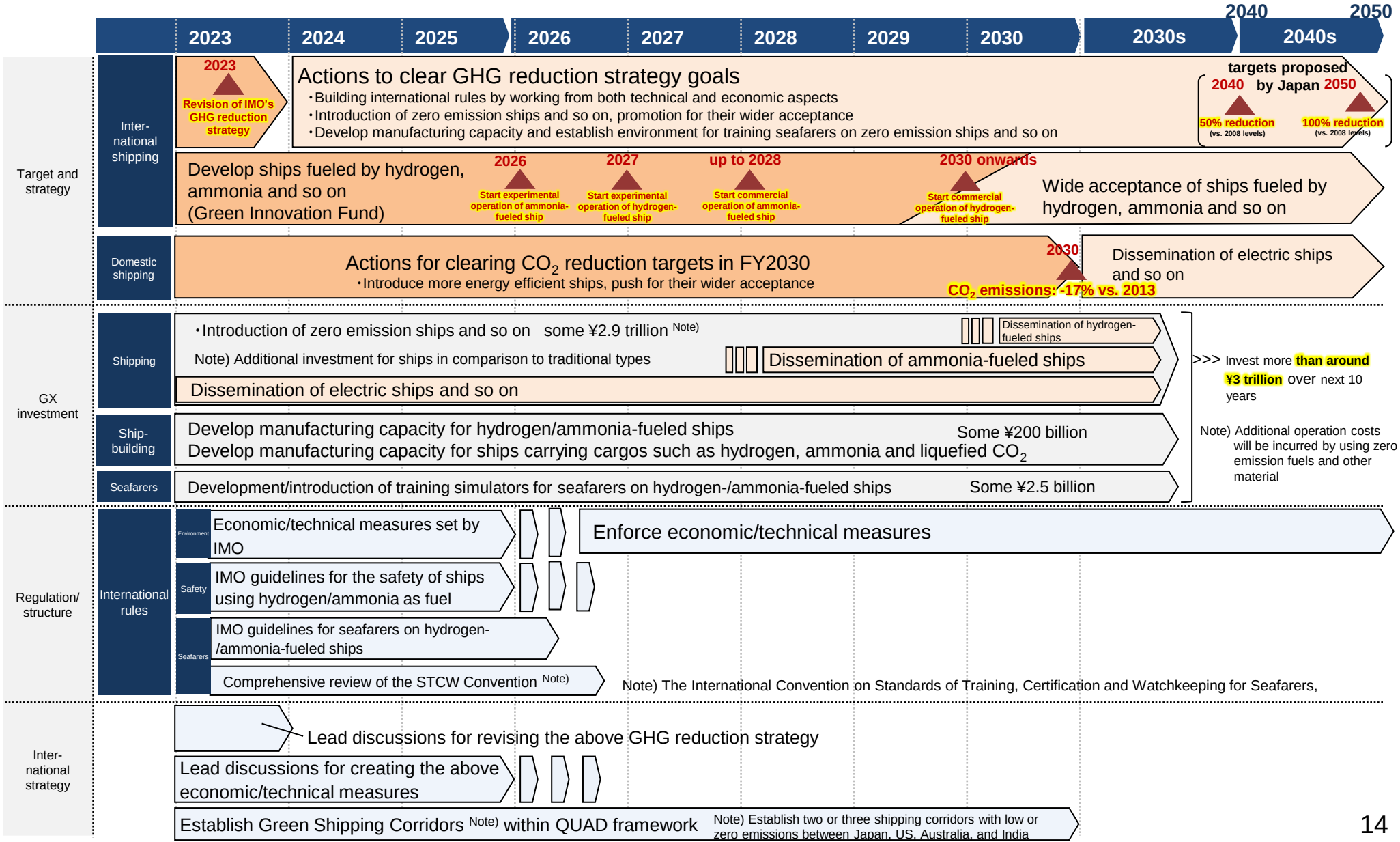
<Future milestones> Case 11: Aircraft industry

■ In order to decarbonize aircraft industry while simultaneously achieving economic growth with next-generation aircraft, develop demonstration model by 2030s and also take actions for establishing international rules as well as study specific measures such as frameworks relevant to mandatory CO_2 reduction under the 2050 net-zero emissions target (ICAO agreement).



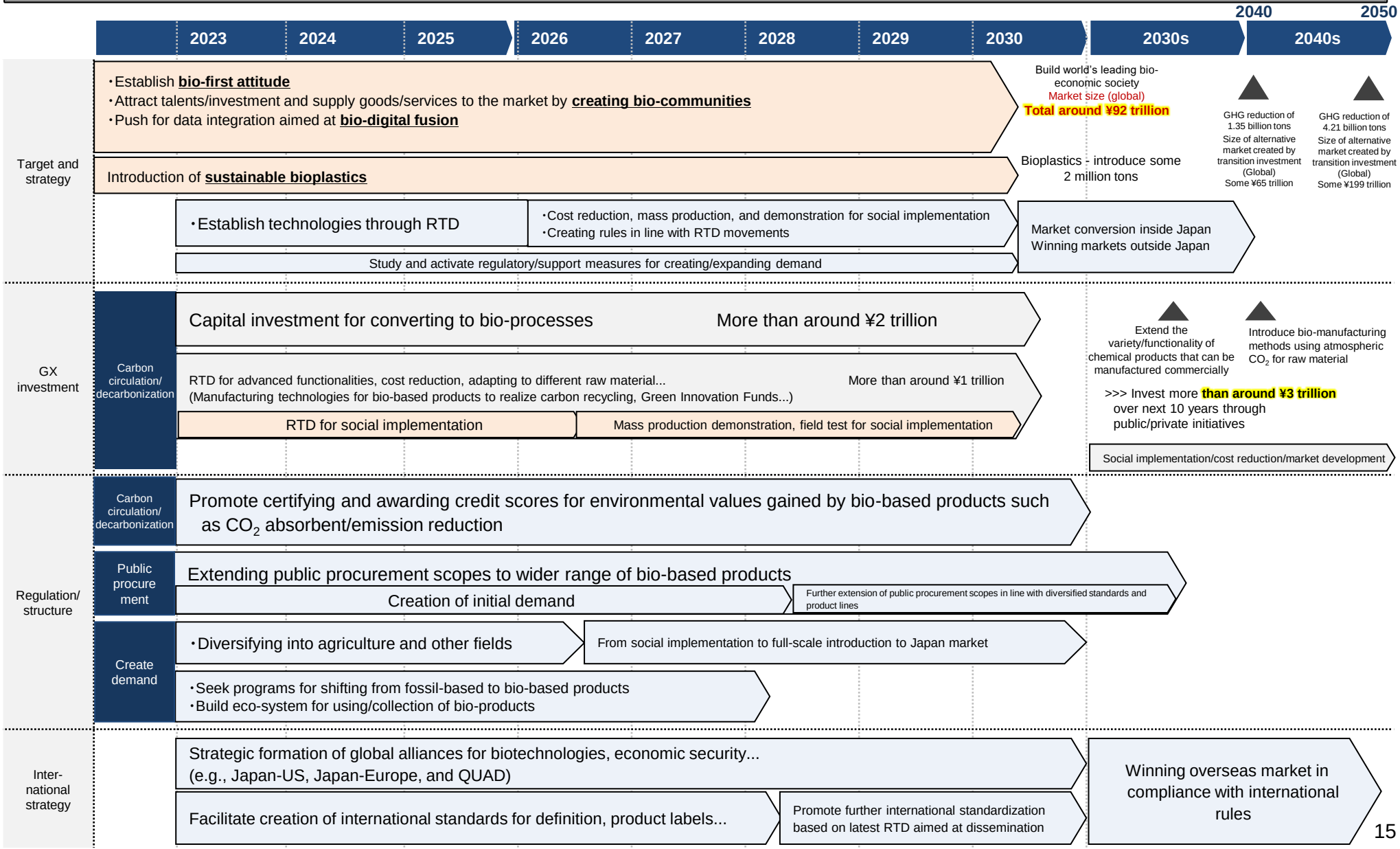
<Future milestones> Case 12: Zero-emission ship (maritime industry)

