

Japan's Net-zero strategies and programs: recent developments and challenges

Central Research Institute of Electric Power Industry
Socio-economic Research Center

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October 27, 2022

About CRIEPI: Central Research Institute of Electric Power Industry

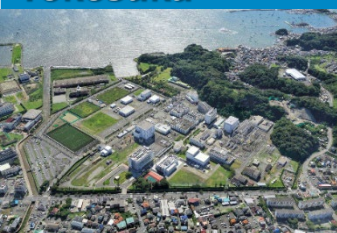
CRIEPI was established in 1951 as a non-profit organization to undertake R&D in energy and the environment to solve various problems in the electric power industry and the society.

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- Socio-economic Research Center
- Nuclear Risk Research Center

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- Energy Transformation Research Laboratory
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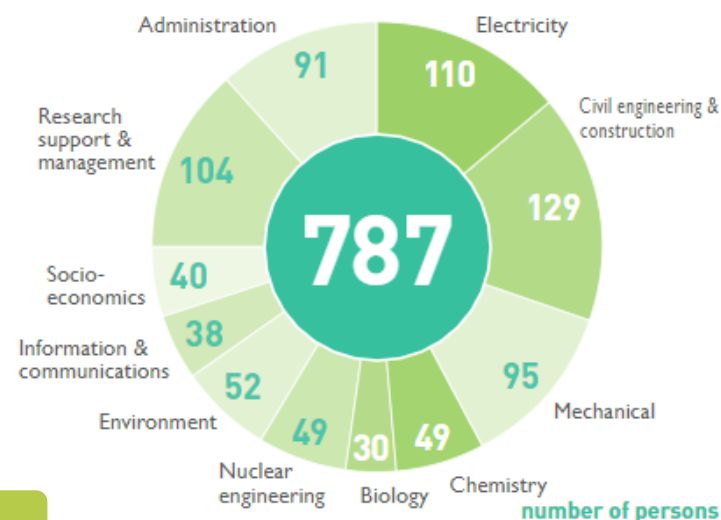
Komae

Abiko



Sustainable System Research Laboratory

Personnel organization



Outline of the presentation

- ◆ Carbon neutral declaration by the former Prime Minister Suga (2020)
- ◆ Japanese strategies and policies for net-zero
 - Green Growth Strategy (Oct. 2020)
 - The 6th Strategic Energy Plan (Oct. 2021)
 - Clean Energy Strategy (Interim Report, May 2022)
 - Green Innovation Fund (Feb. 2021)
 - GX League Initiative (Feb. 2022)
- ◆ Challenges for Japanese net-zero target

Net-zero declaration by the former Prime Minister Suga

*“We hereby declare that by 2050 **Japan will aim to reduce greenhouse gas emissions to net-zero**, that is, to realize a **carbon-neutral**, decarbonized society.*

Addressing climate change is no longer a constraint on economic growth. We need to adjust our mindset to a paradigm shift that proactive climate change measures bring transformation of industrial structures as well as our economy and society, leading to dynamic economic growth.” (26 Oct 2020)

*“**Japan aims to reduce its greenhouse gas emissions by 46 percent in fiscal year 2030** from its fiscal year 2013 levels, setting an ambitious target which is aligned with the long-term goal of achieving net-zero by 2050. Furthermore, Japan will continue strenuous efforts in its challenge to meet the lofty goal of cutting its emission by 50 percent.” (22 Apr 2021)*



Policy Speech by the Prime Minister to the 203rd Session of the Diet, 26 Oct. 2020.

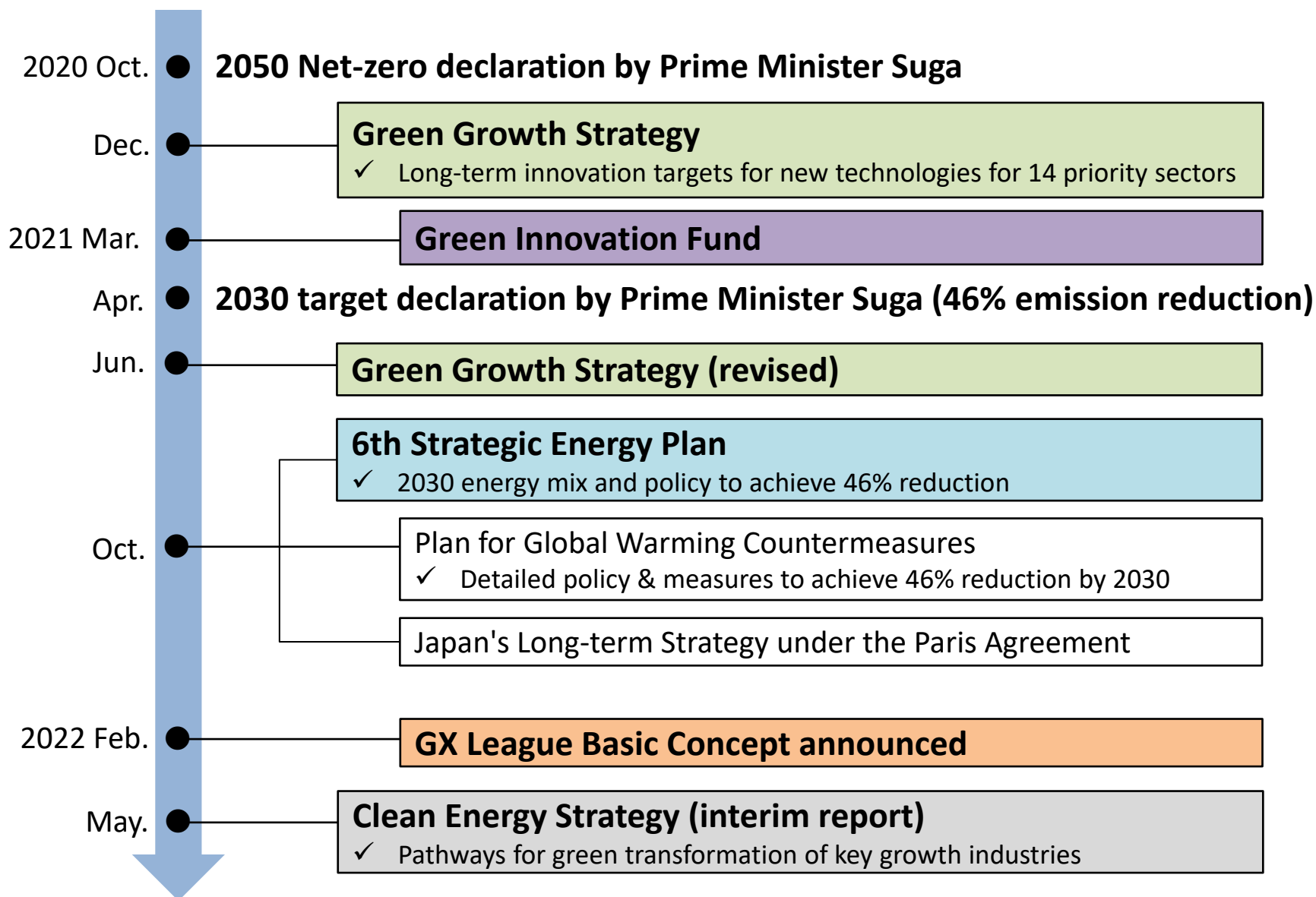


Remarks by the Prime Minister at Leaders Summit on Climate, 22 Apr. 2021.

