Policies and Challenges for Japan's Energy Transition

Japan Updates 2024

ANU Australia-Japan Research Centre

4 September 2024

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- Why energy transition is so important for Japan
- Current status of Japan's energy transition
- Policies and Challenges for energy transition

Why energy transition is so important for Japan

- For climate
  - Japan's long-term climate goal: Net zero by 2050 (2020)
  - Japan's NDC = 2030 climate target (2021): 46 – 50% below 2013 levels
  - 1.5℃ goal: International society "resolves to pursue efforts to limit the temperature increase to 1.5℃" at COP26, repeatedly endorsed by subsequent COP, G7, G20

- Strong voices coming from demand-side
  - Japan Climate Initiative (JCI) (567 companies), Japan Climate Leaders' Partnership (JCLP), RE100 etc.

- For driving Japan's "New growth" = GX

Japan's long-term goal and NDC

- Japan's long-term goal: Net zero by 2050 (2020)
  - “Japan pledges to, by 2050, reduce GHG emission in Japan to net zero, namely become carbon neutral and achieve a decarbonized society”.
  - The pledge is now legalized under the 1998 Law to promote measures to cope with global warming.

- Japan's NDC = 2030 climate target (2021): 46 – 50% below 2013 levels
  - "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."
  -
- Strategic Energy Plan (2021) and National Plan on Climate Change Actions (2021), which include specific targets/milestones such as:
  - Share of renewables in the power mix: 36-38% of total power generated by 2030 (21.7% in 2023)
  - Offshore wind goal: 10GW by 2030, 30-45GW by 2040
  - Mandatory energy efficiency standards for newly constructed houses and buildings by 2030 (to realize ZEB (net zero energy building), ZEH (net zero energy housing))
  - Electrified transport: all new light-duty cars should be electrified by 2035.

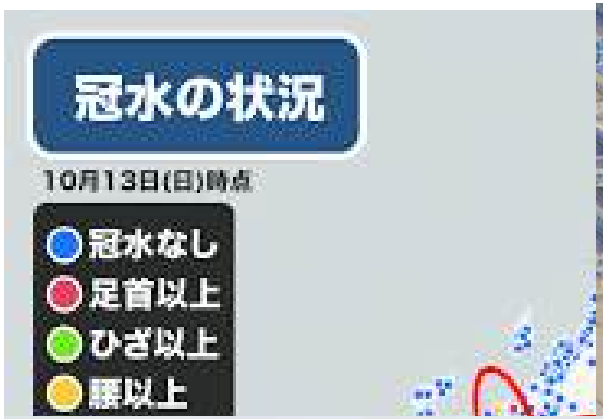
2018 Top 10 Global Economic Loss Events

Date (s)	Event	Location	Deaths	Economic Loss（billion USD）	Insured Loss（billion USD）
October 10-12	Hurricane Michael	US	32	17.0	10.0
September 13-18	Hurricane Florence	US	53	15.0	5.3
November	Camp Fire	US	88	15.0	12.0
September 4-5	Typhoon Jebi (No. 21)	Japan	17	13.0	8.5
July 2-8	Flooding	Japan	246	10.0	2.7
Spring & Summer	Drought	Central & Northern Europe	N/A	9.0	0.3
September 10-18	Typhoon Mangkhut	Oceania, East Asia	161	6.0	1.3
July - September	Flooding	China	89	5.8	0.4
November	Woolsey Fire	US	3	5.8	4.5
August 16-19	Tropical Storm Rumbia	China	53	5.4	0.3
	All Other Events		-	123.0	45
		Totals		225.0	90.0

Source：AON, 2019

Typhoon Hagibis (No. 19) (Oct. 2019)

Roughly $4 billion of the $10 billion damage in insured losses caused by the rainfall can be attributed to climate change（Otto and Li, 2022）. Event attribution.



2019 Top 10 Global Economic Loss Events

Date (s)	Event	Location	Deaths	Economic Loss（USD billions）	Insured Loss（USD billions）
October 6-12	Typhoon Hagibis (No. 19)	Japan	99	15.0	9.0
June - August	Monsoon Floods	China	300	15.0	0.7
September 7-9	Typhoon Faxai（No. 15）	Japan	3	10.0	6.0
May - July	Mississippi Basin Floods	United States	0	10.0	4.0
August 25 – Sep 7	Hurricane Dorian	Bahamas, Caribbean, US, Canada	83	10.0	3.5
March 12-31	Missouri Basin Floods	United States	10	10.0	2.5
June - October	Monsoon Floods	India	1750	10.0	0.2
August 6-13	Typhoon Lekima	China, Philippines, Japan	101	9.5	0.8
March - April	Flooding	Iran	77	8.3	0.2
May 2-5	Cyclone Fani	India, Bangladesh	81	8.1	0.5
		All Other Events		126 billion	44 billion
		Totals		232 billion	71 billion

Source：AON, 2020

Projected changes in extremes are larger in frequency and intensity

1850-1900		Present 1°C	1.5°C	2°C	4°C
Hot temperature extremes over land: 10-year event	Intensity increase	1.2°C hotter	1.9°C hotter	2.6°C hotter	5.1°C hotter
	Frequency per 10 years	2.8 times	4.1 times	5.6 times	9.4 times
Hot temperature extremes over land: 50-year event	Intensity increase	1.2°C hotter	2.0°C hotter	2.7°C hotter	5.3°C hotter
	Frequency per 50 years	4.8 times	8.6 times	13.9 times	39.2 times
Heavy precipitation over land: 10-year event	Intensity increase	6.7% wetter	10.5% wetter	14.0% wetter	30.2% wetter
	Frequency per 10 years	1.3 times	1.5 times	1.7 times	2.7 times
Agricultural & ecological droughts in drying regions: 10 year event	Frequency per 10 years	1.7 times	2.0 times	2.4 times	4.1times

Source: IPCC AR6, 2021

The most recent science tells us

IPCC Sixth Assessment Report Synthesis Report （March 2023）

- Critical decade/decisive decade
  - Climate change as imminent risk. Global climate related economic loss has inreased.
  - Every increment of global warming will intensify multiple and concurrent hazards. "Limits to adaptation"
  - 1.5℃ and 2℃ goals involve rapid and deep, immediate GHG emissions reductions in all sectors this decade. Global net zero CO2 emissions are reached in the early 2050s, and around the early 2070s, respectively.

		Reduction rate compared to emissions in 2019			
		2030	2035	2040	2050
1.5℃ goal （>50%）	GHG	43 [34 - 60]	60 [49 - 77]	69 [58 - 90]	84 [73 - 98]
	CO2	48 [36 - 69]	65 [50 - 96]	80 [61 - 109]	99 [79 - 119]
2℃ goal （>67%）	GHG	21 [1 - 42]	35 [22 - 55]	46 [34 - 63]	64 [53 - 77]
	CO2	22 [1 - 44]	37 [21 - 59]	51 [36 - 70]	73 [55 - 90]

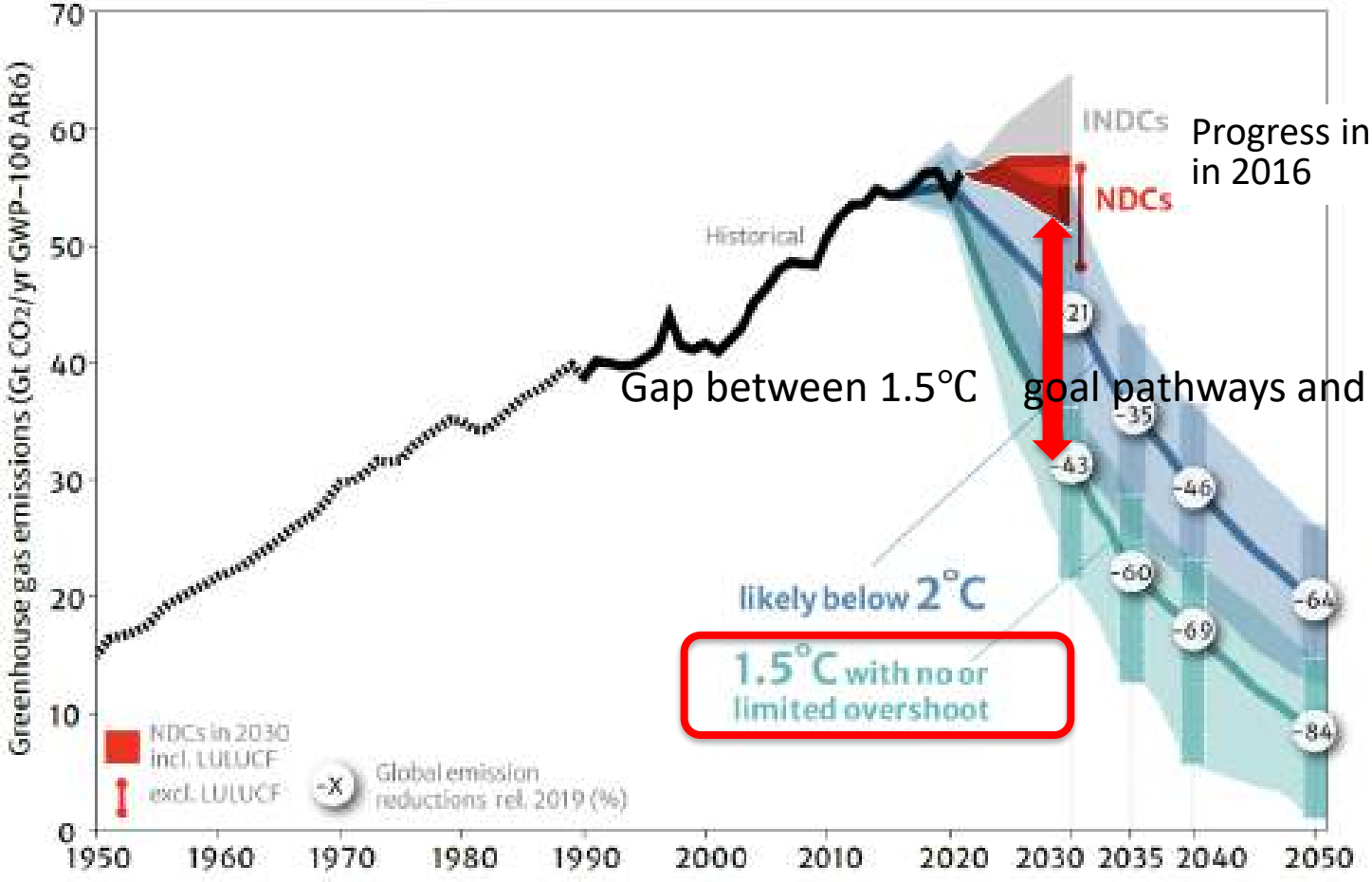
- From goals and policies to implementation and actions
- Extension of our present society will not lead to a sustainable society in future.

= need "systems transitions"

Source：IPCC, 2023, modified by Takamura

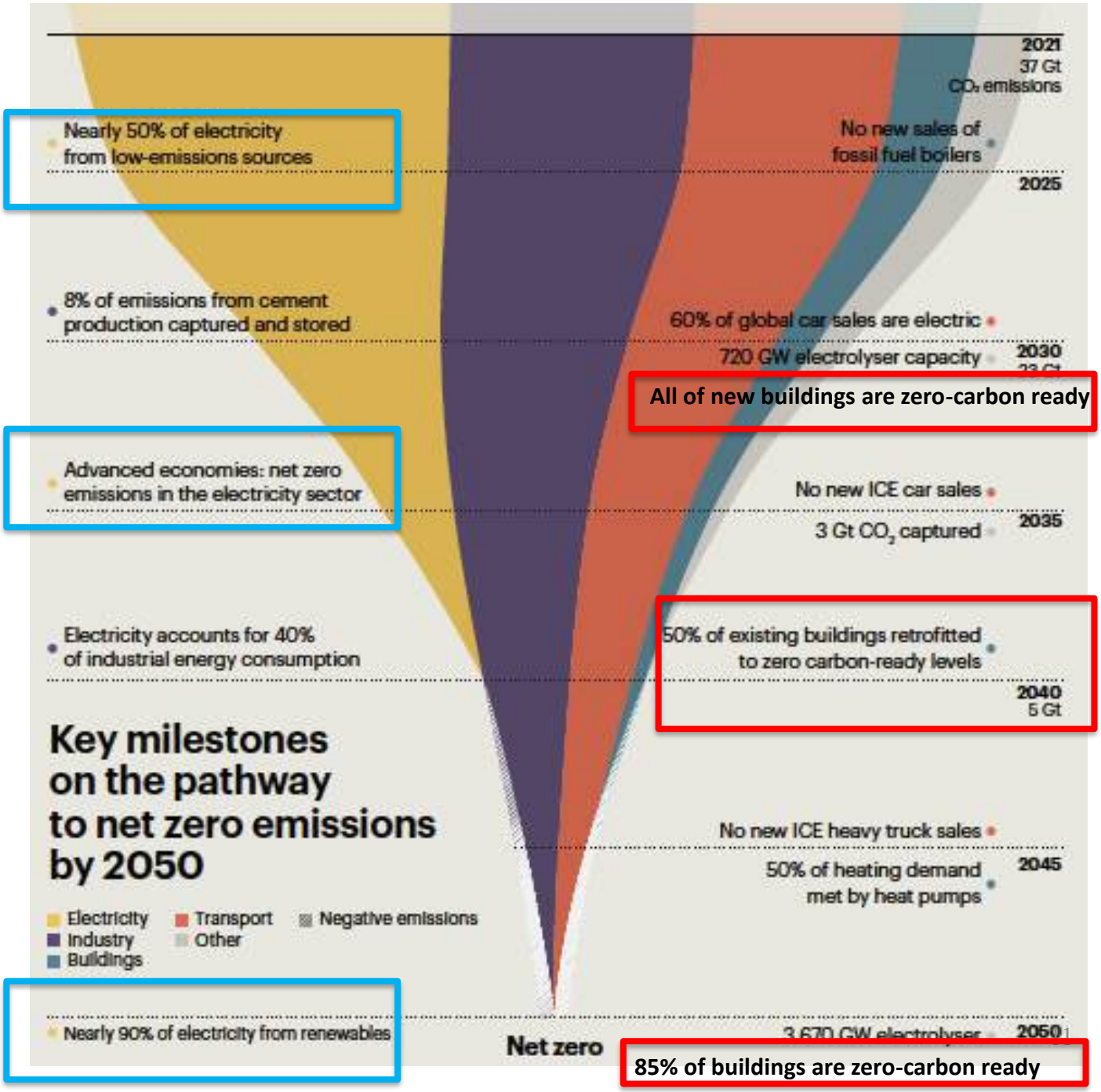
Gap between pathways toward 1.5°C goal and 2030 NDCs