■ In order to clear goals such as net-zero GHG emissions for international shipping by 2050 and those set by the Plan for Global Warming Countermeasures, establish regulatory and structural frameworks by leading initiatives such as the introduction of zero emission ships and so on as well as discussions to establish international rules over the next 10 years to build up international competitiveness of maritime industry.



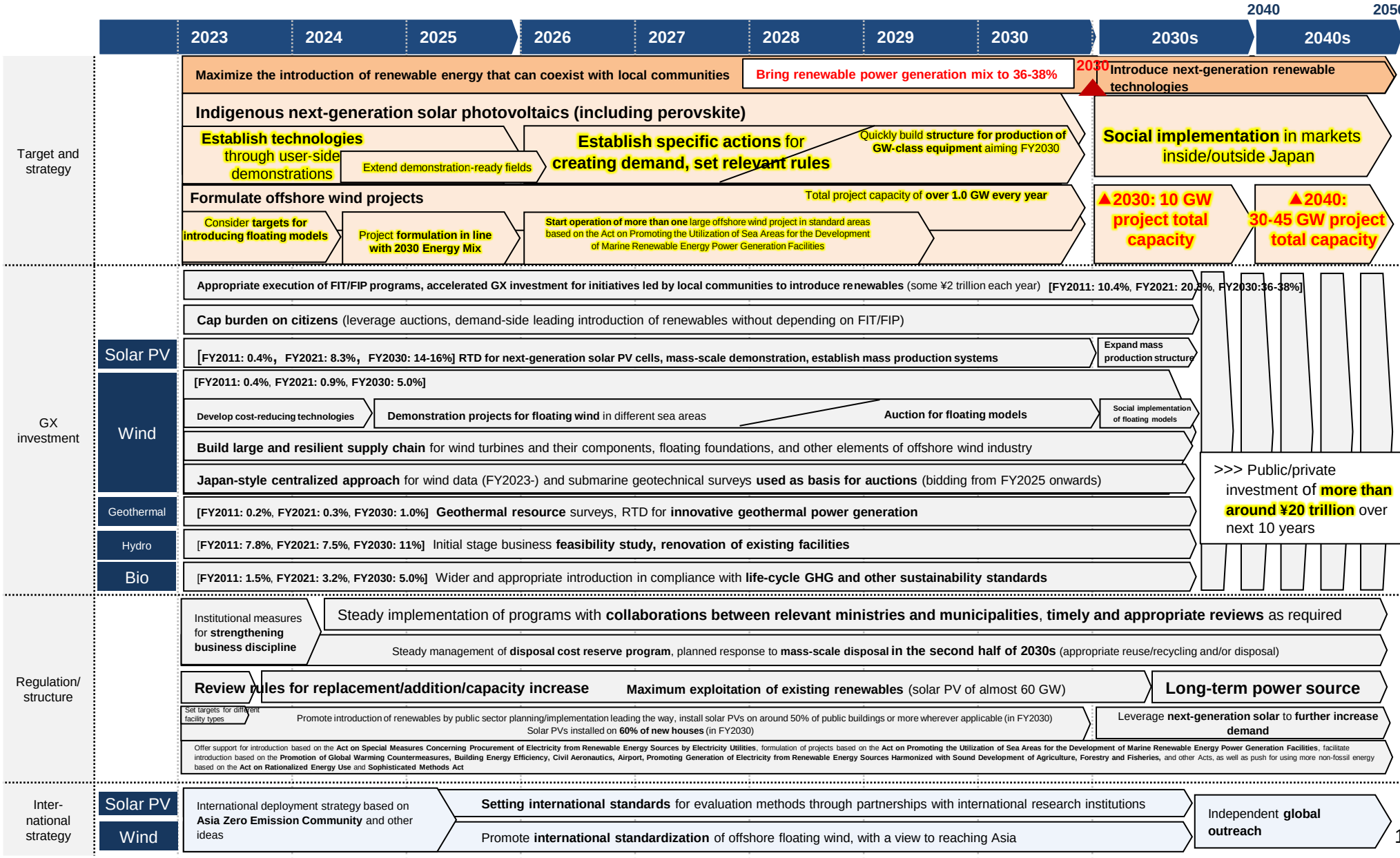
<Future milestones> Case 13: Bio-manufacturing

■ To build a bio-economic society, push for developing bio-manufacturing technologies and introducing bioplastics and other various bio-based products to a wider audience. To facilitate transformation to bio-based processes, advocate establishment and standardization of programs for evaluating environmental values, together with creation of predictable demand through public procurement and other measures, leading to the development of markets inside and outside Japan, thereby stimulating investment inside the country.