(Source: Prime Minister’s Office of Japan website)

https://japan.kantei.go.jp/99_suga/statement/202010/_00006.html, https://japan.kantei.go.jp/99_suga/actions/202104/_00028.html

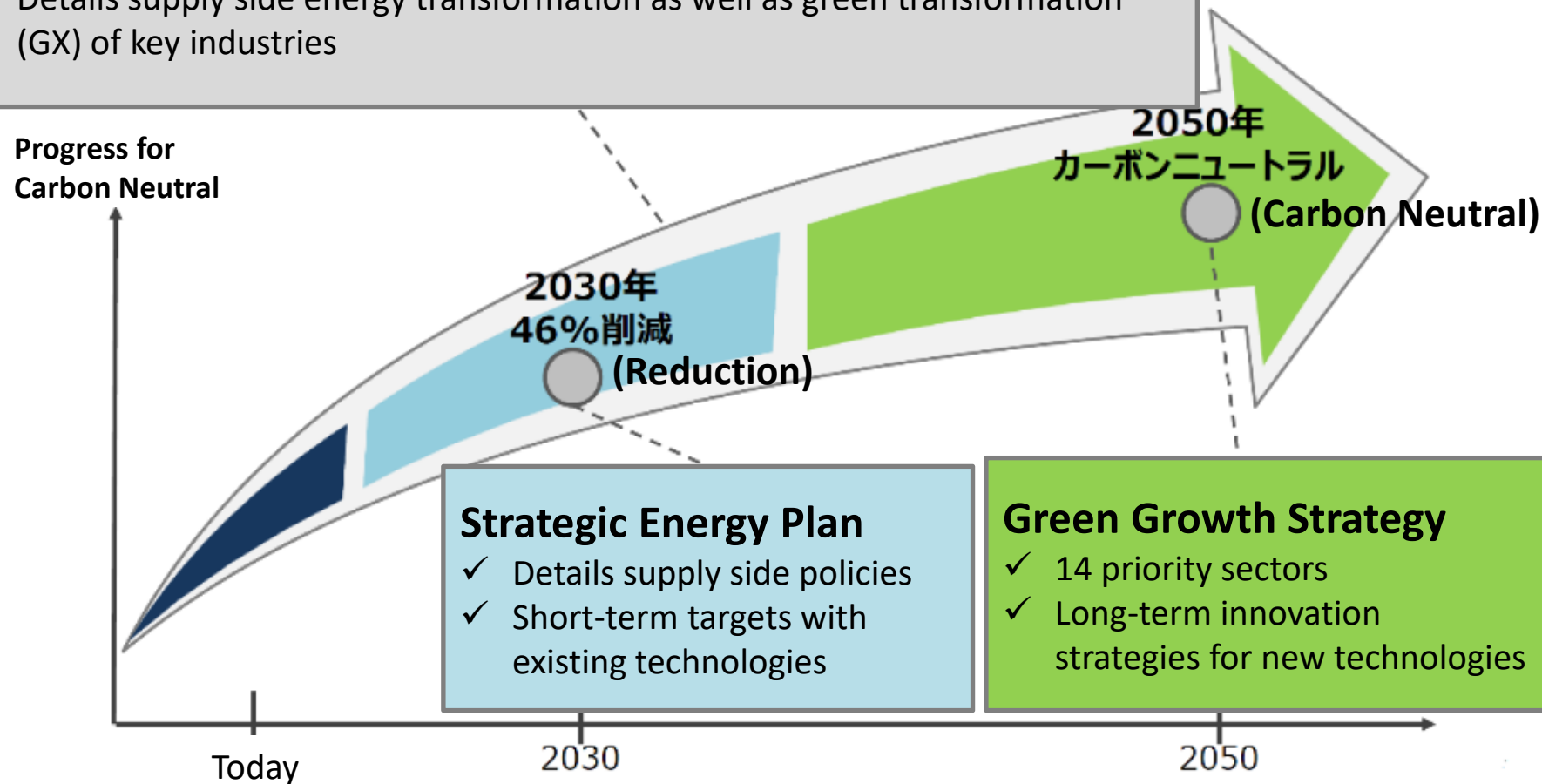
Timeline of Japanese strategies for net-zero