Extension of our present society will not lead to a sustainable society in future.
= need "systems transitions"
Clear long term vision/goal for future society makes us identify and understand challenges.



Source：UNFCCC 2023

Source : IEA 2022

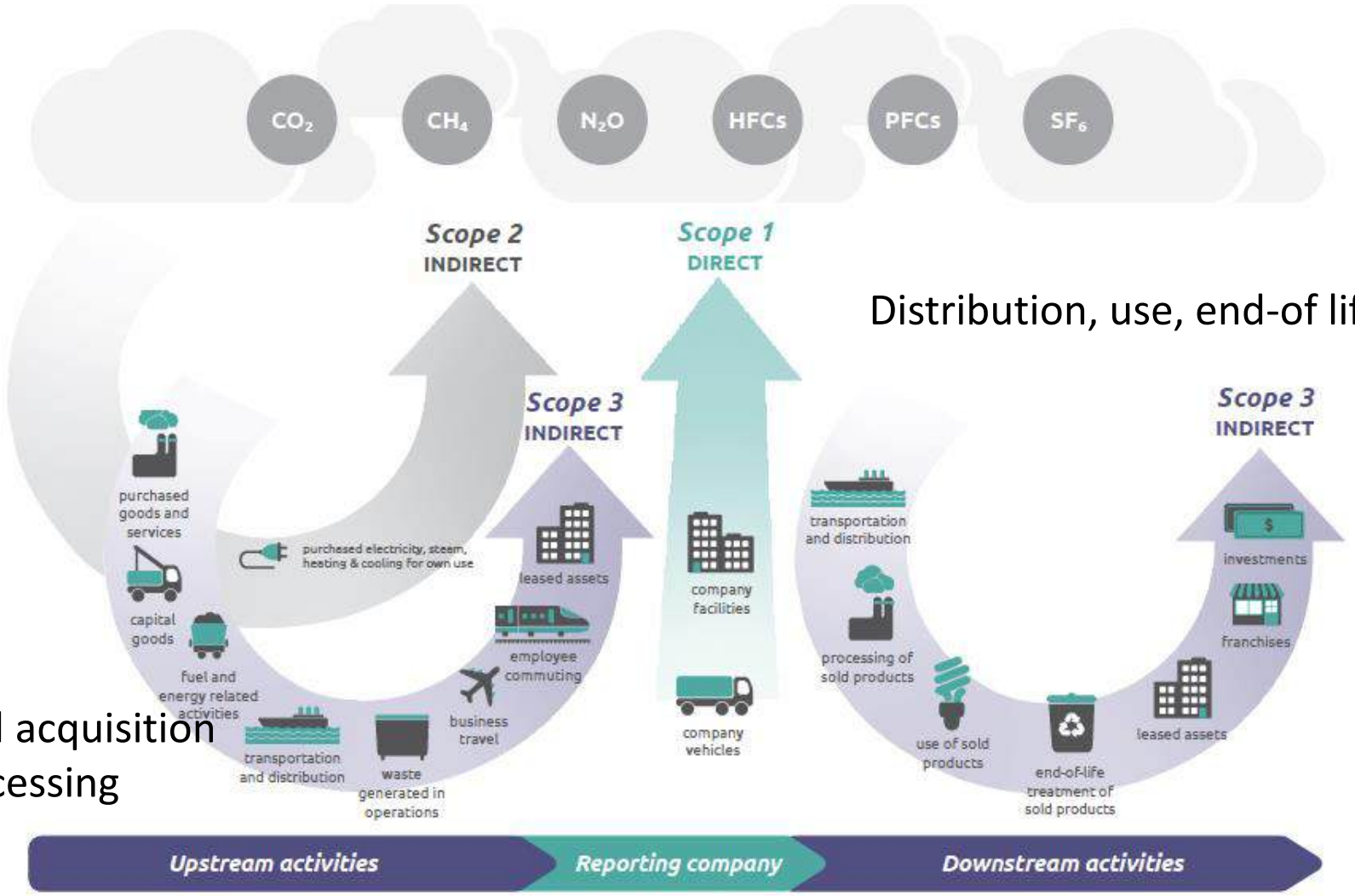


"New normal" towards net zero

- "New normal": Dynamic and drastic changes in businesses towards green economy, especially "net zero by 2050"
  - Most of large companies and of listed companies commit themselves to "net zero by 2050" at the latest, decarbonzation goal.
  - Companies, including banks and financial institutions, do also commit themselves to reduceing scope 3 emissions (emissions from their supply chain and value chain), which means that companies request/encourage its suppliers to reduce their emissions.
    - Ex: Microsoft: (Potential) suppliers are requested to submit its scope 1 and 2 emissions plus scope 3 emissions for being selected as its supplier
    - Ex: Apple: requests its suppliers to produce Apple product by renewables by 2030
    - Ex: Hitachi: its carbon neutrality by 2030 and 100% reduction of its scope 3 emission by 2050
    - Ex: Banking corporations: net zero by 2050 of its portfolio of investment and loan with interim target of 2030 (around 50%)
- Climate actions and clean energy transition to net zero will now enhance competitiveness of companies.

Scope 3 emissions

Value chain emissions



Distribution, use, end-of life

Material acquisition
Pre-processing

Source：WRI/WBCSD Corporate Value Chain (Scope 3) Accounting and Reporting Standard, 2011

Microsoft: “Climate Moonshot”（16 January 2020）

- Carbon negative by 2030
- Remove our historical carbon emission by 2050
- $1 billion climate innovation fund
- Scope 1 and 2 emissions to near zero by the middle of this decade
  - By 2025, shift to 100 percent supply of renewable energy.
- Reduce scope 3 emissions by more than half by 2030 through new steps
  - Since 2021, MS begins to implement new procurement processes and tools to enable and incentivize our suppliers to reduce their scope 1, 2, and 3 emissions.

https://blogs.microsoft.com/blog/2020/01/16/microsoft-will-be-carbon-negative-by-2030/

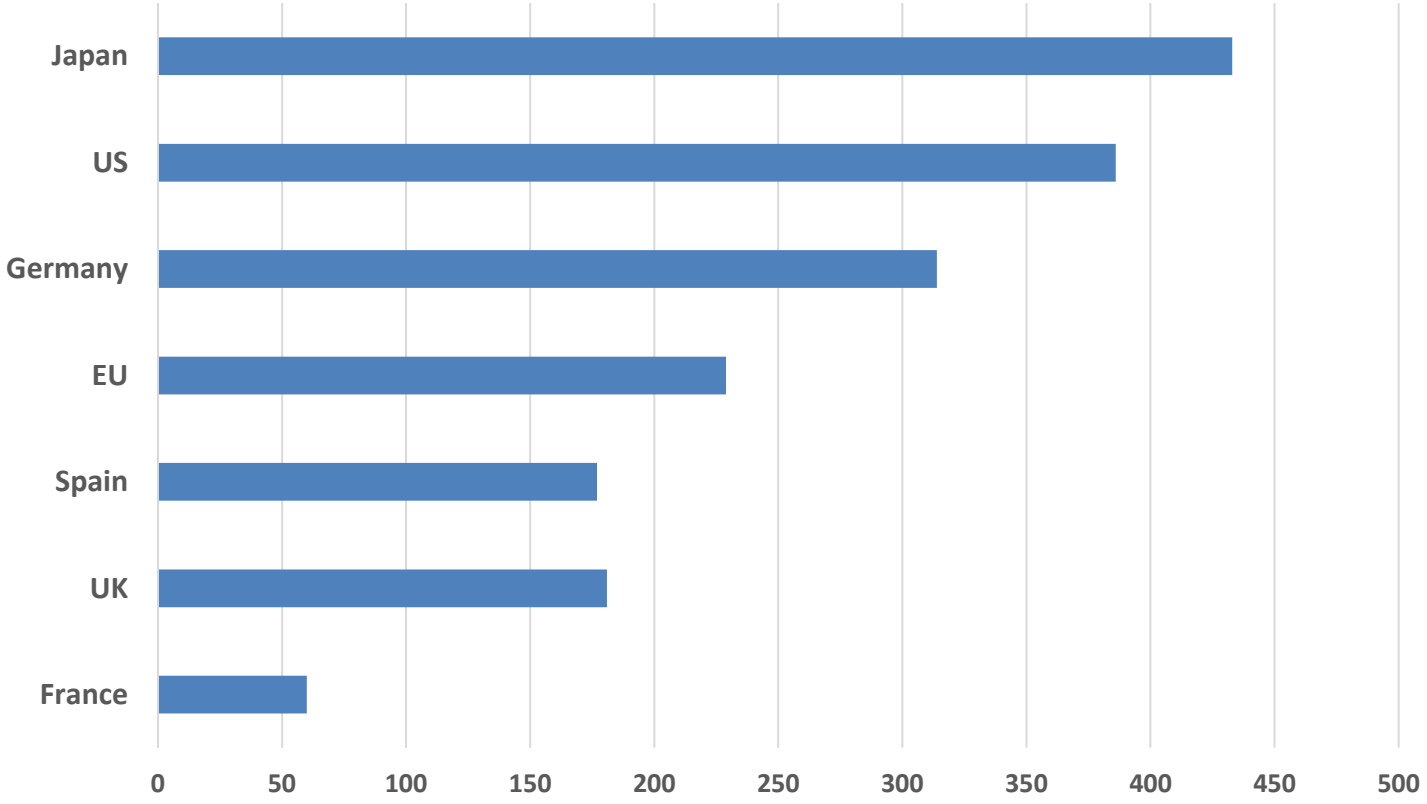
Apple: carbon neutral 2030 （16 July 2020）

- Apple commits to be 100% carbon neutral for its supply chain and products
  - Low carbon product design
  - Energy efficiency
  - Renewable energy
  - Process and material innovations
  - Carbon removal
- Already 100% renewable energy for its operations
- Focusing on creating new projects and moving its entire supply chain to clean power.
- More than 200 manufacturing partners including 35 Japanese companies have committed to 100 percent renewable energy for Apple production.

https://www.apple.com/newsroom/2020/07/apple-commits-to-be-100-percent-carbon-neutral-for-its-supply-chain-and-products-by-2030/