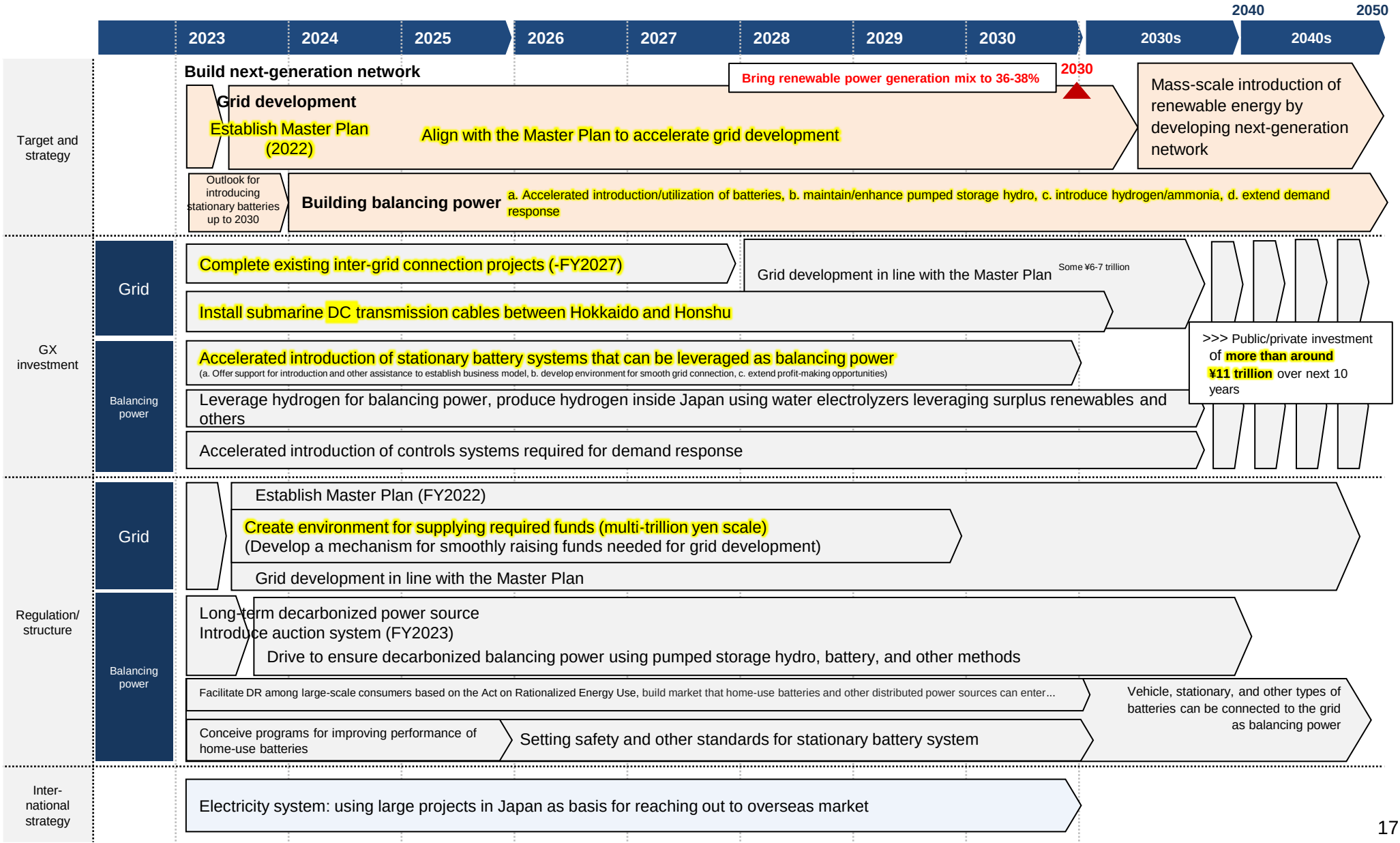
<Future milestones> Case 14: Renewable energy

■ To maximize the introduction of renewable energy sources, strive for social implementation of next-generation renewable energy technologies over the next 10 years by, for example, establishing a structure for mass production of next-generation indigenous solar PV panels and developing large-scale offshore wind projects.