Three basic strategies for net zero

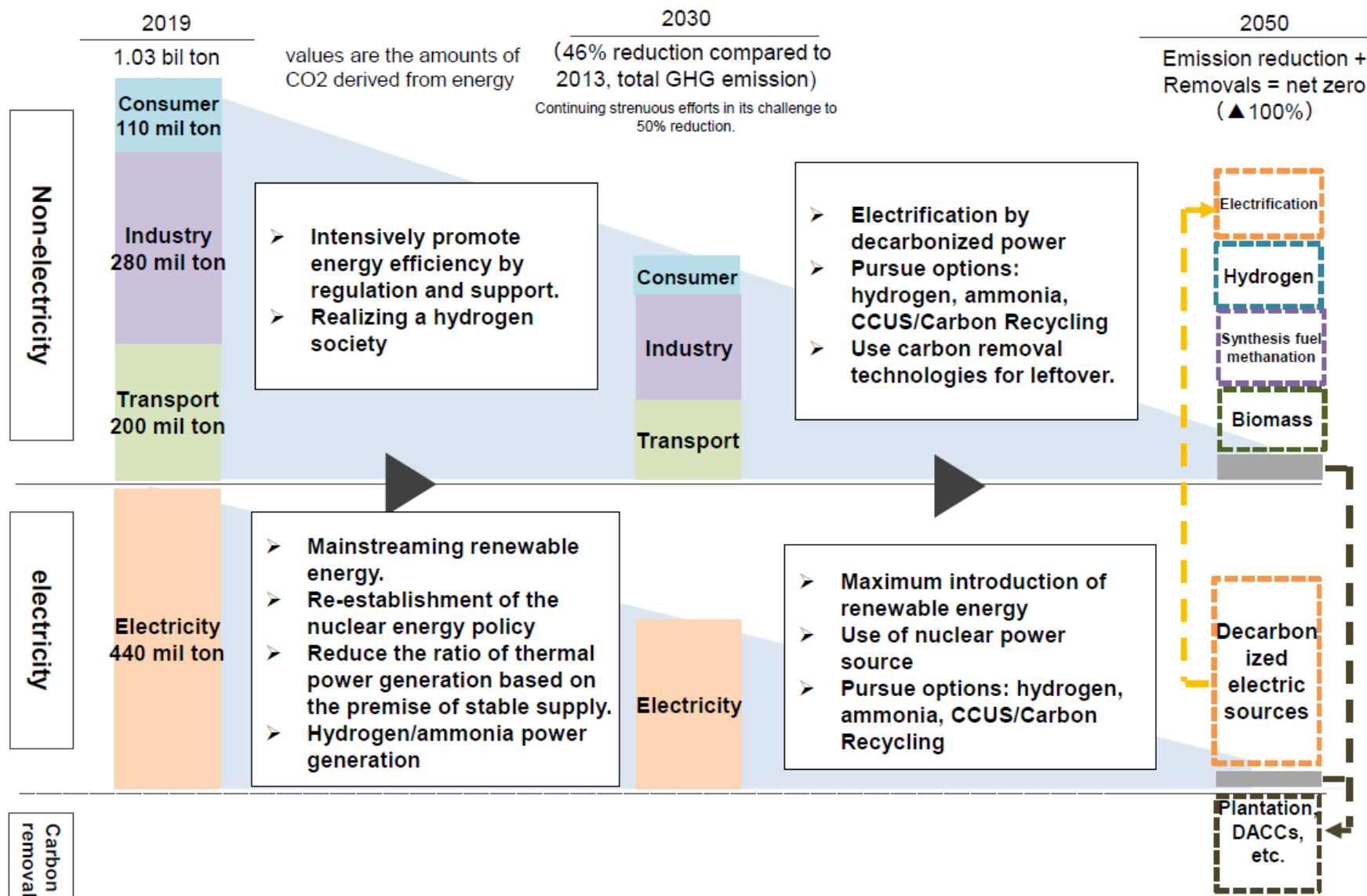
Clean Energy Strategy

- ✓ Outlines feasible pathways for carbon neutral while maintaining stable, low-cost energy supply and economic growth
- ✓ Details supply side energy transformation as well as green transformation (GX) of key industries



(Source: Ministry of Economy, Trade and Industry (METI), "Clean Energy Strategy", May 2022)

Net zero by 2050, presented in **Green Growth Strategy**



(Source: Government of Japan, "Green Growth Strategy", October 2021)

Energy supply & demand balance in 2030, presented in the **Strategic Energy Plan**

Ambitious outlook, consistent with the 46% reduction target in 2030.

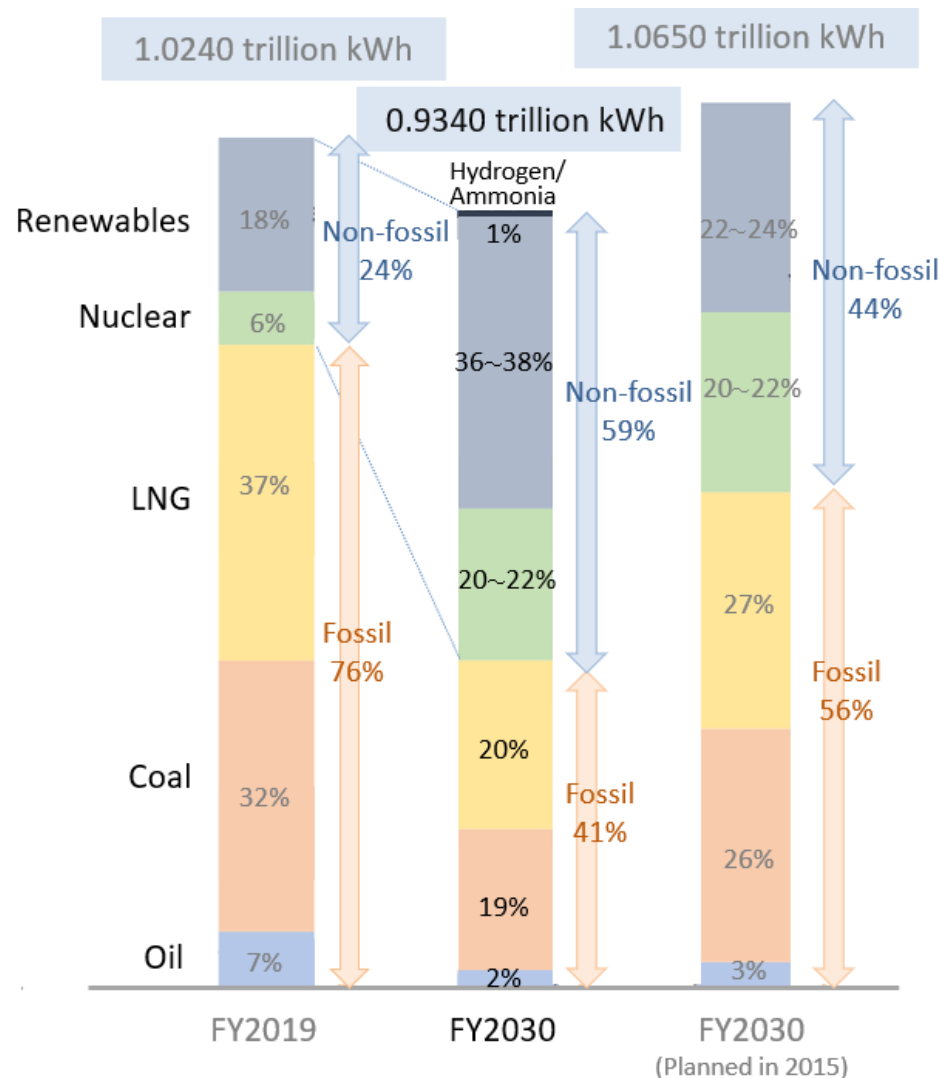
Demand side:

- Assuming **thorough energy efficiency** improvement.
- Decarbonization by **electrification and hydrogen deployment**

Supply side:

- Maximum deployment of renewable** energy. Upgrading grid infrastructure to overcome grid constraints
- Accelerated restart of nuclear power plants** while keeping safety as top priority
- Thermal power mix as low as possible**, while maintaining stable power supply. Fading out inefficient thermal power plants
- Hydrogen/ammonia** as a new source

Power mix outlook in 2030

















(Source: METI "Green Growth Strategy", October 2021)

Green Growth Strategy: 14 target sectors

- The strategy specifies targets and action plans for 14 promising sectors.