Emission intensity of electricity (2020)
（grams CO2/kWh）

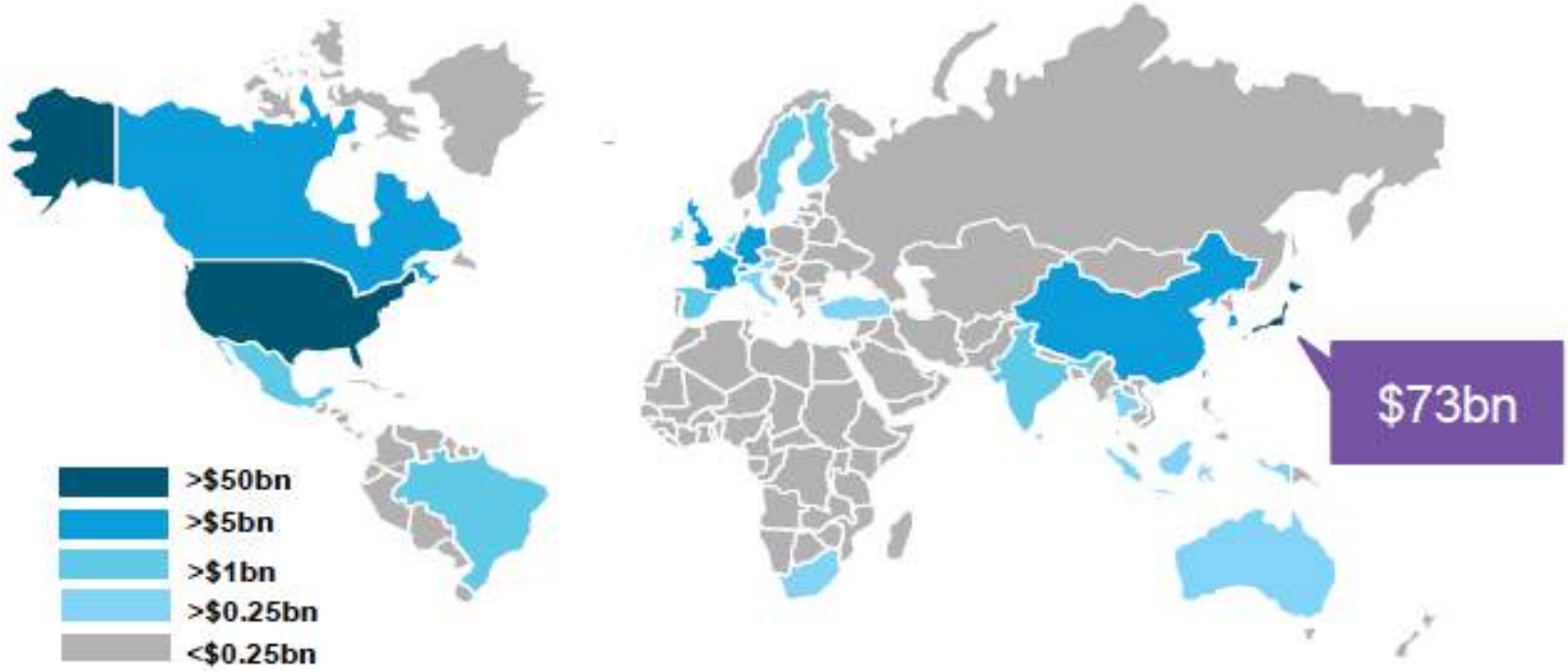
Japan is the one of developed countries with highest emission intensity.



Source：Japan, UK, US: Data published by Government
Others: European Environment Agency

Business risk due to difficulty in procuring renewable energy

Japanese companies have faced business risk leading to 73 billion dollars.



Source: BloombergNEF, Bloomberg Terminal
Note: Chart is based on data available on Bloomberg's SPLC function, and does not necessarily represent the entire supply chain for this group of selected companies.

“Sony warns it could move factories over Japanese energy policy”

- Sony warns it could move factories over Japanese energy policy (Financial Times, 27 Nov. 2020)
  - “So they told me either we do something about renewables or they have to move out of Japan.” (Minister Kono (at that time))

https://www.ft.com/content/bbd59494-ac64-4dda-8da5-a2990d8936d3

Governments push companies to integrate climate risks into their business.

Climate policy as driver of economic growth: GX

- Climate policy is not only to protect climate system but also aims to drive economic growth and development: GX

- Developments of GX policy
  - Feb. 2023: Cabinet approved "the Basic Policy for the Realization of GX".
  - May 2023: GX Promotion Act enacted.
  - July 2023: Cabinet approved "GX Promotion Strategy".
  - Dec. 2023: “Sector-specific Investment Strategies”
  -
  - May 2024: Deliberation started on a GX 2040 vision as well as a new Strategic Energy Plan, a new Climate Action Plan and an updated NDC, to be completed by the end of FY2024.

The Basic Policy for the Realization of GX (Feb. 2023) (extract)

- "…the idea of Green Transformation, or GX, means a thorough overhaul of its post-war industrial/energy policies, as GX will transform our entire industrial and social structures centering around fossil energy sources, long established since the Industrial Revolution, into ones based on clean energy."
- "…Making the most of these technological advantages to accelerate GX will lead to the stable supply of energy as well as providing opportunities for putting Japan on track for a dramatic bounce-back to economic growth. Japan's economy needs to grow by leveraging the expertise and insight accumulated in the country's private sector to support other countries' effort for achieving net-zero GHG emissions, as well as creating new demand and markets in decarbonization business which will ultimately lead to reinforcing Japan's industrial competitiveness."
- "GX introduction can lead the way to clearing Japan's global commitment of 46% reduction of GHG emissions in FY2030 and achieving net-zero GHG emissions by 2050.This initiative can also bring stable supply of inexpensive energy by reorganizing energy supply-demand structures, and furthermore, reforming Japan's industrial and social structures, and building a society in which all citizens, including future generations, can live an affluent life."

GX Promotion Strategy – Japan's Challenge

■ Based on the **GX Promotion Act** (enacted May 2023), the Japanese government adopted the **"GX Promotion Strategy" in July** 2023. The **strategy sets forth necessary policies to be implemented to achieve 150 trillion yen of public and private investments** to realize GX (green transformation),a transition from a fossil fuel-oriented economic and industrial structure since the Industrial Revolution to a clean energy-oriented one.

1. Green Transformation based on the Steady Supply of Energy

①Efforts to promote energy saving

②Renewable energy as a major source

- Substantial grid enhancement
- Next generation solar panels, floating offshore wind

③Utilization of nuclear energy

- Developing next generation reactors with substantially enhanced safety features
- Extension of operation periods of existing reactors with a premise of safety as a top priority

④Other efforts

- Support for RDD&D of hydrogen, ammonia, CCS/CR, E-fuel, batteries and others

2. Implementation and realization of "Pro-Growth Carbon Pricing Concept"

① Upfront investment support provided through issuing GX Economy Transition Bonds (20 trillion yen in 10 years)

②Adoption of Pro-Growth Carbon Pricing

i. Emission Trading System 【FY2026～】

ii. Auction of emission quotas by power producers 【FY2033～】

iii. Carbon surcharges for fossil fuels 【FY2028～】

③Utilization of new financial measures

④International cooperation

⑤Social measures to promote GX (just transition, demand creation, SMEs)

Source: METI 2024

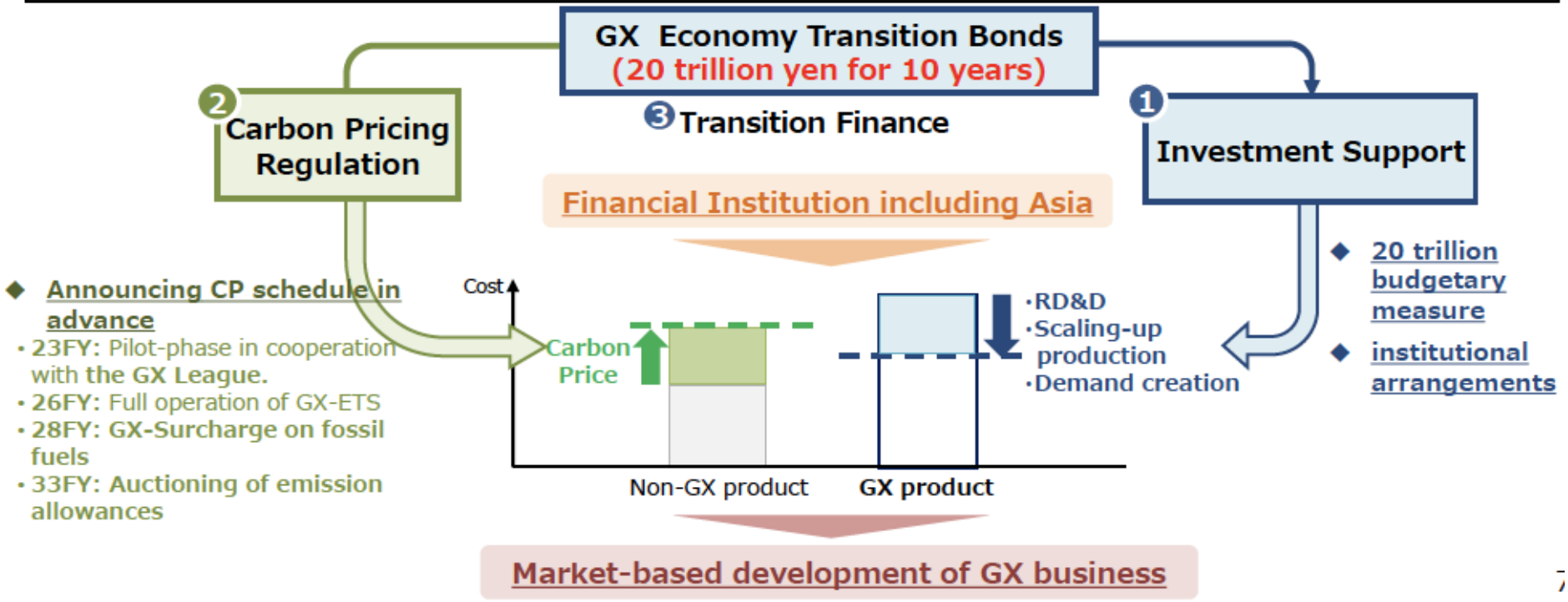
Pro-Growth Carbon Pricing Framework

■ To promote the GX investment, a "**Pro-Growth Carbon Pricing Framework**" will be implemented.

① **Issuing GX Transition Bonds** (20 trillion yen for 10 years)

② Implementing **carbon pricing** mechanisms to incentivize early GX investment **later**
(1) Full-scale operation of ETS in heavy-emission industries [from FY2026]
+ Allowance **auctioning** for power generation companies [from FY2033]
(2) Introducing **GX-Surcharge** on fossil fuel supply [from FY2028]

③ Significantly enhancing **finance support programs** for public-private partnership **now**



Source: METI 2024

Investment Promotion Measures Taking Advantage of GX Economy Transition Bonds

		Public & private investment	Key investment promotion measures	Already supported (FY2022~FY2023)	Budget support After FY2024	Note
Manufacturing	Steel Chemicals Paper and Pulp Cement	3 trillion yen~ 3 trillion yen~ 1 trillion yen~ 1 trillion yen~	• Support for capital investment for conversion of manufacturing processes		480 billion yen (5 years)	• Total amount of capital investment support for four industries (iron and steel, chemical, pulp and paper, cement) is 1.3 trillion yen over 10 years • Provide R&D support for hydrogen reduction steel making, etc. through the Green Innovation (GI) Fund, and tax credits based on green steel/ green chemical production volume
Transportation	Automobiles	34 trillion yen~	• EV for passenger cars • EV for commercial vehicles	219.1 billion yen 54.5 billion yen		• Provide R&D support for next-generation batteries/motors, synthetic fuels, etc. through the GI Fund, and tax credits based on production volume of EVs
	Batteries	7 trillion yen~	• Production facility	597.4 billion yen	230 billion yen	• Allocate 230 billion yen to the Economic Security Fund
			• Storage batteries for stationary use		40 billion yen (3 years)	• Provide R&D support for all solid-state batteries, etc. through the GI Fund
	Aircraft	4 trillion yen~	• Core technologies for next-generation aircraft			• Consider measures based on the "Next-Generation Aircraft Strategy" to be formulated by the end of FY2023
	SAF	1 trillion yen~	• SAF manufacturing and supply chain development		340 billion yen (5 years)	• Provide R&D support for SAF and next-generation aircraft through the GI Fund, and provide tax credits based on SAF production volume, etc.
	Ships	3 trillion yen~	• Production facilities (e.g. as zero-emission vessels)		60 billion yen (5 years)	• Provide R&D support for ammonia ships, etc., through the GI Fund
Life-related	Life-related Industry	14 trillion yen~	• Retrofitting homes with insulated windows • High-efficiency water heaters • Retrofitting of commercial, educational and other buildings	235 billion yen 58 billion yen 33.9 billion yen		• 2 trillion yen support for 3 years including automobiles, etc (including support from sources other than GX Economy Transition Bond)
	Resource Circulation	2 trillion yen~	• Building a recycling-oriented business model		30 billion yen (3 years)	• Provide R&D support for pyrolysis technology, etc., through the GI Fund
	Semiconductor	12 trillion yen~	• Production facilities for power semiconductors, etc. • Technology development of AI semiconductors, optoelectronic integration, etc.	432.9 billion yen 103.1 billion yen		• Provide R&D support for power semiconductors, etc., through the GI Fund
Energy	Hydrogen and its Derivatives	7 trillion yen~	• Support for the price difference with existing raw materials/ fuels		460 billion yen (5 years)	• Total amount of support focusing on price gaps at 3 trillion yen for 15 years from the beginning of supply
			• Development of supply centers for hydrogen, etc.			• Provide R&D support for supply chain establishment through the GI Fund • Consider support for facility development based on feasibility studies
	Next-Generation Renewable Energy	31 trillion yen~	• Supply chain of perovskite solar cells, floating offshore wind, and water electrolyzers		420 billion yen (5 years)	• Total amount of support to be approximately 1 trillion yen over 10 years • Provide R&D support for perovskite solar cells, etc. through the GI Fund
	Nuclear Power	1 trillion yen~	• Development of next-generation innovative reactors	89.1 billion yen	160 billion yen (3 years)	
	CCS	4 trillion yen~	• Building a CCS value chain			• Consider measures based on the results of feasibility studies of advanced CCS projects, etc.
	Cross-sectoral measures		• Energy saving subsidies for SMEs, support for deep tech start-ups, R&D by the GI Fund, financial support by GX organization, regional decarbonization grants, etc.	1,149 billion yen	166 billion yen	• 700 billion yen support for 3 years • 200 billion yen support for 5 years • 2 trillion yen in the third supplementary budget for FY2020 • Financing support through debt guarantees, etc.
	Tax measures		• New tax credits based on production volume of green steel, green chemicals, SAF, EVs, etc.			