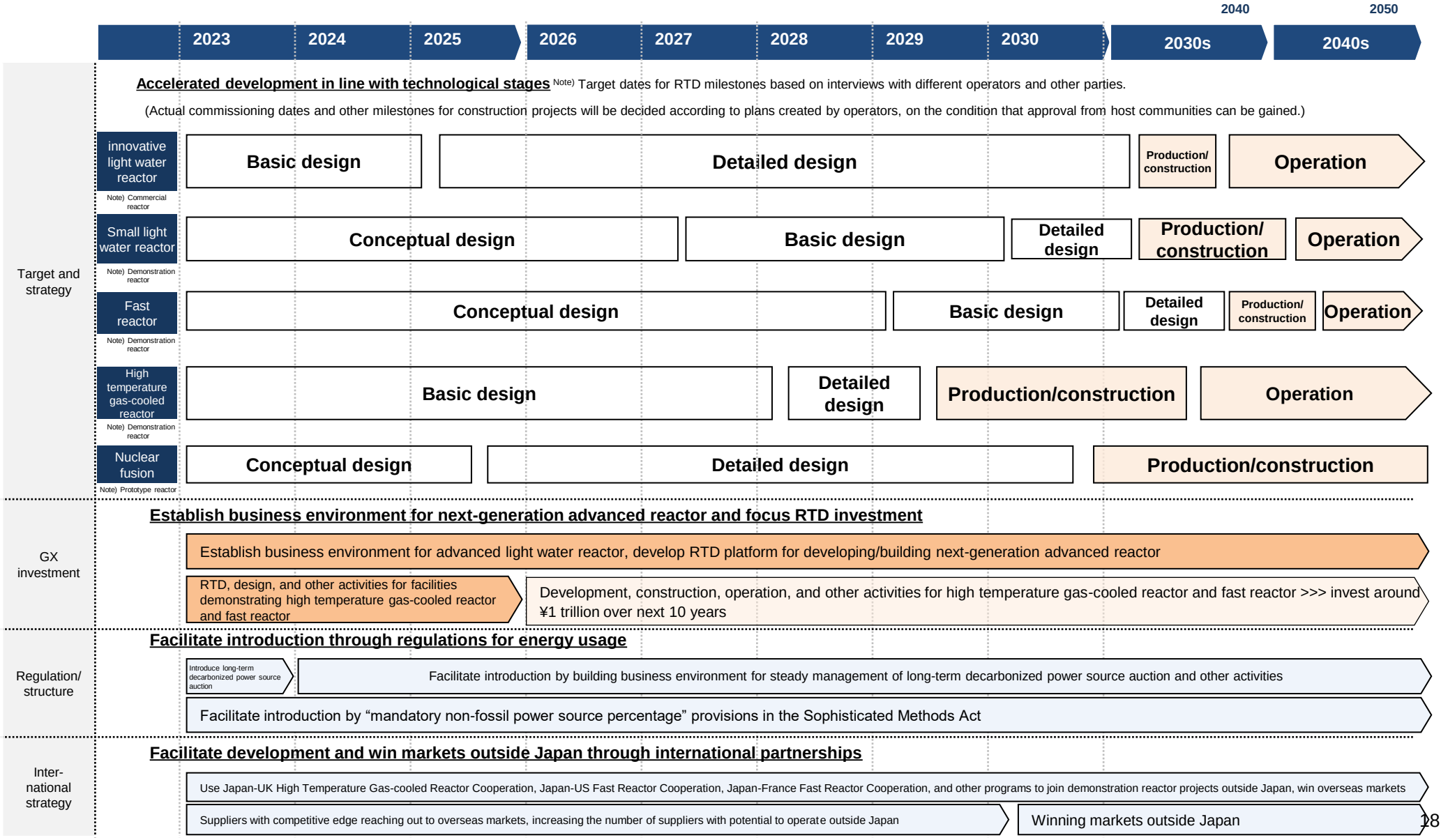
<Future milestones> Case 15: Next-generation network (grid and balancing power)

■ In order to maximize the introduction of renewable energy, build a resilient next-generation electricity network by accelerating grid development based on the Master Plan while promoting DR based on the Act on Rationalized Energy Use over the next 10 years.



<Future milestones> Case 16: Next-generation advanced reactor

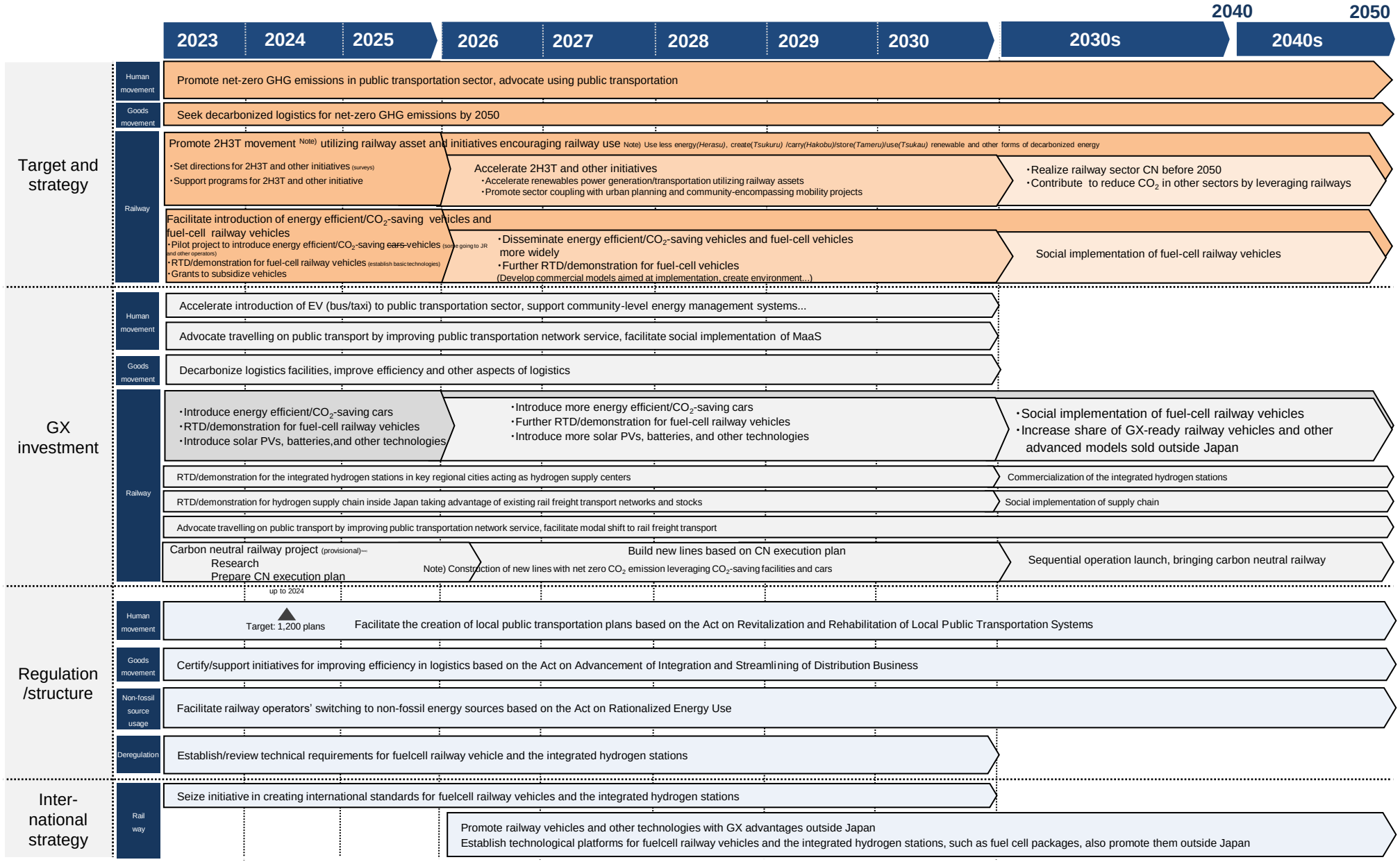
■ Ensuring safety as top priority, develop/build next-generation advanced reactor embedded with new safety mechanism.