14 target sectors expected to grow in achieving 2050 carbon neutrality

 Offshore wind/solar/geothermal power <ul style="list-style-type: none"> In 2040, 30-45 GW projects [Offshore wind]. In 2030, power generation cost of 14 yen/kWh by next-generation solar cells [Solar]. <p>1</p>	 Hydrogen/fuel ammonia <ul style="list-style-type: none"> In 2050, about 20 million tons introduced [Hydrogen]. 500 billion yen market in Southeast Asia [fuel ammonia]. <p>2</p>	 Next-generation heat energy <ul style="list-style-type: none"> In 2050, injecting synthetic methane by 90% into existing infrastructure. <p>3</p>	 Nuclear <ul style="list-style-type: none"> In 2030, carbon-free hydrogen production technology for HTGR established. <p>4</p>	 Automobile/battery <ul style="list-style-type: none"> In 2035, electrified vehicles accounting for 100% of new passenger car sales. <p>5</p>
 Semiconductor/information and communication <ul style="list-style-type: none"> In 2040, semiconductor/information and communication industries achieving carbon neutrality. <p>6</p>	 Shipping <ul style="list-style-type: none"> Before the conventional target year of 2028, realizing the commercial operation of zero-emission ships. <p>7</p>	 Logistics, people flow, and civil engineering infrastructure <ul style="list-style-type: none"> In 2050, carbon-neutral ports realizing decarbonization of ports and construction work. <p>8</p>	 Food, agriculture, forestry and fisheries <ul style="list-style-type: none"> In 2050, zero CO₂ emissions from fossil fuels in agriculture, forestry, and fisheries sectors. <p>9</p>	 Aircraft <ul style="list-style-type: none"> Starting from 2030, installing core technologies such as batteries in stages. <p>10</p>
 Carbon recycling/material <ul style="list-style-type: none"> In 2050, artificial photosynthesis plastics on par with existing products [CR]. Realizing zero carbon steel [Material]. <p>11</p>	 Housing and building/ next-generation power management <ul style="list-style-type: none"> In 2030, average of new houses and buildings being ZEH and ZEB [housing and buildings]. <p>12</p>	 Resource circulation-related <ul style="list-style-type: none"> In 2030, approx. 2 million tons of biomass plastics introduced. <p>13</p>	 Life style-related <ul style="list-style-type: none"> In 2050, a carbon-neutral, resilient, and comfortable life. <p>14</p>	

(Source: METI "Green Growth Strategy", October 2021)

Green Growth Strategy: policy tools

- The strategy also specifies policy tools to stimulate innovations.

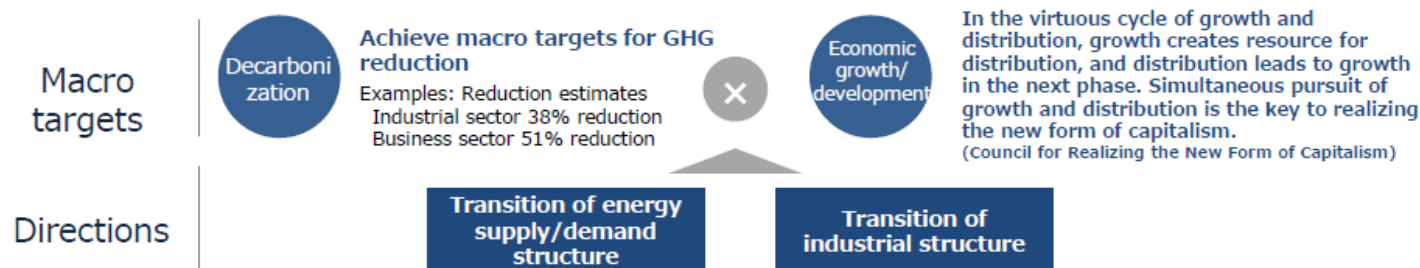
Policy tools to stimulate development and commercialization of innovative solutions

1	Budget	<ul style="list-style-type: none"> - Green Innovation Fund (2 trillion yen ~ 14 billion USD) - Mechanism to gain commitment of top management - Focused investments in projects of particular importance
2	Tax systems	Tax systems to promote investment toward carbon neutrality (UP to 10% tax deduction, 50% special depreciation)
3	Finance	<ul style="list-style-type: none"> - Sector-specific roadmaps for high-emission industries - Enhancement of the quality and quantity of disclosure based on TCFD, etc. - Creation of a “green international financial center”
4	Regulatory reform and standardization	<ul style="list-style-type: none"> - Regulatory reform to accommodate new technologies - Standardization with a view to market formation - Carbon pricing that contributes to growth
5	International cooperation	<ul style="list-style-type: none"> - Technical cooperation between Japan and the US and between Japan and the EU - Asia Energy Transition Initiative - Tokyo “Beyond-Zero” Week
6	Promotion of university initiatives	<ul style="list-style-type: none"> - Human resource development in universities, etc. - Analysis methods and statistics related to carbon neutrality
7	Expo 2025 Osaka	<ul style="list-style-type: none"> - A place for the demonstration of revolutionary innovation technologies - People’s Living Lab (A testing ground for future society)
8	Youth Working Group	Proposals from the working-age population in 2050

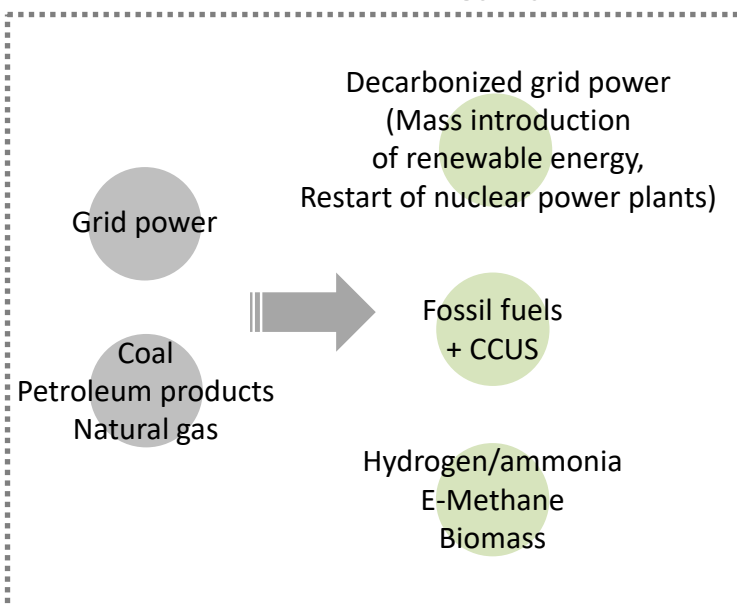
(Source: METI “Green Growth Strategy”, October 2021)

Clean Energy Strategy: GX of energy and industrial structure

(GX: green transformation)