Budget support after FY2024: Approx. 2.4 trillion yen Budget including already supported are in blue figures: Approx. 13 trillion yen

Source: METI 2024

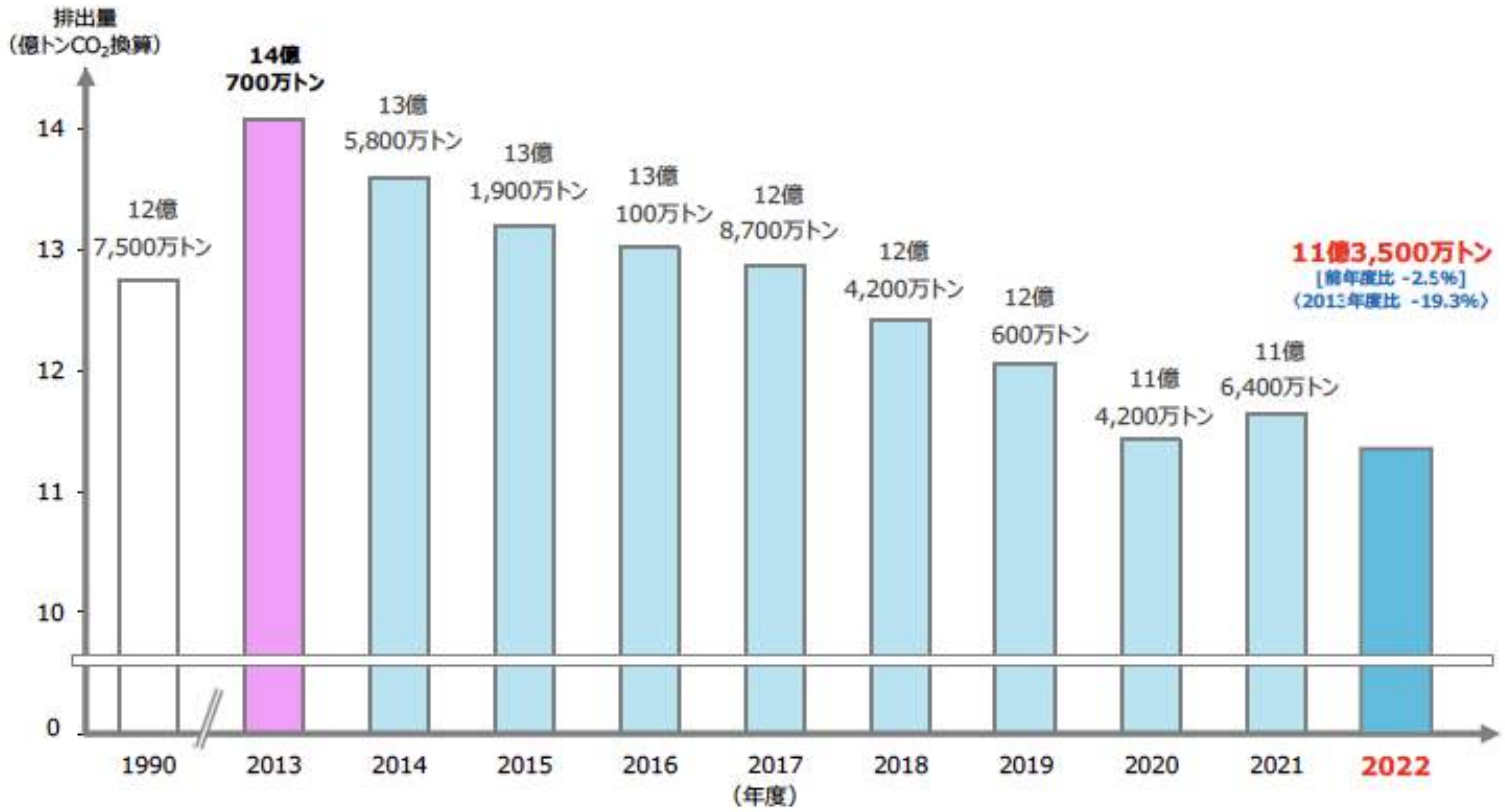
Special importance of 2024 – 2025

- For that purpose, review process of Strategic Energy Plan (the most recently revised in 2021) started on 15 May and the one of National Plan on Climate Actions (the most recently revised 2021) are underway.
  - Under the Paris Agreement, a new Nationally Determined Contribution (NDC) is expected to be submitted next year 2025. Expected that NDC should be the one beyond 2030 (2035 NDC recommended).
  - Climate policy and energy policy are very much interlinked. CO2 emissions from energy use account for about 85% of Japan's GHG emissions.
  - Prime Minister Kishida instructed to complete the work for finalizing "GX 2040 Vision", "Strategic Energy Plan", "Climate Action Plan" and NDC by the end of FY2024 (next March 2025).
  - Drafts of Strategic Energy Plan and Climate Action Plan are expected to be finalized by the end of 2024 (then submitted to public comments).

- This process is critical, which would frame decarbonization pathway for one or 2 decades to come.

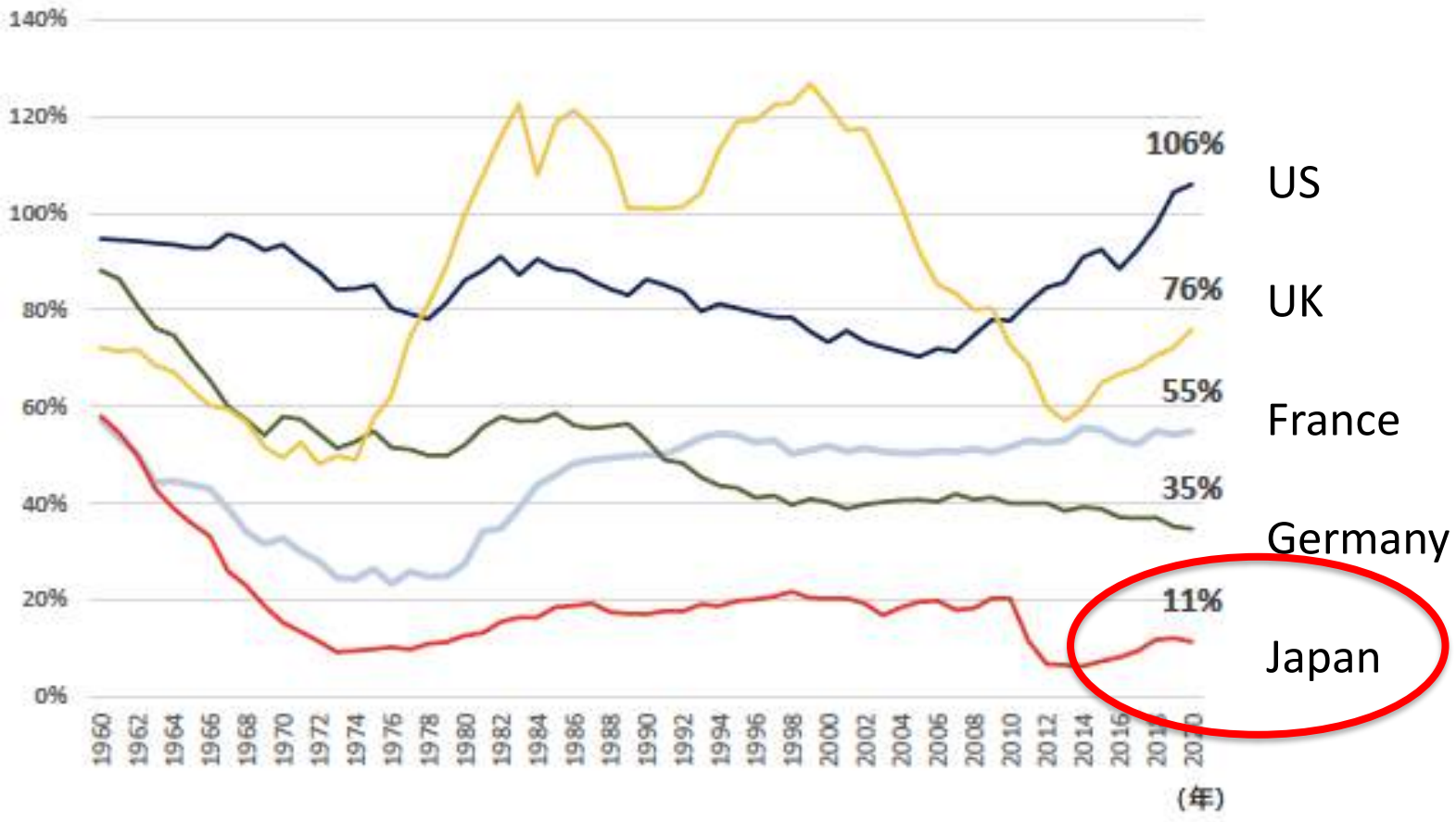
Japan's GHG emission trends（FY 2022）

Emission in FY2013 (baseyear): 1.407 GtCO2eq
Emission in FY2022: 1.135 GtCO2eq(19.3% below 2013)= lowest level since 1990
About 90% of total primary energy consumption depends on imported fossil fuels
CO2 from energy use accounts for about 85% of Japan's GHG emission
= energy transition is key for Japan's emission reduction.



Source：Ministry of the Environment, Japan, 2024

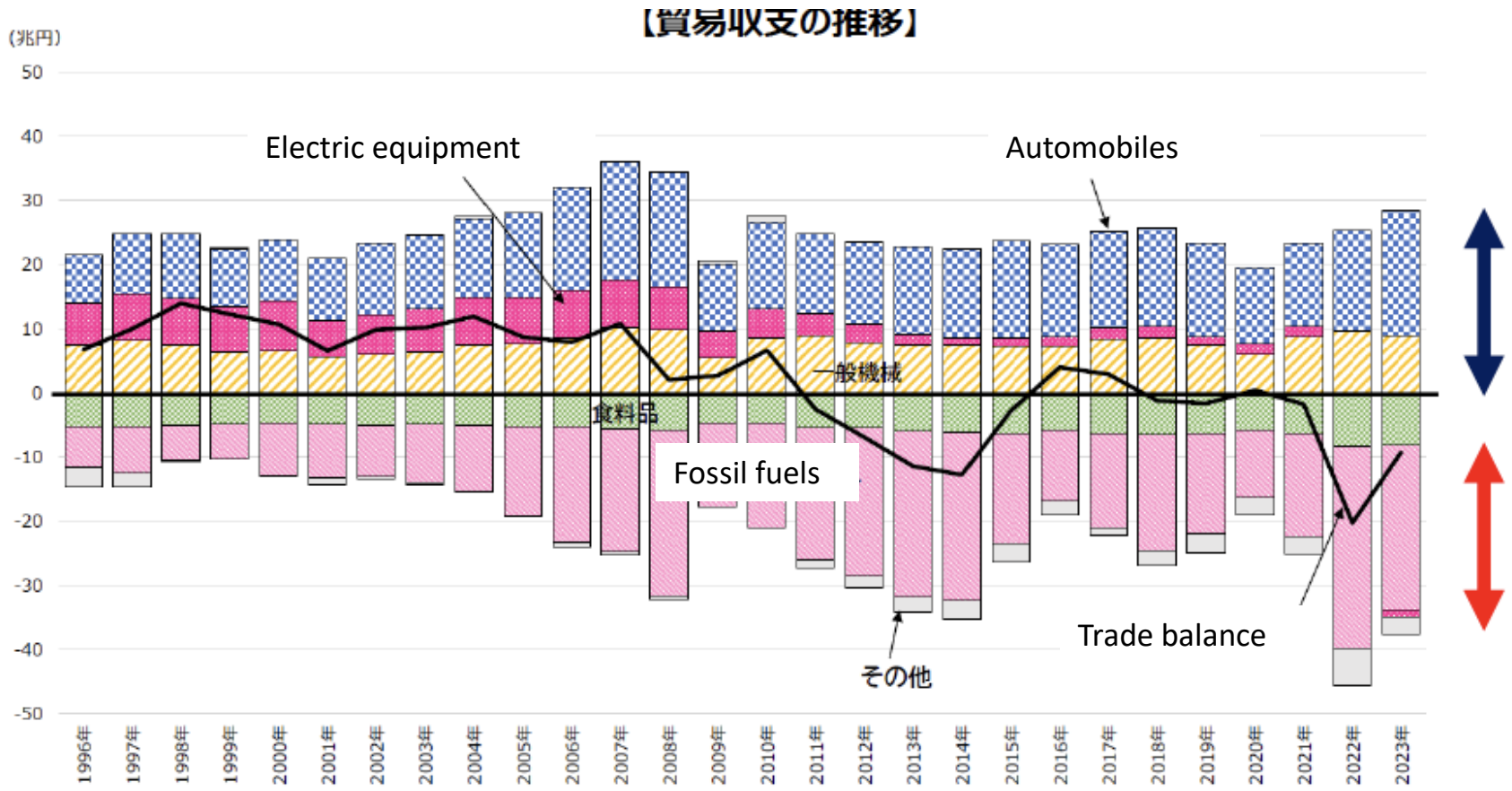
Energy self-sufficiency rate trends



Source：Agency for natural resources and energy, 2022, modified by Takamura

Trade balance trends

Japan pays all gains from export of automobiles and electric equipment for imports of fossil fuels