<Future milestones> Case 17: Transportation sector

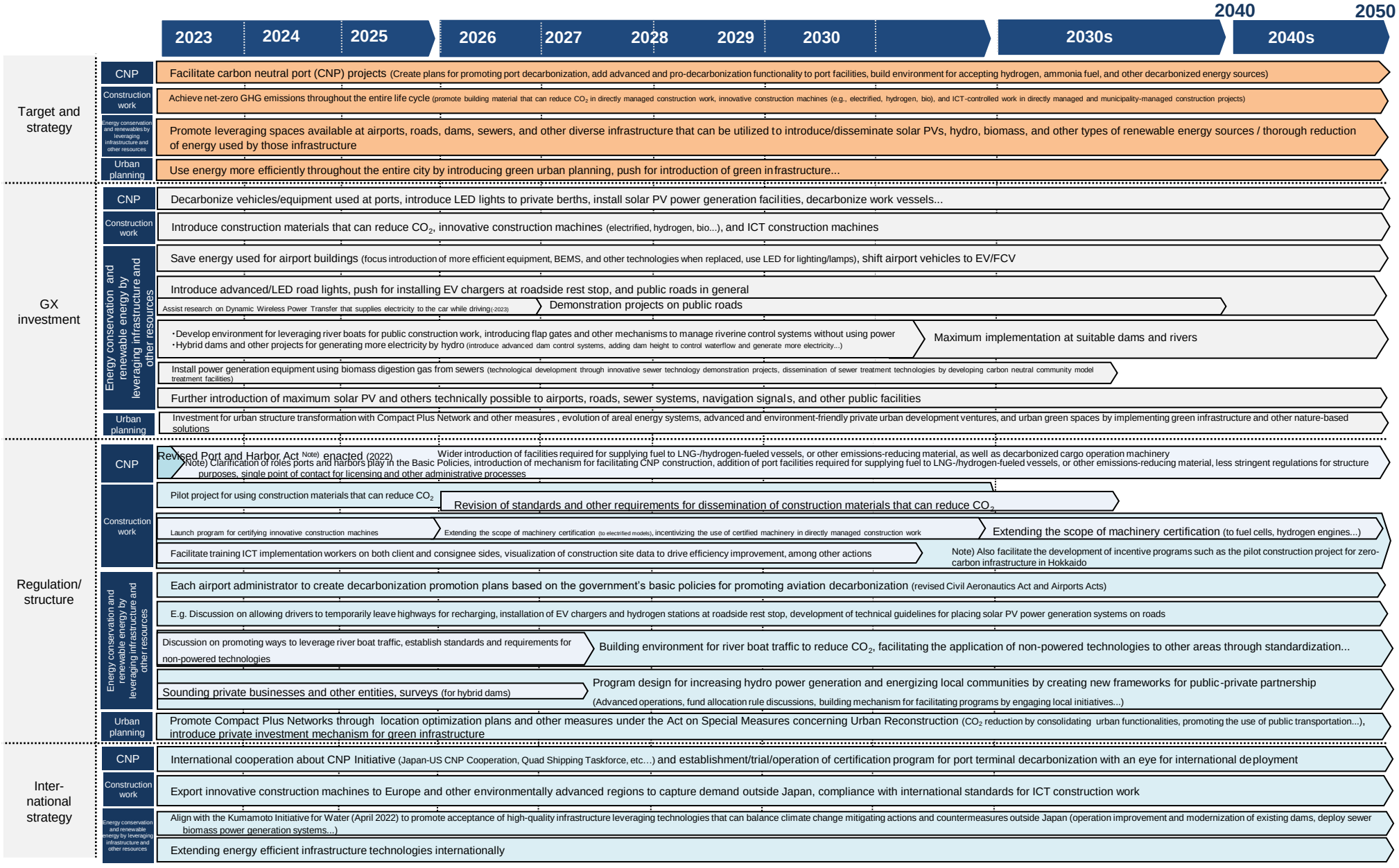
Note) Except for maritime/automotive/aircraft industries already mentioned

■ The transportation sector accounts for almost 20% of Japan's total CO_2 emissions. In order to transform the demand structure and save energy as well as use more non-fossil fuels for rail and other transportation modes as well as human and goods movements, based on the Act on Rationalizing Energy Use and other provisions, facilitate initiatives for switching to clean energy sources in planned and strategical manners over the next 10 years so as to increase private investment in transportation business and other relevant industries.