Transformation of energy system



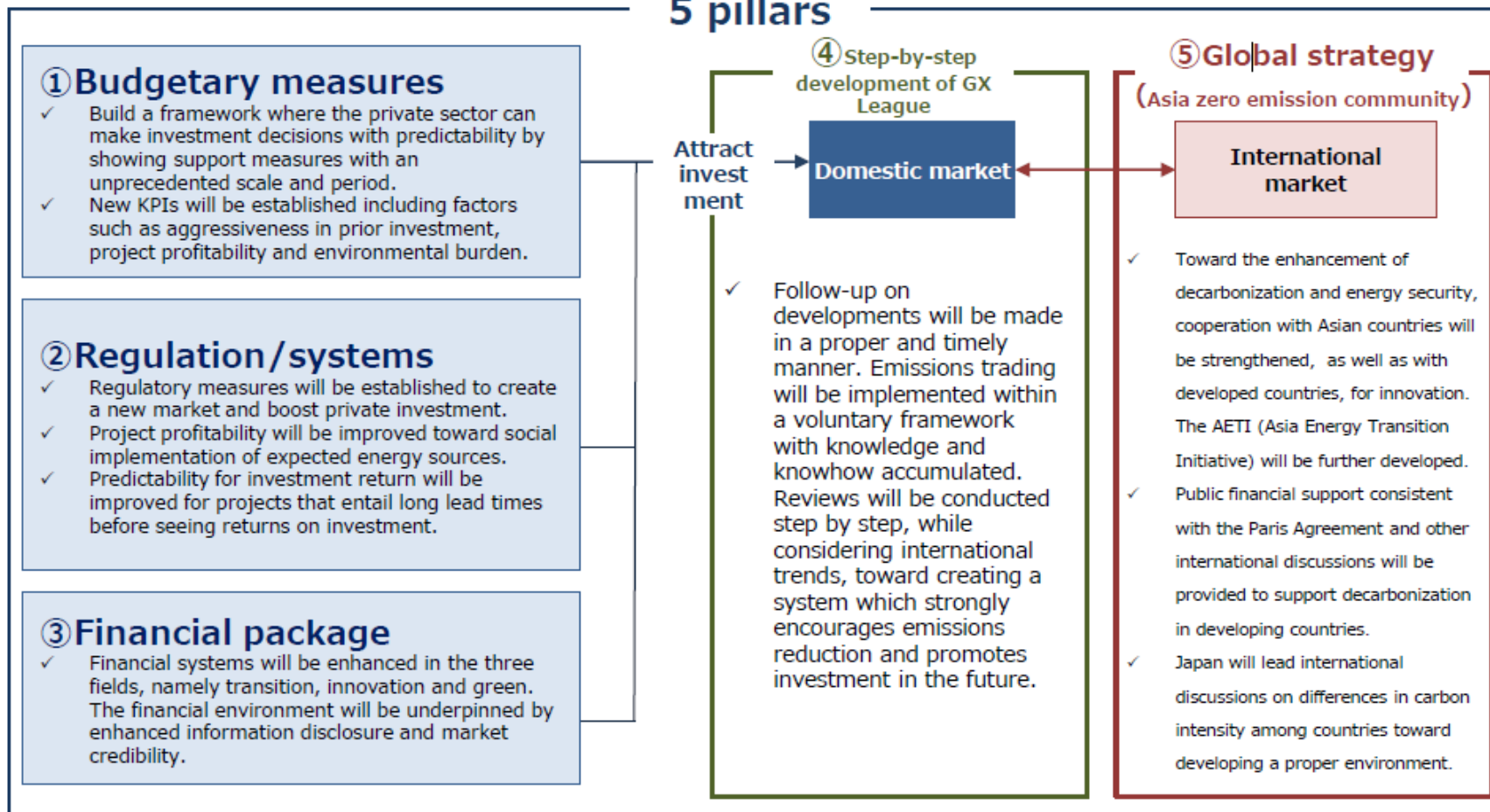
Transformation of industrial structure

Hydrogen/ammonia	Support measures based on cost differentials with conventional fuels
Offshore wind	Increase domestic demand, acquire overseas markets
Batteries	600 GWh of annual liquid LiBs manufacturing capacity by 2030, commercialize all-solid-state batteries by around 2030
Nuclear power	Maintain supply chains, technologies and human resources, international standardization of innovative reactors
Carbon Recycling	Carbon capture target cost at 2,000 yen (~15 USD)/t-CO2 by 2030, dissemination of SAF, E-methane and synthetic fuels
Steelmaking	Accelerate new technologies such as hydrogen-reduction steelmaking
Automobile	100% electrified vehicles in new car sales by 2035
Transport	R&D of hydrogen/ammonia fueled zero-emission ships, SAF 10% of all aviation fuels in 2030
Buildings, Infrastructure	Stricter regulations for houses/buildings (ZEB/ZEH), construction materials with less emissions
Food/agriculture	Promotion of Strategy for Sustainable Food Systems
CCS	Commercialization of CCS by 2030.
Negative emissions	R&D and initial demand creation

(Source: Ministry of Economy, Trade and Industry (METI),
"Clean Energy Strategy Interim Report", May 2022)