Source：Agency for natural resources and energy, 2024, modified by Takamura

Outlook for Energy mix in FY2030 (The 6th Strategic Energy Plan)

-Points of outlook for energy supply and demand in FY2030-

- The 6th Strategic Energy Plan was approved by the Cabinet in October 2021.
  - ① Further pursuit of thorough **energy efficiency improvement by 62 million kl**※ by FY2030.
  - ② Raise the percentage of **renewable energy to 36-38%** by FY2030.
    - → **solar - 14-16%; wind power - 5%** of that total.
  - ③ A new goal of **hydrogen/ammonia to 1%** (as power use) by FY2030.

※Reduction in energy consumption from 2013. (Crude oil equivalent)

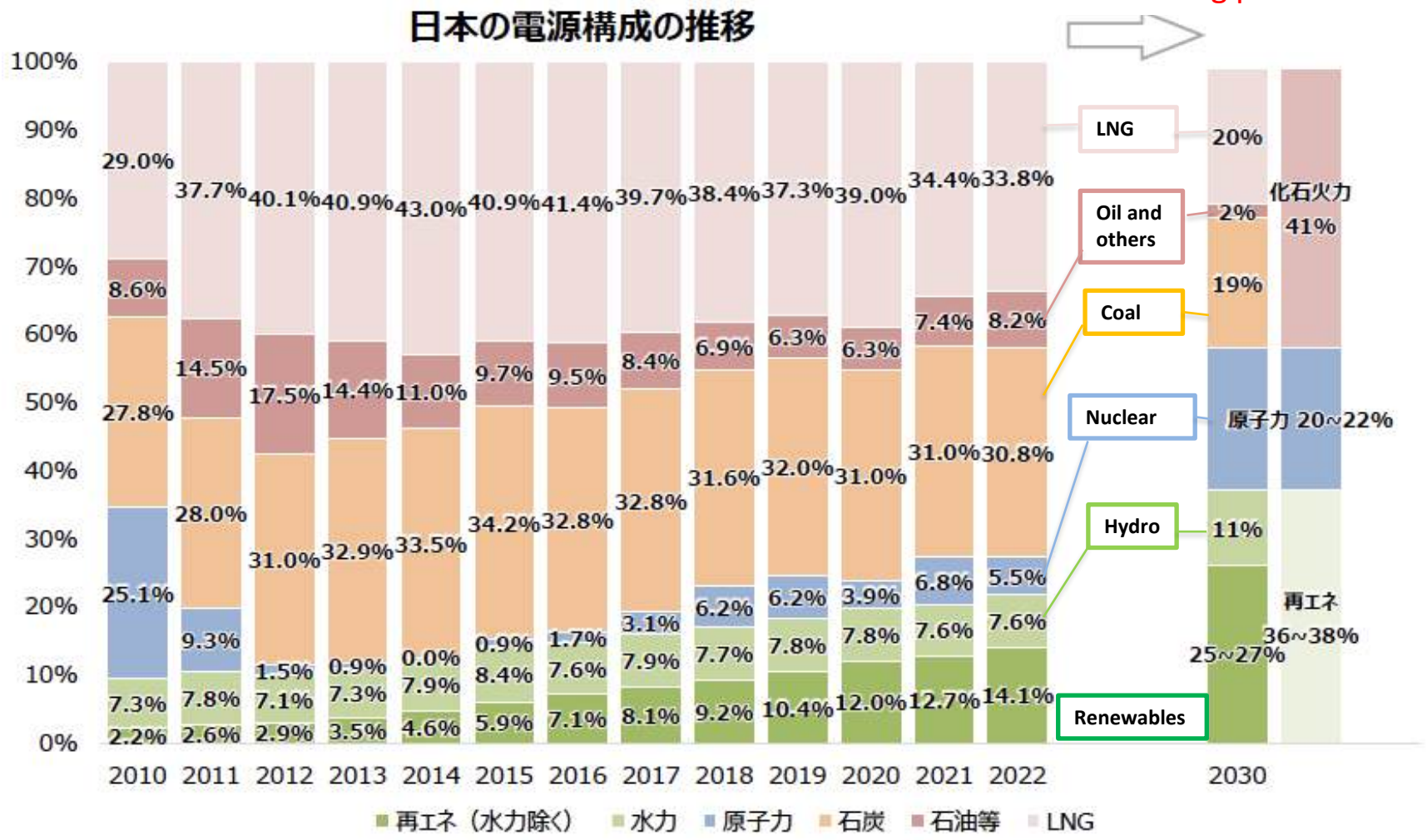
		Current energy mix (in FY2022)		Energy mix in FY2030 (ambitious outlook)	
①	**Energy efficiency improvement** (ratio to final energy consumption)	–		**62 million kl** (17.7%)	
	Final energy consumption (without energy conservation)	306 million kl		350 million kl	
Power generation mix Electricity generated: Approx. 934 TWh (2030)	② **Renewable energy**	21.7%	solar 9.2%, wind 0.9%, geothermal 0.3%, hydropower 7.6%, biomass 3.7%	**36-38%**[*1]	solar 14～16%, wind 5%, geothermal 1%, hydropower 11%, biomass 5%
	③ **Hydrogen/Ammonia**	0%		**1%**	
	Nuclear	5.5%		**20-22%**	
	LNG	33.8%		**20%**	
	Coal	30.8%		**19%**	
	Oil, etc.	8.2%		**2%**	
(+ non-energy related gases/sinks)					
GHG reduction rate (ref. 2013)		19.3%		**46%**[*2]	

[*1] If progress is made in utilization and implementation of R&D of renewable energy currently underway, 38% or higher will be aimed at.
[*2] Continuing strenuous efforts in its challenge to meet the lofty goal of cutting its emission by 50%

Source：Takamura based on Agency for natural resources and energy, 2023 and Ministry of Environment 2024

Trends in power mix (Japan)

Energy transition toward decarbonizing power sector



Source：Takamura based on Agency for natural resources and energy, 2024

Challenges of policies (1)

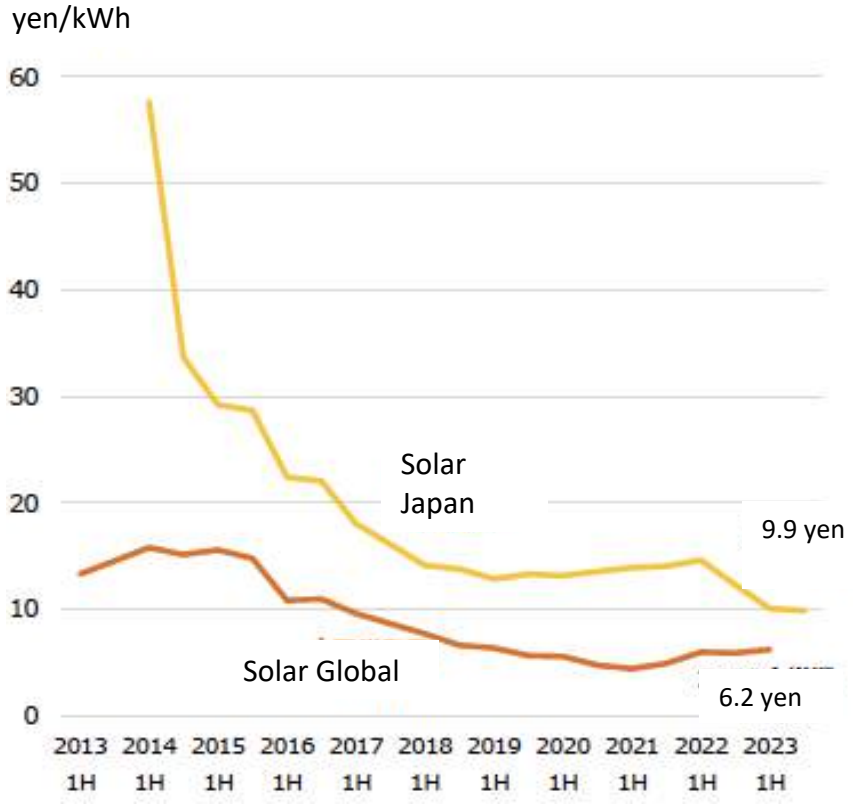
- Climate goal and target look "ambitious", but introduction and implementation of policies is not match with the speed and scale and needs to be accelerated.
  - Speed and scale of emission reduction should be aligned with pathways towards 1.5℃ goal, which is also necessary to catch up with accelerating global transition for strengthening Japan's competitiveness.
  - Especially, decarbonizing energy sector need to be accelerated.
    - GHG emissions from energy use accounts for 85% of total GHG emission.
    - G7 Leaders agreed to decarbonize power sector by 2035.
    - For Japanese companies' competitiveness. For Japan attractive as business location
  - Choice of pathways and technologies.
    - Highlight "various and practical pathways towards carbon neutrality/net-zero emissions".
    - Concerns have been raised: legitimize delayed policy implementation (especially delayed energy transition) ? and to allow continued use of fossil fired generation plants?

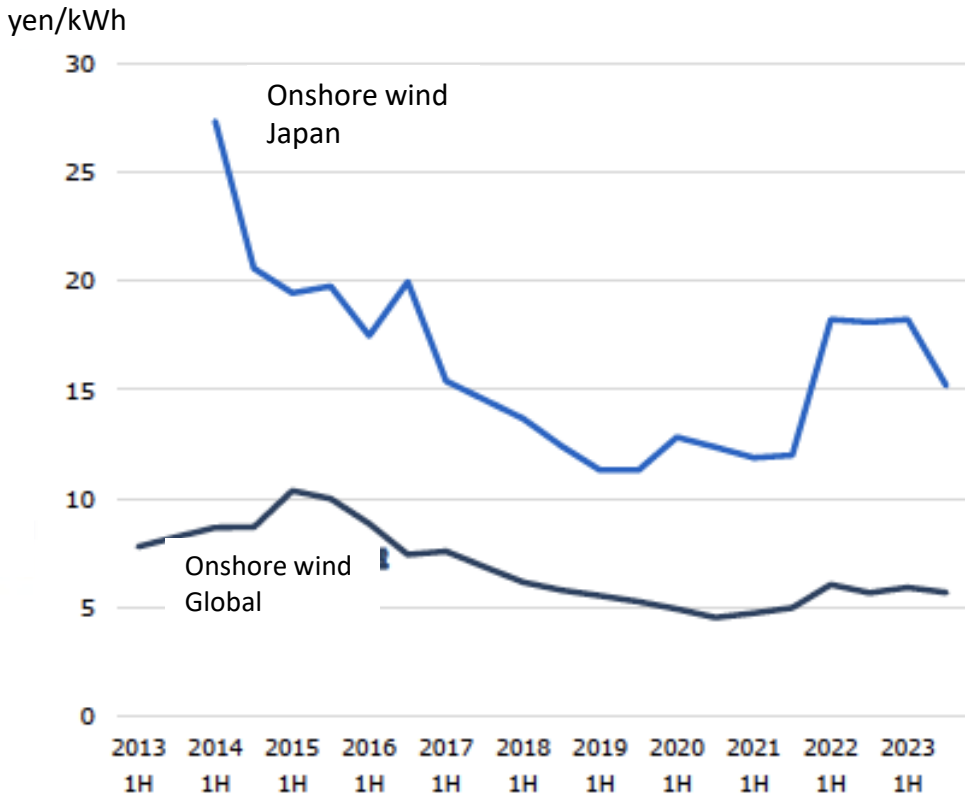
Challenges of policies (2)