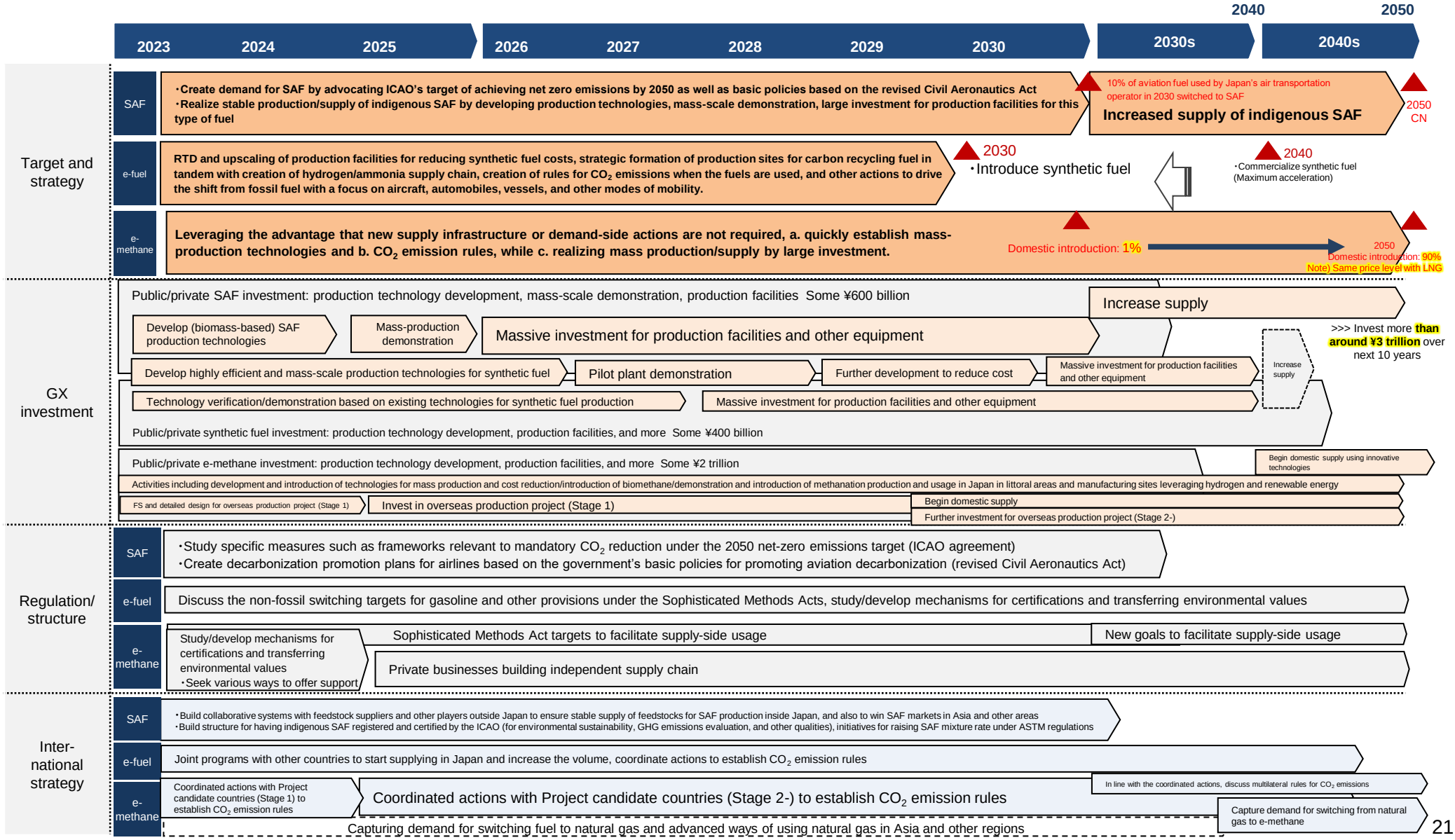
<Future milestones> Case 18: Infrastructure areas

■ To decarbonize industries and ports while enhancing their competitiveness, development of Carbon Neutral Ports (CNP) and decarbonization of their construction processes will be promoted. Introduction of renewable energy sources by leveraging airports, roads, dams, sewers, and other components of infrastructure, a thorough reduction of energy consumption, and development of cities and communities that will help decarbonization, among other projects, will be facilitated.



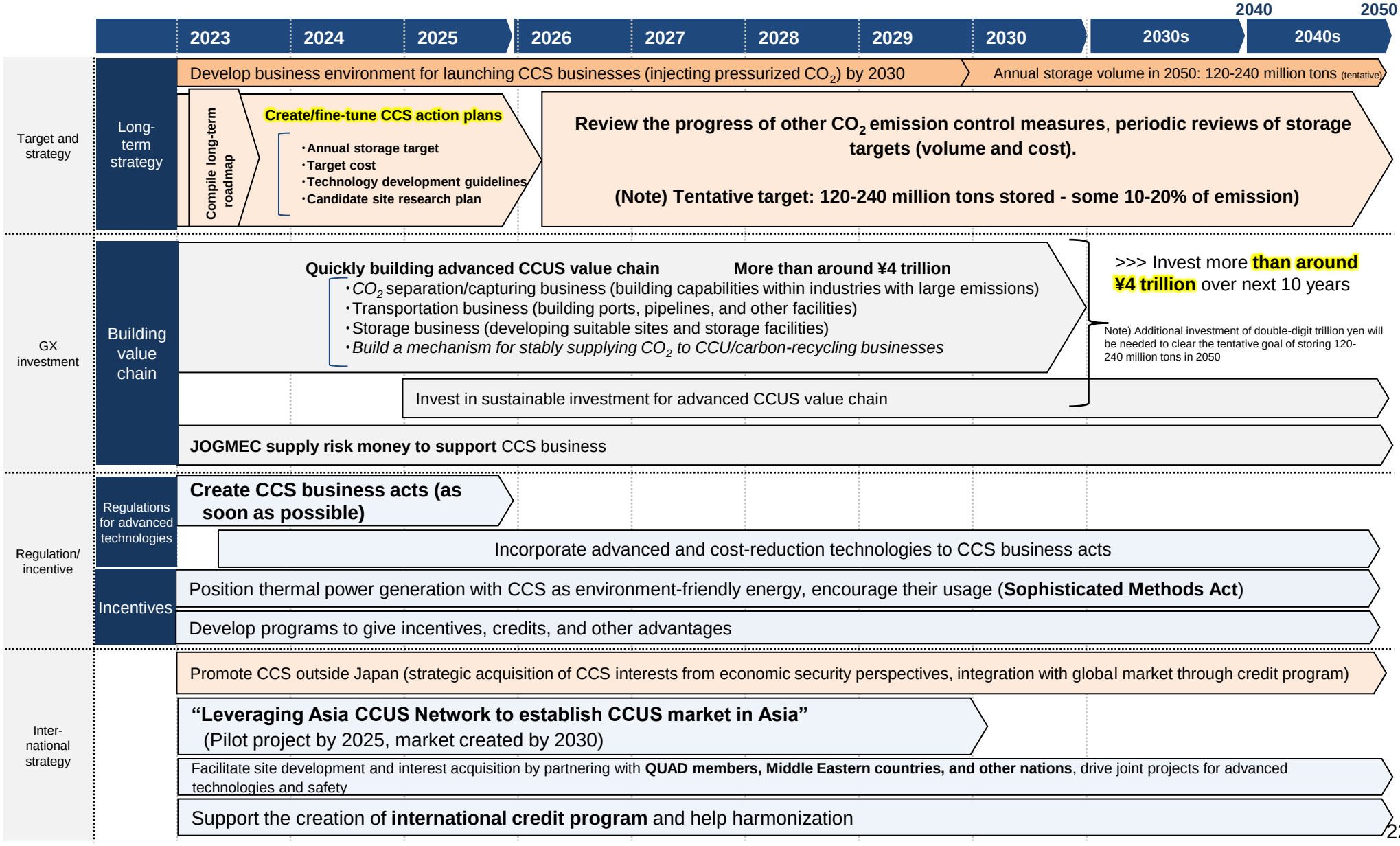
<Future milestones> Case 19: Carbon-recycling fuel (SAF, synthetic fuel, e-methane)

■ In order to promote the usage of SAF, e-fuel, e-methane, and other products that can help decarbonization, work on developing/demonstrating technologies and capital investment, while developing regulations/structures and coordinating discussions on the establishment of international rules over the next 10 years.