Clean Energy Strategy: policy support for GX

5 pillars

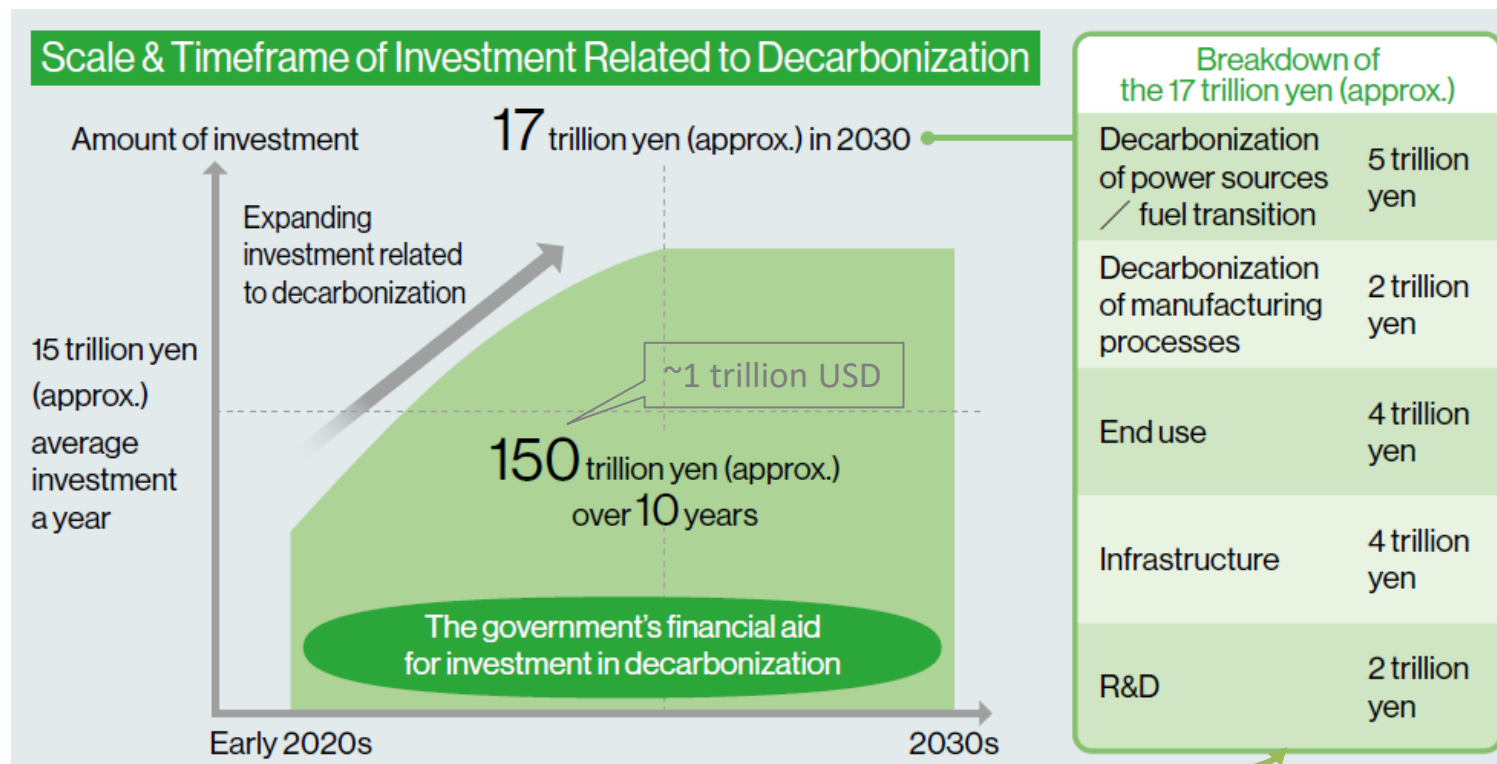


Common bases

- Development of Environment toward digitalization
- Creation of innovation and its social implementation
- Training of working people and researchers, elementary and secondary education
- Decarbonization efforts in local communities and daily living as well as resource circulation

(Source: Ministry of Economy, Trade and Industry (METI), “Clean Energy Strategy Interim Report”, May 2022)

Clean Energy Strategy: investments required for net-zero



Examples of investment area

(trillion yen)

Decarbonization of power sources	Renewable energy	2	Infrastructure	Upgrade of power grid	0.5
	Hydrogen/ammonia	0.3		EV infrastructure	0.2
	Battery production	0.6		Digitalization	3.5
Decarbonization of manufacturing processes	Energy efficiency	1.4	R&D	Carbon recycle	0.5
	Heat pumps/cogenerations	0.5		Decarbonized production process	0.1
End use	Energy-efficient buildings	1.8		Nuclear	0.1
	Next generation vehicles	1.8		Advanced CCS	0.6

(Source: Ministry of Economy, Trade and Industry (METI), "Clean Energy Strategy Interim Report", May 2022)

Government funding and **GX Economic Transition Bonds**

*“In order to transform the current fossil-fueled society to a carbon-neutral one, we will realize **decarbonization investments of over 150 trillion yen over the next decade through public-private collaborations.**”*

~1 trillion USD

*“To realize investments of over 150 trillion yen over the next decade, we will substantiate a carbon pricing framework, which intends both economic growth and emission reductions, and under this framework, **we will raise about 20 trillion yen of government funds in the form of GX Economic Transition Bonds**, named tentatively, which would be backed up by future financial resources.”*

~140 billion USD

[Note: tentative translation by the author]



Prime Minister Kishida's comment at the Advisory Panel on a “Clean Energy Strategy”, May 19, 2022.

(Source: Prime Minister's Office of Japan website)
https://www.kantei.go.jp/jp/101_kishida/actions/202205/19energy.html

Green Innovation Fund (GI Fund)

- ◆ 2 trillion-yen fund as part of NEDO (New Energy and Industrial Technology Development Organization)
- ◆ Provide continuous support for 10 years for R&D, demonstration, and commercialization projects that have will make significant contributions to carbon neutrality
- ◆ Key performance indicators: performance, cost, production, emission reduction.
 - International competitiveness, commercialization status, attractiveness for private investment are also monitored.
- ◆ Requires commitment of the top management of the participating companies to commercialize the output
 - Has an incentive system for commercialization (10% additional funding)

1 Purpose and Outline

To achieve carbon neutrality by 2050, **METI established a 2 trillion-yen fund as part of NEDO** and provide **continuous support for R&D projects, demonstrations, and social implementation projects for 10 years to companies that commit to ambitious goals.**

3 Support Target

METI's support will focus on **priority fields for which implementation plans have been formulated within the Green Growth Strategy, where policy effects are significant, and long-term continuous support is required to realize public implementation.**

- ✓ Average size of conventional R&D projects (20 billion yen) or more.
- ✓ Projects for which short-term government support programs is sufficient are not eligible.
- ✓ Main implementers should be companies or other profit-making businesses capable of carrying out the entire process of public implementation (participation of small and medium-sized venture companies is encouraged; participation of universities and research institutions is also expected).
- ✓ The project must include innovative and fundamental R&D elements that are worthy of being commissioned by the government.

2 Program Target

(Per project)

Ambitious 2030 Target

(Performance, Cost, etc.)

Monitor Cross-sectoral monitoring of fund projects based on the following;

- *International Competitiveness
- *Commercialization (TRL, etc.)
- *Potential for attracting private investment

- **CO₂ Reduction Effect**
- **Economic Effect**

4 Strategy for Maximizing Results

To ensure that research and development results are steadily implemented publicly, METI seeks **the commitment of the managers of companies and other organizations to persevere in challenging these goals as long-term business issues.**

(Efforts required of company managers)

- *Submission of the vision and the long-term business strategy at the time of application
- *Attendance and report to the WG
- *Submission of a management sheet showing the status of initiatives

(Implementation of a system to enhance commitment)

- 1) If the status of the project is inadequate, the project will be canceled, and a portion of the consignment fee will be returned.
- 2) Introduction of a system (an incentive measure) that allows the government to pay more depending on the degree of achievement of targets.