- Delayed decarbonization of energy sector, especially power sector
  - Further expansion of renewables: drastically expanded since introduction of Feed-in Tariffs scheme in 2012, but its speed and scale has slowed down.
    - Lowering tariffs
    - Insufficient priority access to grid: Limited priority access to grid vis a vis fossil fired plants and priority given to nuclear. Increasing curtailment.
    - Social acceptance of local population
  - Main areas to further expand the introduction of renewables
    - Solar: building integrated PV, solar sharing in farmland, advanced solar PV
    - Wind: Especially, offshore wind (including floating offshore wind)
      - In some areas, bids were made at zero subsidy level, i.e. projects will not receive a subsidy on top of the wholesale electricity price.
      - A new bill to expand offshore wind to EEZ before the Diet.
    - Geothermal
  - Regulatory and institutional reforms are essential.
    - System integration (flexibility), including grid and interconnection, and its cost
    - Electricity market reform

Trends in LCOE of solar and wind (Japan)

Japan's solar LCOE has declined by 63% from 2010 to 2019 and by 62% from 2013 to 2020 (IRENA, 2020 and IRENA, 2021)

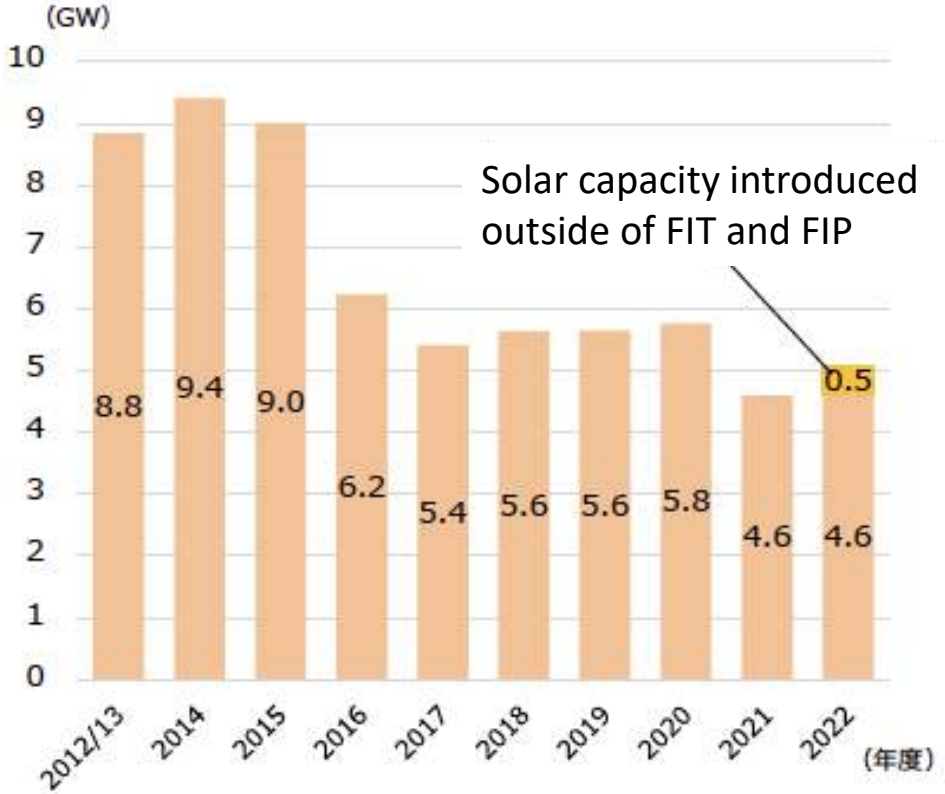




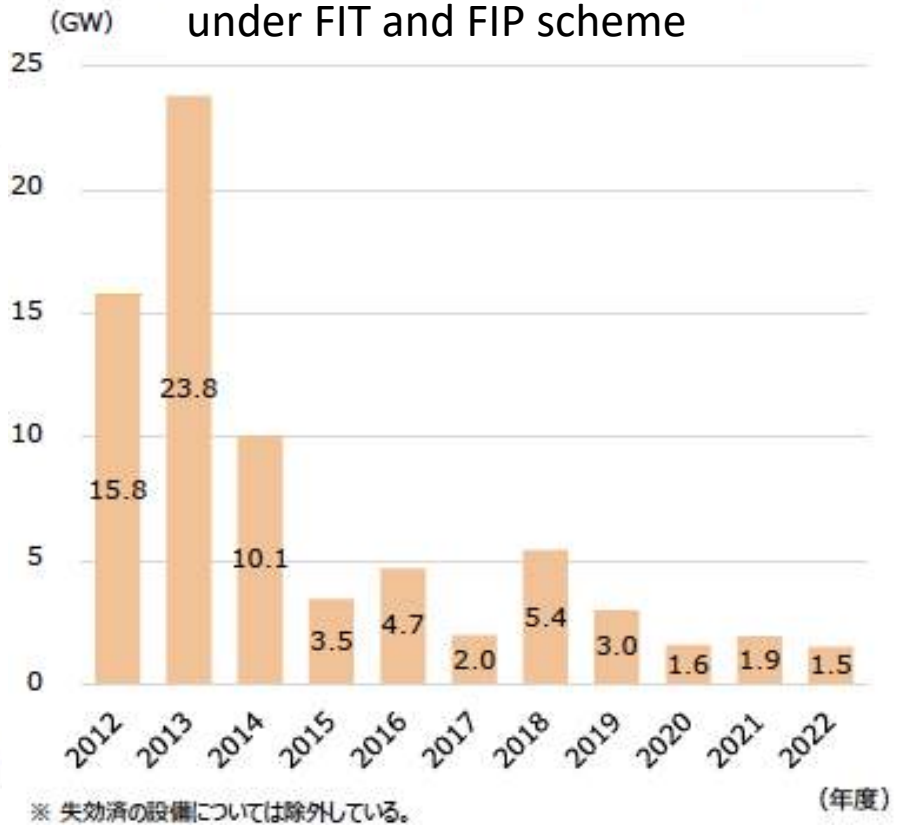
Source：Takamura based on Agency for natural resources and energy, 2024

10 year-trends in solar

Solar capacity introduced



Solar capacity certified under FIT and FIP scheme

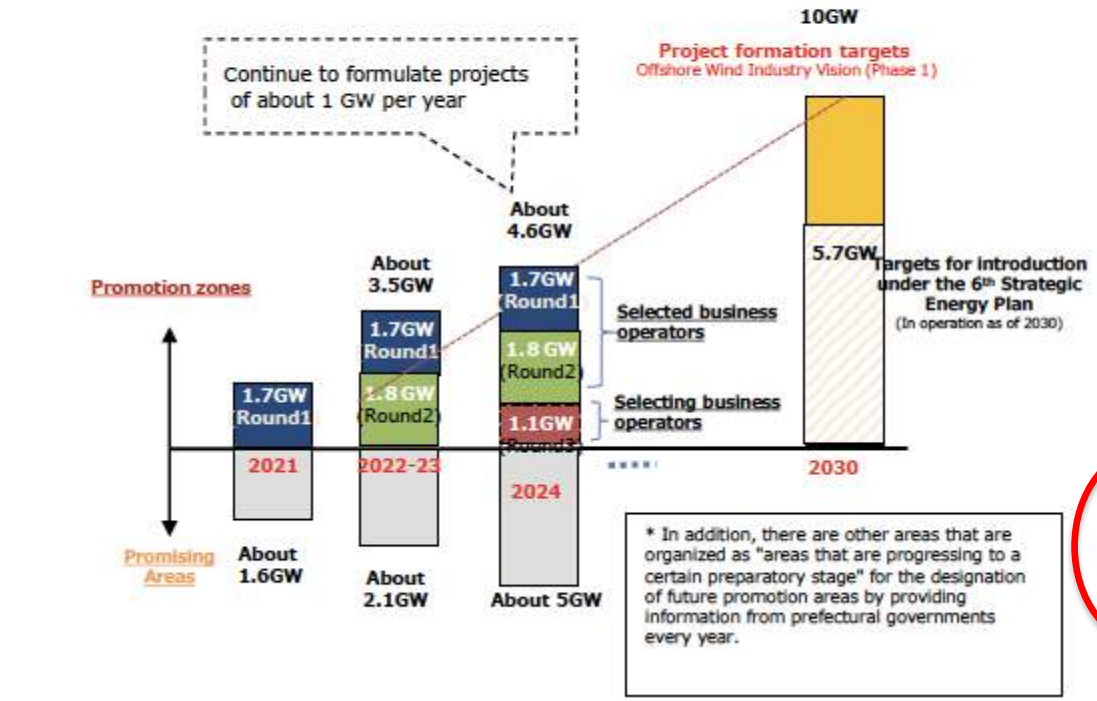


Source：Takamura based on Agency for natural resources and energy, 2024

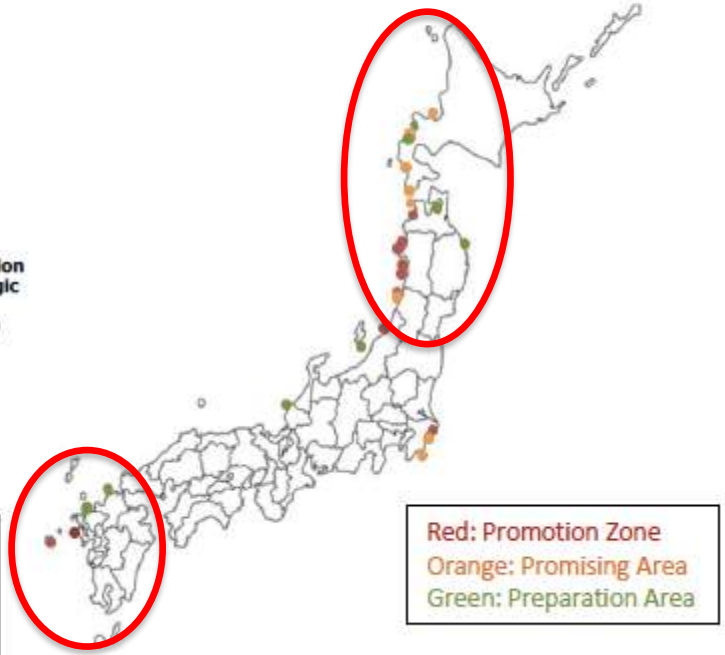
Accelerating offshore wind power deployment

- **The Act on Promoting the Utilization of Sea Areas for the Development of Marine Renewable Energy Power Generation Facilities** is a law that publicly solicits offshore wind power generation companies and permits them to occupy sea areas for 30 years (enforced on April 1, 2019).
- In December 2020, **the "Offshore Wind Industry Vision (Phase 1)" set targets of continuously developing appr. 1 GW/year of projects, total 10 GW by 2030 and 30~45 GW by 2040**.
- **Act for Promoting Offshore Wind in EEZ** is under the debate in the Diet.

Project formation to achieve 10 GW



Promotion Zones



Source：Takamura based on Agency for natural resources and energy, 2024

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)
- **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-)

Solar
2030: 104-118 GW

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**

Source: METI 2023

Challenges of policies (3)

- Delayed decarbonization of power sector (cont'd)
  - Clear plan and signal is needed to provide and enhance predictability
  - Coal accounts for around 30% of power mix since these 10 years, while coal should be reduced to 19% of power mix by 2030.
  - Only voluntary and weak measure to "fade down" (not phase down/out) inefficient coal fire plants by 2030. No clear plan beyond 2030. No clear plan towards decarbonization of power sector.
  - Hydrogen co-firing and ammonia co-firing for decarbonizing power sector. Cost (+energy penalty), timeline etc. are challenges.
    - Newly enacted legislation to promote hydrogen introduces CfD (Contract for Differences).
  - Carbon pricing/Price on carbon
    - The more renewables expand, the more gas-fired power generation declines, not coal fired power generation.
    - Provide more predictability for mid- and long- term investment in decarbonization.
    - Emissions trading may be the first regulatory measure to change the landscape (so far always voluntary).
  - Changing role of thermal power generation (?): from main source of power supply to:
    - Providing flexibility
    - As strategic reserves

Challenges of policies (4)

- Revisit nuclear policy?
  - Low carbon power technology
  - Generation cost increases (safety, longer project period etc.)
  - Back-end cost, social acceptance…
- Heat, transport fuels etc. other than electricity
  - Electricity accounts for about 40% of primary energy consumption
  - Energy efficiency, Electrification, Alternatives (new fuels)
  - Hydrogen Society Promotion Act (the Hydrogen Act)
  - Impacted by the scale and speed of decarbonization of power sector
- Security at stake in the context of energy transition

Implications for security

- Climate action and energy transition (will) have a significant implications for security.
  - Added values, for instance, for energy efficiency improvements and renewables for enhancing energy security and reducing trade deficit.
  - Security implications in terms of resources necessary for energy transition.
    - Policy to enhance material efficiency and circular economy
    - New generation of renewables, for instance

Subsidy Schemes for Hydrogen (1)