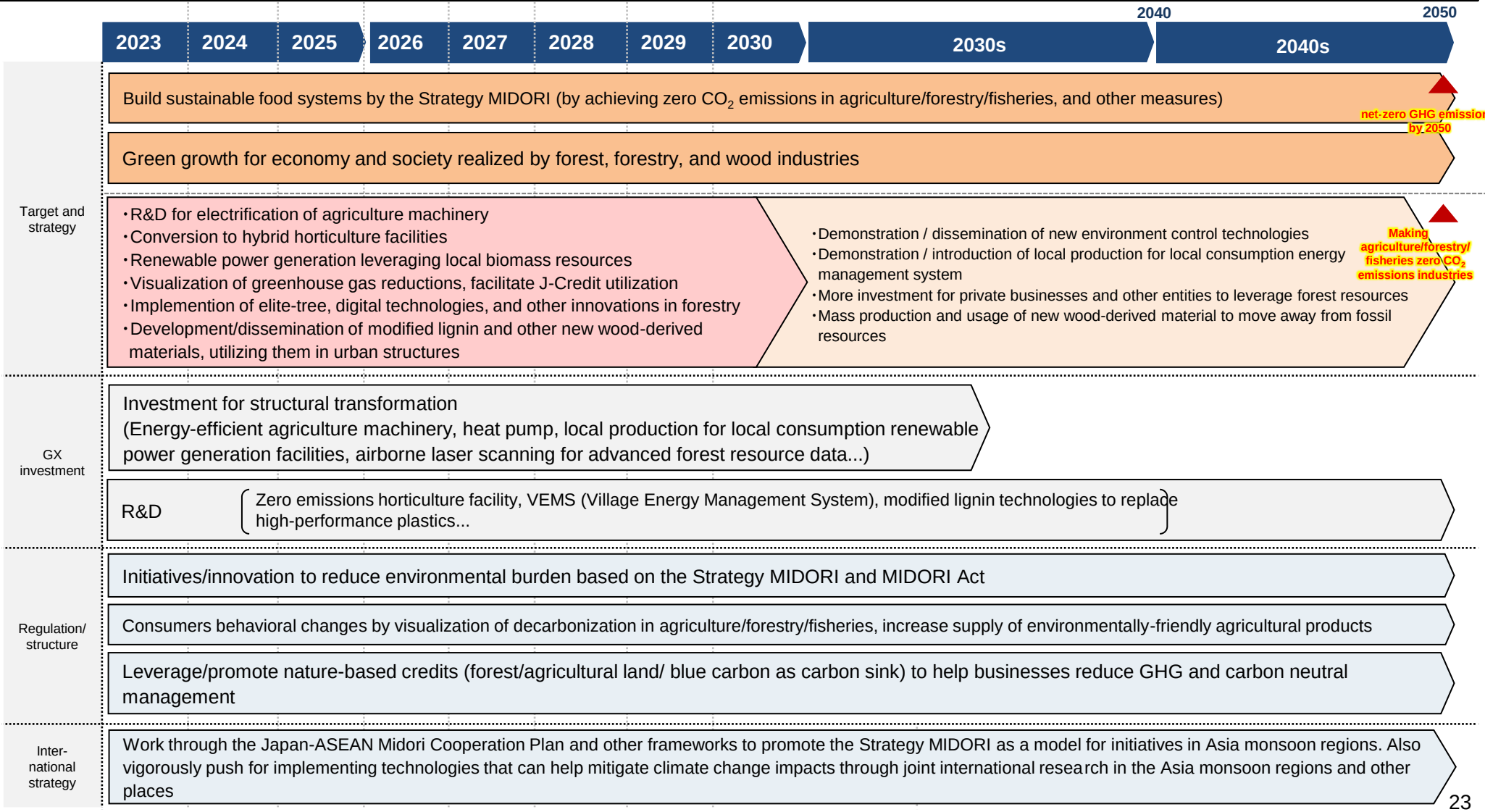
<Future milestones> Case 20: CCS

■ In order to secure the annual CCS capacity required for achieving net-zero GHG emissions by 2050, build advanced CCUS value chain and win CCUS markets in Asia over the next 10 years, and also develop CCS business acts as quickly as possible to create business environment for launching businesses by 2030.



<Future milestones> Case 21: Food, agriculture, forestry, and fisheries industry

- Based on the Strategy for Sustainable Food Systems, MIDORI (launched in May 2021) and MIDORI Act (established in April 2022 and enforced in July 2022), promote initiatives to transform the agriculture, forestry, fisheries and food industries to decarbonize and reduce environmental burden.
- Forest, agricultural land, seaweed forest, other places where the agriculture, forestry, and fisheries operate play an indispensable role as greenhouse gas sink in achieving net-zero GHG emissions by 2050. Their function will be enhanced by stakeholders' behavioral changes and other methods in order to attract private investment.