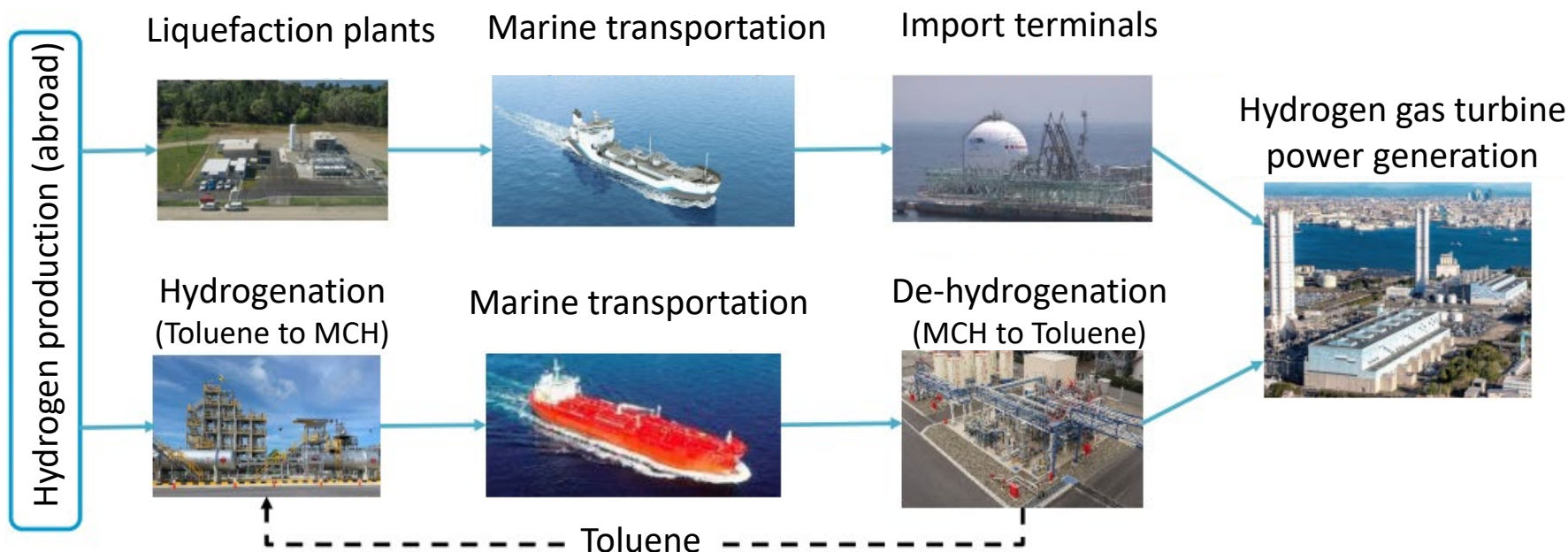
Projects of Green Innovation Fund (as of 18 Oct. 2022)

		Budget (100 mil. yen)
WG1: Green electricity	1. Cost Reductions for Offshore Wind Power Generation	1,195
	2. Next-Generation Solar Cells	498
WG2: Energy transformation	3. Large-scale Hydrogen Supply Chain	3,000
	4. Hydrogen Production through Water Electrolysis using Renewables	700
	5. Iron and Steelmaking Processes using Hydrogen	1,935
	6. Fuel Ammonia Supply Chain	688
	7. Technology for Producing Raw Materials for Plastics Using CO2	1,262
	8. Technology for Producing Synthetic Fuels Using CO2	1,153
	9. Technology for Producing Concrete and Cement Using CO2	568
	10. Technology for CO2 separation & capture	382
	11. Technology for CO2 emission reduction in waste management	(TBD)
WG3: Industrial transformation	12. Next-generation Storage Battery and Motor Development	1,510
	13. On-board computing/simulation technologies for electrified vehicles	420
	14. Smart mobility society	1,130
	15. Next-generation Digital Infrastructure	1,410
	16. Next-generation Aircraft Development	211
	17. Next-generation Ship Development	350
	18. Technology for CO2 emission reduction in food and agriculture sector	159
	19. Carbon recycle using bio-manufacturing technology	1,767

(Source: Ministry of Economy, Trade and Industry (METI) website at https://www.meti.go.jp/policy/energy_environment/global_warming/gifund/index.html)

An example of GI funded project: Large-scale Hydrogen Supply Chain

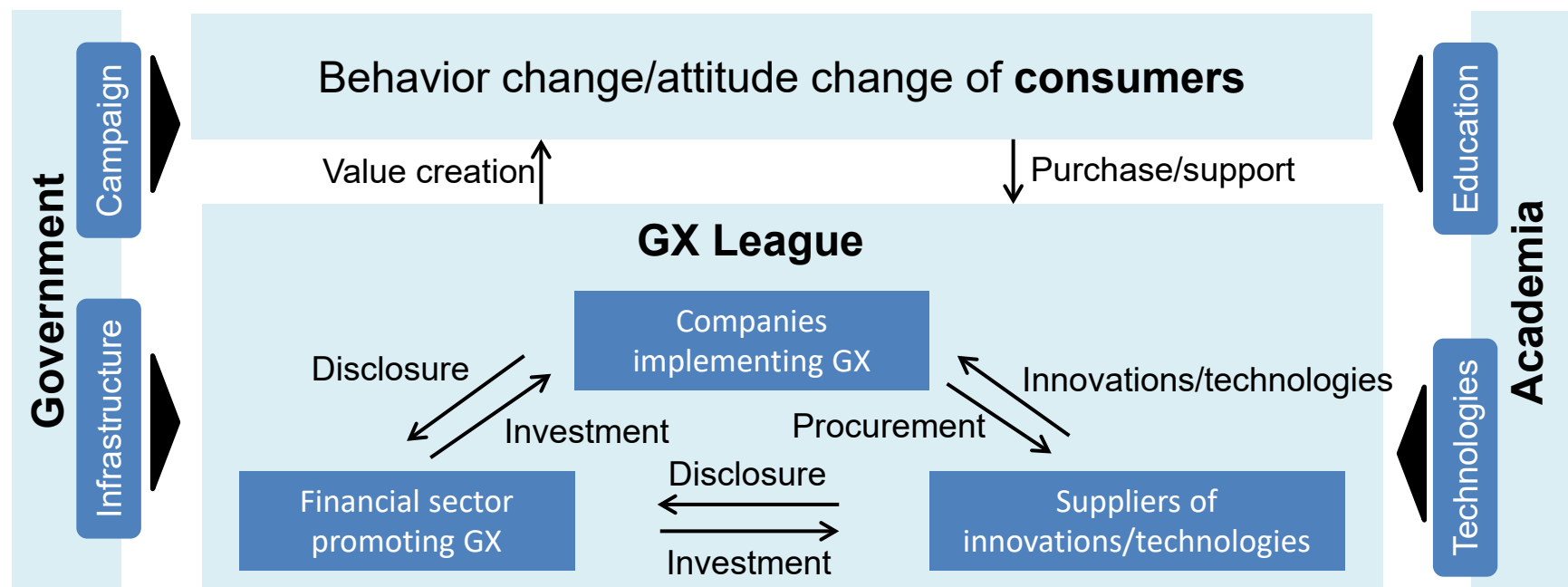
- ◆ Objective: Reduce hydrogen supply cost to 30 yen/Nm³ by 2030, and 20 yen/Nm³ or below by 2050 (similar level to fossil fuels), through:
 - Large-scale hydrogen supply chain demonstration, and development of innovative hydrogen transportation technology, and
 - Demonstration of hydrogen power generation technology at an actual power plant.
- ◆ Participants: Japan Hydrogen Energy, Kawasaki Heavy Industry, ENEOS, JERA, Kansai Electric Power Company
- ◆ Government funding: 300 billion yen (~ 2 billion USD) / 10 years



(Source: Ministry of Economy, Trade and Industry (METI) website and NEDO website at <https://green-innovation.nedo.go.jp/en/project/hydrogen-supply-chain/>)

GX League Initiative: Basic concept

- ◆ The government has established “GX League” in Feb. 2022, as a voluntary league of leading companies, expecting them to actively promote GX.
- ◆ It also aims to serve as a voluntary system for emission trading.
- ◆ 496 companies participated (as of Sep. 2022)
- ◆ The idea of GX League is based on **Green Growth Strategy**, stipulating the introduction of “carbon pricing that contributes economic growth.”