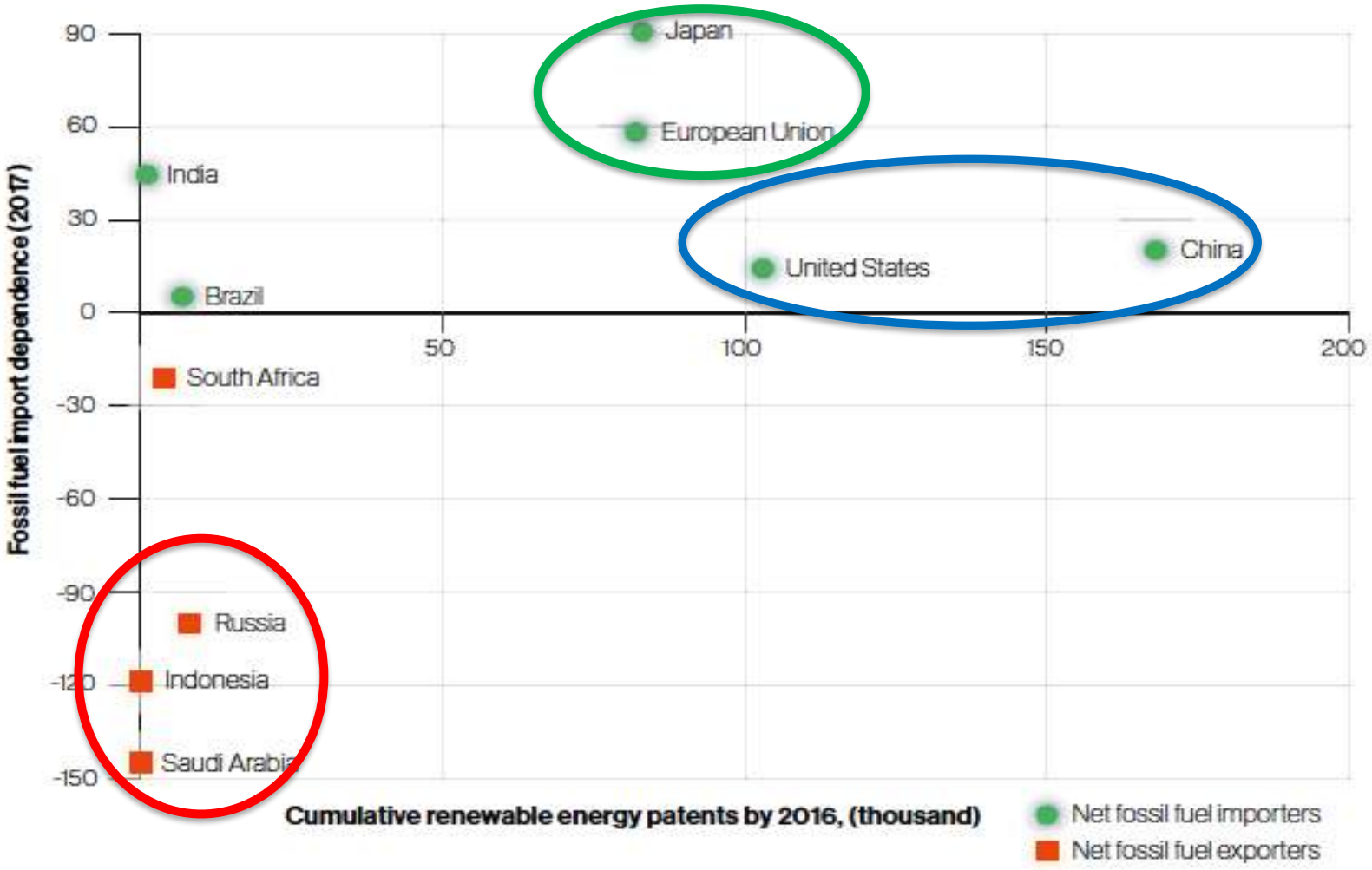
- Hydrogen Society Promotion Act (the Hydrogen Act) was passed on 17 May 2024.
- 2 subsidy schemes has established
  - CfD Scheme
    - providing support for the price gap between the sourcing of low carbon hydrogen and its derivatives as compared to conventional fuels
    - open to suppliers of Low Carbon Fuels that have either been produced domestically or which are imported into Japan, provided that their business plans are approved by the Government
    - Eligibility criteria: "Low carbon fuels"
    - Support is provided for 15 years. Supported businesses are obliged to continue to supply the hydrogen at least 10 years after support period ends.
  - Clusters Support Scheme
    - providing subsidies for the development of specific industrial areas (or "clusters") that have the capacity to accommodate large-scale hydrogen/ammonia project

Subsidy Schemes for Hydrogen (2)

- In order to be eligible for support under the CfD, hydrogen (and its derivatives – ammonia, e-methane and e-fuel) (Low Carbon Fuels) must meet a specified maximum carbon intensity that depending on the type of fuel.
- CO2 emissions reduction of 70% as compared to a fossil fuel comparator (ex. gray hydrogen)

Type	System boundary	Carbon Intensity
Hydrogen	Well to Gate	3.4kg-CO2e/kg-H2 (or lower)
Ammonia	Well to Gate	0.87kg-CO2e/kg-NH3 (or lower)
E-fuel	Whole supply chain	39.9g-CO2e/MJ (or lower)
E-methane	Whole supply chain	49.3g-CO2e/MJ (or lower)

Impacts of energy transition on international relations

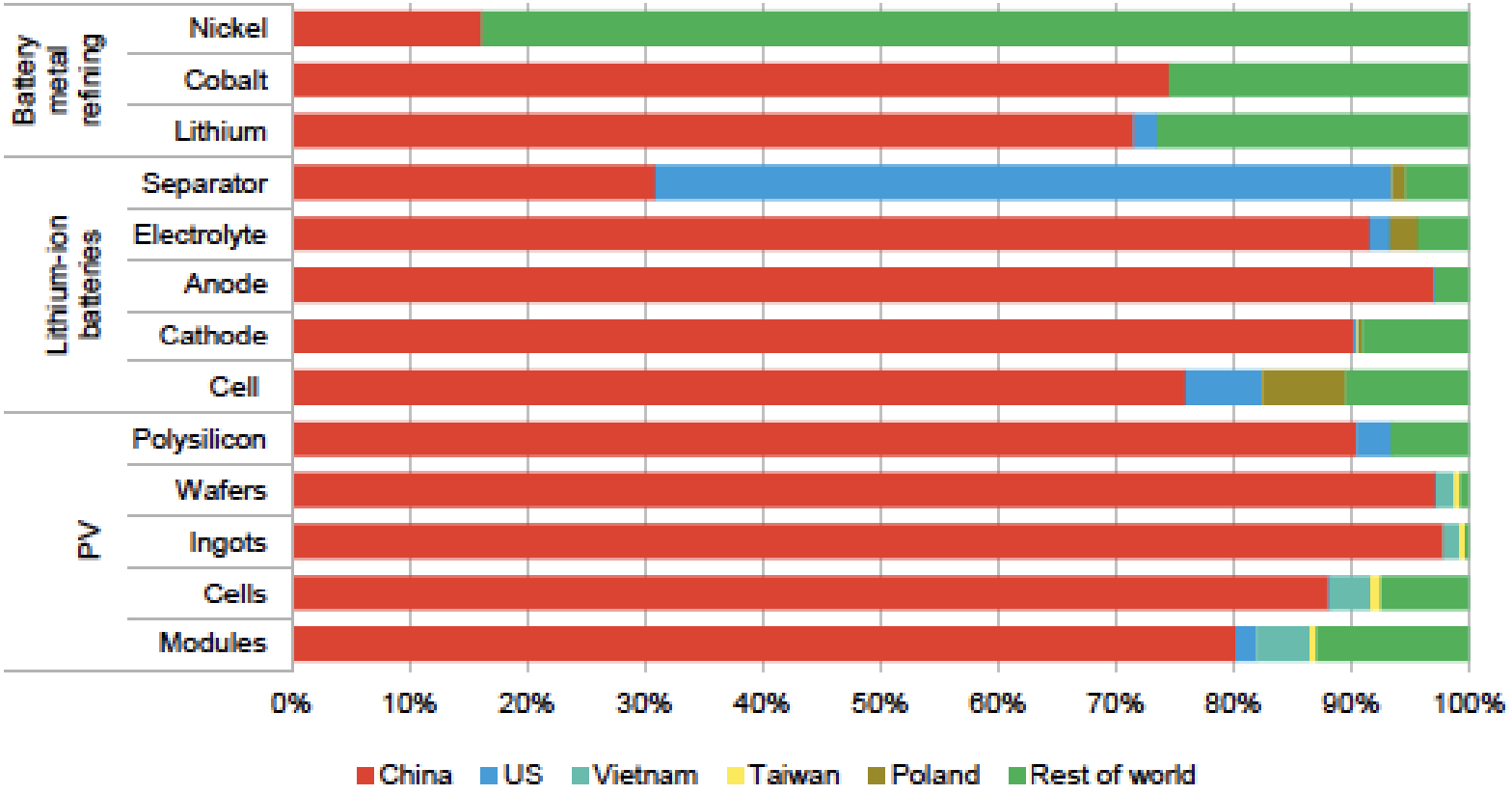


Source: IRENA, 2019

Battery and solar commodities production remains highly geographically concentrated

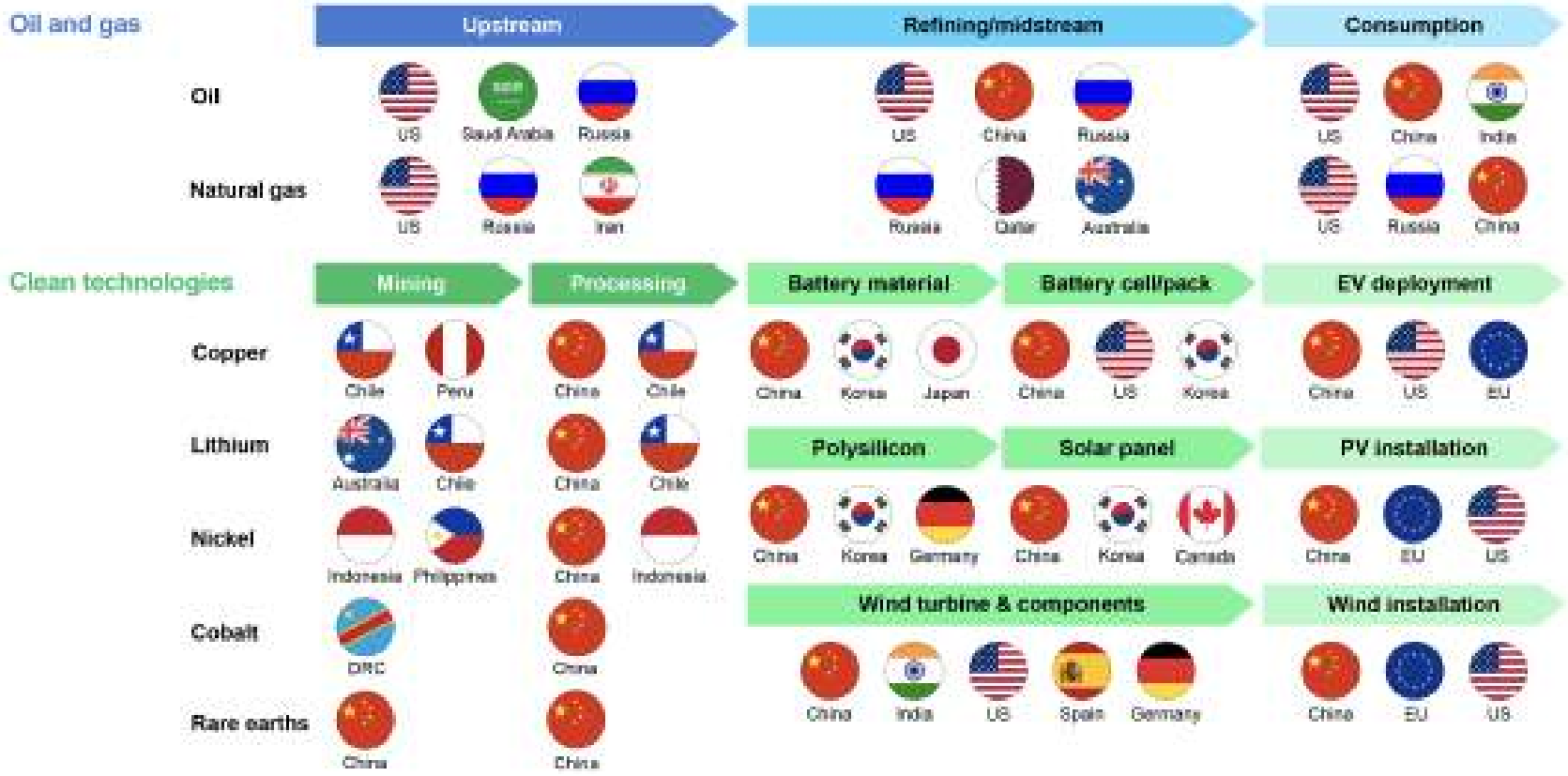
Current production capacity by location

Source：BloombergNEF, 2022



Source: BNEF. Note: PV components expressed in MW; separators in m2; battery metals and other battery components in tons. Data for August 2022 except metal refining which is 2021. Oversupply in the solar sector is such that nameplate capacity for most segments of the PV value chain far exceeds yearly output. Nickel is the battery-grade class 1 variety.