<Future milestones> Case 22: Community and daily life

■ In order to decarbonize communities and daily life, deploy designate Decarbonization Leading Areas, accelerate implementation of priority measures proactively for administrative work and projects in municipalities, including businesses owned by them, and spread initiatives of regional decarbonization throughout Japan, and also encourage behavior change and life style transformation through new national movements and other programs to create widespread demands for decarbonized products, and facilitate structural transformation of industries and society based on characteristics of each community.

	by around 2025	up to 2030	2030s	2040s
Target and strategy	Create more than 100 Decarbonization Leading Areas Clear FY2030 reduction targets for greenhouse gas reduction in buildings sector Clear pioneering targets set in line with government action plans		Achieve decarbonization in many communities before 2050, transition to next period in which local societies, having surmounted challenges for their communities, are resilient and energized	
	Regional revitalization achieved			
GX investment	・Renewable energy, stationary storage batteries, xEVs, private transmission lines ・Next-generation solar PVs (including perovskite) ・Houses/buildings (ZEB/ZEH and insulation-improvement renovation) ・Produce/use green hydrogen Note) New technologies will be applied as they are developed			
Regulation/ structure	Decarbonization Leading Areas: Designate Decarbonization Leading Areas to encourage competition between different areas			
	Decarbonization Leading Areas: Accelerate support through grants and special provisions for municipality finance	Focus support		
	Nationwide deployment of regional decarbonization: Stronger local government action plans as requirement for grants and other support Visualize municipality initiatives' progress	Enhance initiatives through local government action plans program		
	Nationwide deployment of regional decarbonization: Accelerate priority measures focus actions through grants and Special Grants to Local Governments ・Engage residents and businesses to accelerate region-wide decarbonization ・Proactive decarbonization of administrative processes in municipalities, including businesses owned by them	Focus support		
	Nationwide deployment of regional decarbonization: PPA model support, assist local businesses in installing CO_2-reducing facility, electrification, fuel switching, and other actions			
	Support offered through the Japan Green Investment Corp. for Carbon Neutrality and local financial institutions			
	Encourage behavior change, lifestyle transformation, and stimulate demand through new national movements and other programs			
Inter-national strategy	Make cities more decarbonized and more resilient through city-to-city collaboration			
	Facilitate formation of international cooperative programs for regional decarbonization in collaboration with stakeholders			

Future steps for renewable energy policy

- Spring 2023 | -2025 | 2030 | 2050

[Build next-generation network]

- Fully leverage the potentials of sites suited to renewable energy facilities by **installing submarine cables for DC transmission from Hokkaido** (new 2 GW capacity (FY2030))
- **Enhancing east-west inter-grid connection** by scaling 50-60 Hz conversion capacity (from 2.1 GW to 3 GW (FY2027))
- **Grid development based on the Master Plan** due FY2022 (some ¥6-7 trillion: estimate by the Organization for Cross-regional Coordination of Transmission Operators, JAPAN)
- **Develop environment for raising funds (several trillion yen)** needed for grid investment (extension of period covered by grid development subsidy (allocated from renewable energy tariff revenues and other sources), loans by public organizations)

a. Grid development and securing balancing power for mass-scale introduction of renewable energy

[Secure balancing power]

- **Accelerated introduction of stationary battery systems**
  - Establish introduction outlook for 2030, stimulate private investment
  - Market development and other actions to create more revenue opportunities, develop environment enabling smooth grid connection, introduction assistance and other measures to help businesses become self-sustainable quickly
- **Long-Term Decarbonized Power Resource Auction**
  - Use the long-term decarbonized power source auction to be launched in FY2023 to facilitate investment for rechargeable batteries, pumped storage hydro, hydrogen, ammonia, and other decarbonized power sources with balancing power
- **Leverage hydrogen and ammonia**
  - Build large and resilient supply chain, encourage domestic production using surplus renewable energy and other sources Establish comprehensive structure based on regulation-support package, including support focusing on price gaps from existing fuels and support for facility development

Volume to be introduced (hydrogen/ammonia)
2030: 3 million tons / 3 million tons
2050: 20 million tons / 30 million tons

[Accelerated innovation]

- **Indigenous next-generation solar PVs** (perovskite, rooftop and wall surface installations)

From user-side demonstration (FY2023-) to demand creation (FY2026-) to early-stage GW-class mass production (FY2030)

Solar
2030: 104-118 GW

- **Offshore wind**

From setting target for introduction of floating types (FY2023) to offshore demonstration of floating types (FY2023-) to bidding for floating types (second half of 2020s)

From centralized wind data and submarine geotechnical surveys (2023-) to auctions based on the results (2025-)

Total project capacity of over 1.0 GW every year

Formulate offshore wind projects
2030: 10 GW
2040: 30-45 GW

b. Maximum introduction of indigenous renewable energy
36-38% in 2030
(Cabinet decision of October 2021)

[Maximum introduction of indigenous renewable energy]

- More stringent regulatory measures for **stronger business discipline**
- **Leverage auctions and new programs (FIP) to alleviate burden on citizens (FY2022-)**
- **Extended introduction of renewable energy coexisting with local communities**
  - Public sector leading by example: install about 50% of applicable structures (6.0 GW)
  - Facilitate renewable energy that can coexist with local communities using promotional district program under the revised Act on Promotion of Global Warming Countermeasures and other methods (8.2 GW)
- **Maximum exploitation of existing renewable energy (solar PV: some 60 GW)**: facilitate additional investment to increase output and turning them into long-term power sources
- Steady management of **disposal cost reserve program**, planned response to **mass-scale disposal in the second half of 2030s**

Future steps for nuclear energy policy

- Spring 2023 | - Spring 2024 | 2030 | 2050

(by this winter)

[Already restarted] 10 units (western Japan)

● Strive to shorten construction period, coordinate regular inspection schedules...

>>> ensure **up to nine units** are operational

a. Accelerate restart

(20-22% in 2030)

>>> **・Voluntary initiatives to improve safety**
・Coexisting with host communities
・Better communication with different population groups

(Next summer/winter-)

[Construction approved] seven units (including eastern Japan) Note) Different levels of progress in construction

● Safe and smooth construction work, steady restart
(Takahama Units 1/2, Onagawa Unit 2, Shimane Unit 2)

● Initiatives to secure local communities' agreement
(Kashiwazaki-Kariwa, Tokai Dai-ni)

– Government at the front line of contact, structural reform of operating organization...

(mid-2020s onwards)

[Application for construction approval]
10 units already applied, nine unapplied for

● Better bilateral communication for fair and just assessment

● Initiatives for securing agreement, business environment creation...

[Actions with perspectives for developments after restart]

● **Ensure alternatives exist: develop/build next-generation advanced reactor, review operational lifespan**, or other options

● **Ensure predictability: facilitate nuclear fuel-cycle, establish procedure for steady and efficient decommissioning, complete overhaul of government-led initiatives to realize final disposal site**, and other actions

b. Achieve net-zero GHG emissions by 2050, stable supply