(Source: Ministry of Economy, Trade and Industry (METI), “GX League Basic Concept”, Feb. 2022)

GX League Initiative: requirements and incentives

Requirements for participant companies

- ❑ Reduce own emissions: set quantitative target toward 2030 in line with 2050 carbon neutrality
- ❑ Reduce supply-chain emissions: set quantitative target toward 2030 (*voluntary)
- ❑ Provide green products and services to transform the market

Projects

- ❑ A visioning forum to discuss and propose a carbon neutral, sustainable future
- ❑ A rulemaking forum to discuss and propose market design
- ❑ **A voluntary system for emission trading (under discussion)**

Incentives

- ❑ Branding as a leading GX company
- ❑ Fund raising from ESG financial market
- ❑ Preferential subsidies (under discussion)

1. Set the voluntary target and action plan for 2030, and disclose them to the capital market (Pledge & Review)
2. Implement the plan, monitor and report the progress
3. Trade emission reduction credits among participant companies, or buy from other carbon markets in case of shortfall

Concluding remarks: Challenges for Japanese net-zero target

- ◆ Since the declaration for a net-zero society by the former Prime Minister Suga in October 2020, Japan has made several strategies to achieve the ambitious goal.
- ◆ The net-zero vision has been further materialized/substantiated by the **Green Growth Strategy**, the **6th Strategic Energy Plan**, and **Clean Energy Strategy**. They serve as foundations of further policy measures and as roadmaps for each industry sector.
- ◆ So far, the major programs established for a net-zero society are the **Green Innovation Fund** with 2 trillion yen funding, and the **GX League Initiative**, participated by 500 leading companies.
- ◆ A number of challenges lie ahead of the extremely ambitious goal, including:
 - ❑ How can the government secure financial resources of **GX Economic Bond**, amounting to 20 trillion yen?
 - ❑ Can the public funding stimulate much larger investments from private sector, and achieve more than 150 trillion yen investment jointly?
 - ❑ Will the investments achieve decarbonization and economic growth of Japanese economy simultaneously?

THANK YOU!

Central Research Institute of Electric Power Industry

Socio-economic Research Center

Senior Researcher

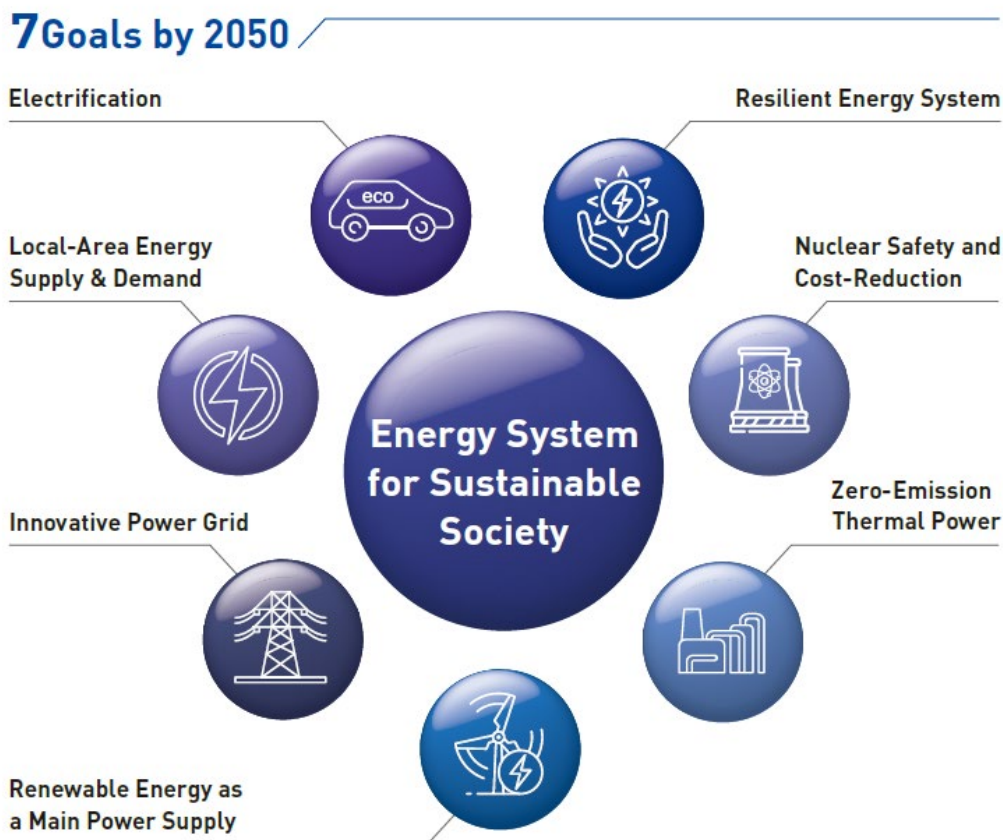
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About CRIEPI: Central Research Institute of Electric Power Industry

CRIEPI's Vision: Energy system for sustainable society

Japan's goal of carbon neutrality by 2050 is also a major challenge for the electric power industry. We recognize that a transformation of energy systems is required and aim to realize a sustainable energy system by then.



About CRIEPI: Laboratories and centers

Socio-Economic Research Center (SERC)

The SERC engages in analysis that takes an extensive overlook of technological infrastructure that underpins society and the economy, energy supply-demand and electric power and in the timely and effective communication of the results of that analysis.

Nuclear Risk Research Center (NRRC)

The NRRC promotes the development and usage of methods for the likes of Probabilistic Risk Assessment (PRA) and Risk-Informed Decision-Making (RIDM), and pushes forward with initiatives aimed at improving the safety of nuclear power facilities.

Energy Transformation Research Laboratory (EXRL)

The EXRL promotes the development of innovative technologies to convert and store energy, the long-term use of nuclear power plants, the development of next-generation nuclear reactors, and the realization of zero-emission thermal power generation.

Grid Innovation Research Laboratory (GdRL)

The GdRL promotes research and development that contributes to the building of new wide-area systems and regional energy supply-demand infrastructure and to electrification in the industry, transport and household domains in order to simultaneously facilitate increases in renewable energy and its guaranteed supply.

Sustainable System Research Laboratory (SSRL)

The SSRL promotes research and development pertaining to the reinforcement of resilience through effective disaster risk prevention, operation and preservation for electric power equipment, the construction, operation and preservation of renewable energy power source equipment for the likes of offshore wind power generation, the disposal of radioactive waste, and radiation safety.