Supply chain of minerals necessary for clean energy technologies



Source：IEA、 2021

Advanced Solar Photovoltaic

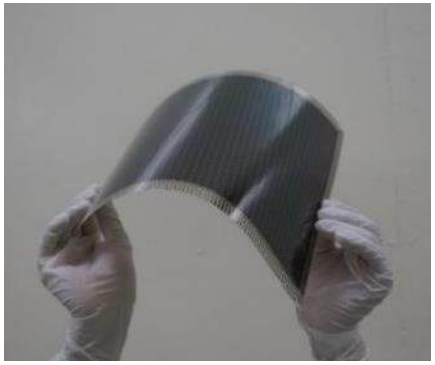
Development of technologies

- In place of silicon solar cells, **perovskite solar cells are becoming promising as next-generation solar cells:** lightweight, can be manufactured in fewer processes, and have lower environmental burden during manufacture.

【Major characteristics】

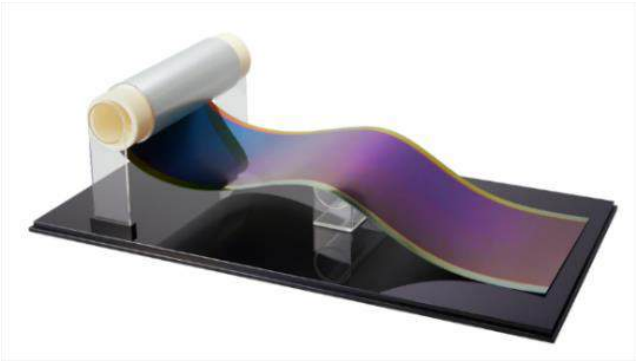
- **Installable on the walls of buildings** and other places where it is not possible to install previously.
- **Japan and Chile are major producers** of “Iodine”, the main raw material; **can reduce reliance on China**.
- A **new technology in R&D stage in the various countries;** potential that **countries other than China can capture the market**.

- In Japan, we are accelerating R&D and plan **social implementation through demonstration projects in 2025**.
- Therefore, in anticipation of the practical use of perovskite solar cells in the future, it is important **to promote the development of an international business environment from an early stage**.



(TOSHIBA CORPORATION)

(TAISEI CORPORATION)



(SEKISUI CHEMICAL CO., LTD)

Source：Agency for natural resources and energy, 2023

Challenges of policies (5)

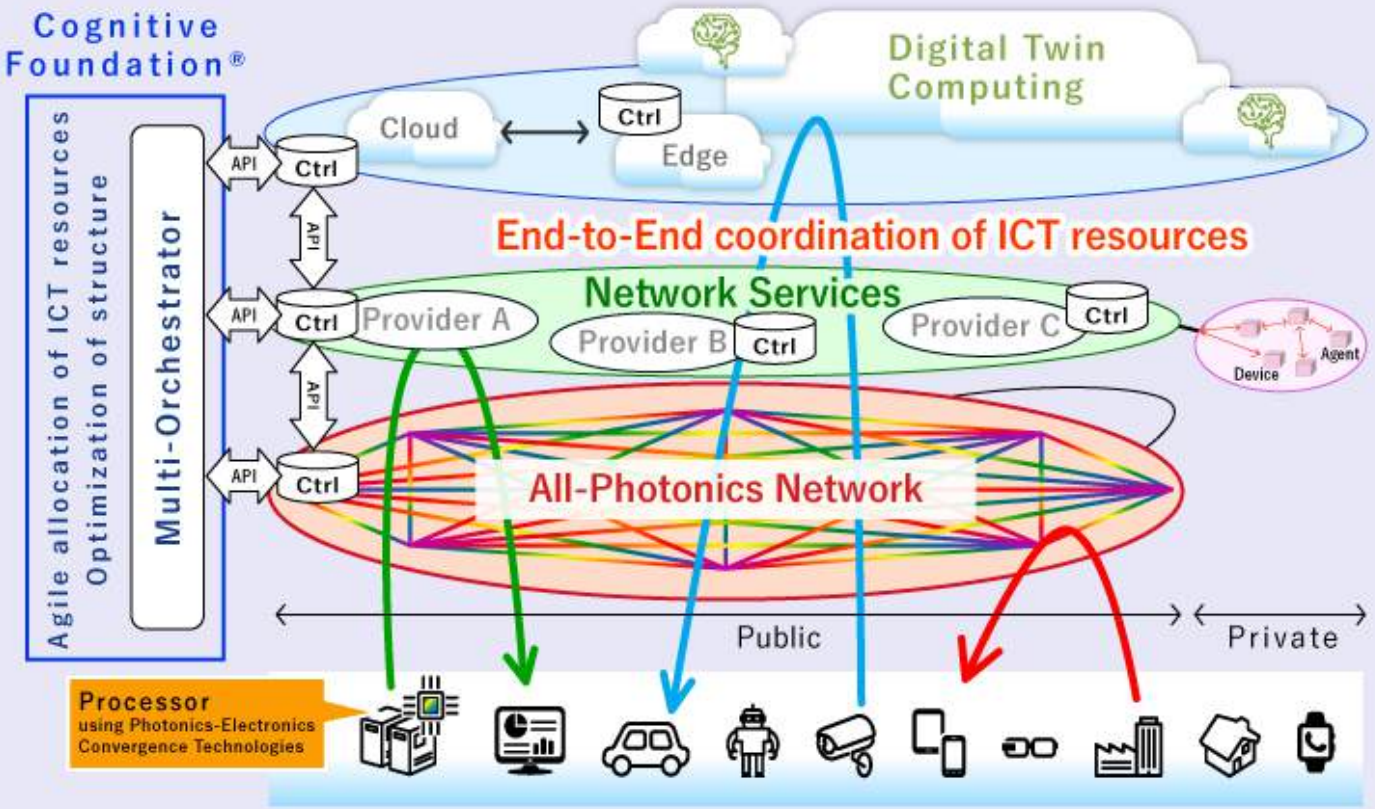
- Japan's electricity demand will increase?
  - It is projected that "Increasing number of data centers (DCs) and expanding use of AI etc. will raise electricity demand."
  - Increasing number of construction plans of DCs. Geopolitical situation would make Japan more attractive as location of DC.
  - But to what extent?
  - Potentials for limiting power demand exist as well.
    - Economic incentives to reducing power demand.
    - Innovation such as Photonics-Electronics Convergence Technology. NTT's IOWN
    - DX would make our society more energy efficient.
    - (For Japan) Decrease in population and the ongoing aging of population
  - Operators of DCs seek low carbon energy, especially renewables.

IOWN (NTT Group)

What's IOWN?

Innovative Optical and Wireless Network(IOWN)

Realizing a Smart World by using the 3 elements of All Photonics Network, Digital Twin Computing and Cognitive Foundation



Some concluding remarks

- Special importance of 2024 and 2025
  - Elaboration of GX vision, Strategic energy plan, climate plan and NDC toward 2040 will frame Japan's policy for a couple of decades to come.
- Implications of energy transition for security.
- Impacts outside of Japan, impacts on transition of Asian countries, especially ASEAN countries, as well as impacts on trade partners, where market and value chain of Japanese business are located.
  - Asia Zero Emission Community (AZEC)
  - Japan's ODA(FY2022): 17.5 billion dollars. About 60% (56% for FY2022) go to Asia (excluding Middle East countries).
- New era of Australia - Japan strategic collaboration, starting with in energy and trade

Asia Zero Emission Community (AZEC)

- Nov. 2022: Joint Announcement on Asia Zero Emission Community (AZEC) Concept by Japan and Indonesia.

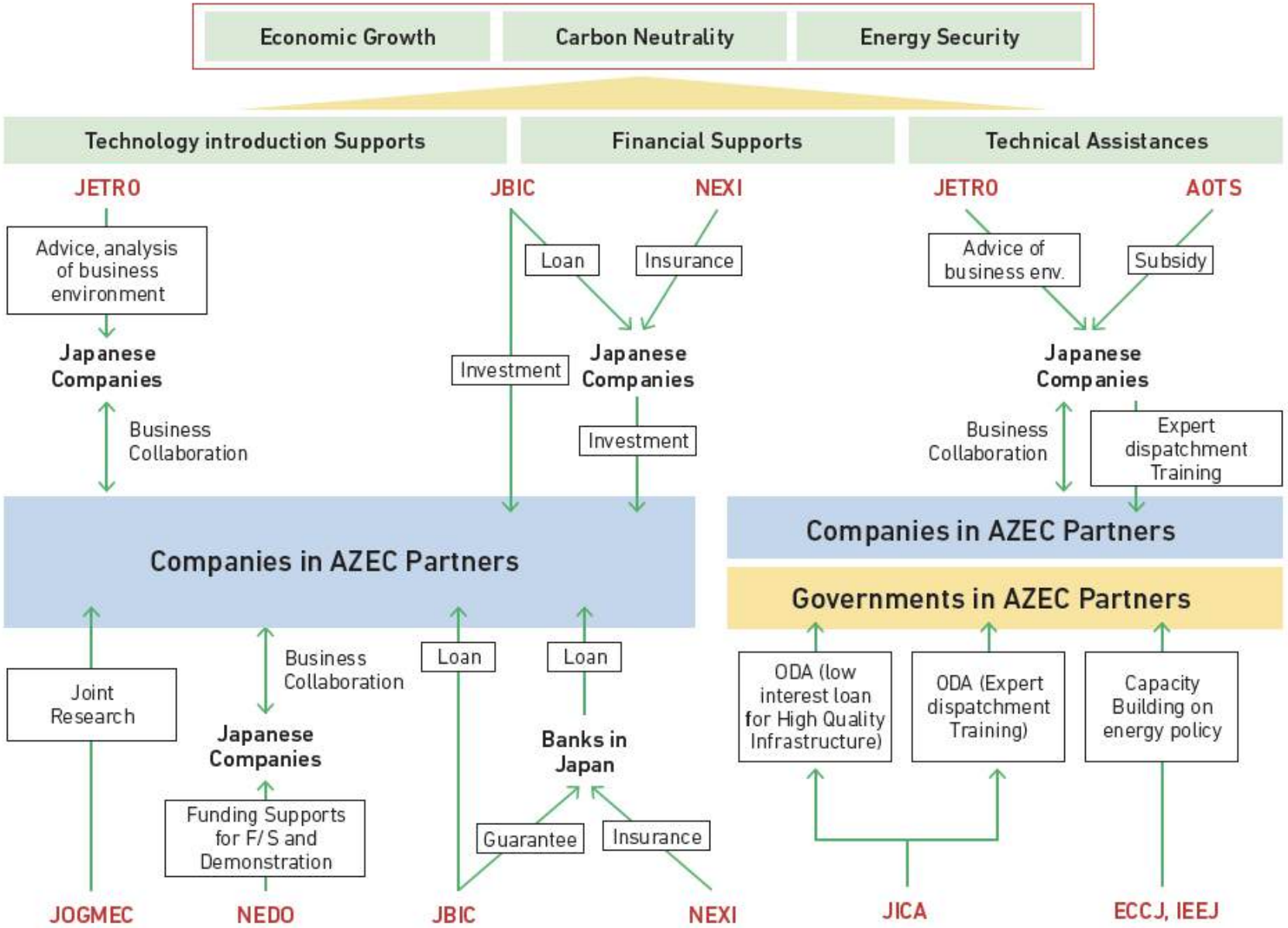
- Dec. 2023: Asia Zero Emission Community (AZEC) Leaders Meeting
  - Attended by the leaders of Australia, Brunei Darussalam, Cambodia, Indonesia, Japan, Lao PDR, Malaysia, the Philippines, Singapore, Thailand, and Viet Nam.
  - Joint Statement on 18 Dec. 2024
  - Consensus by Leaders
    - 1. promote decarbonization towards carbon neutrality/net-zero emissions, achieving economic growth, energy security and resilience. Various and practical pathways towards carbon neutrality/net-zero emissions
    - 2. Promoting policy support and collaboration (especially establishment of Asia Zero Emission Center at ERIA), Public-private collaboration
    - 3. Greening supply chain, promoting green finance

- AZEC progress report 2023
  - https://www.meti.go.jp/press/2023/12/20231218004/20231218004-3.pdf
  - MOU concluded on the projects
    - Energy efficiency, Renewables, Hydrogen and its derivatives

- August 2024: 2nd Asia Zero Emission Community (AZEC) Ministerial Meeting

Outline of Supports in AZEC

*Including, but not limited to the chart below.



Source: ERIA and Secretariat of AZEC 2023

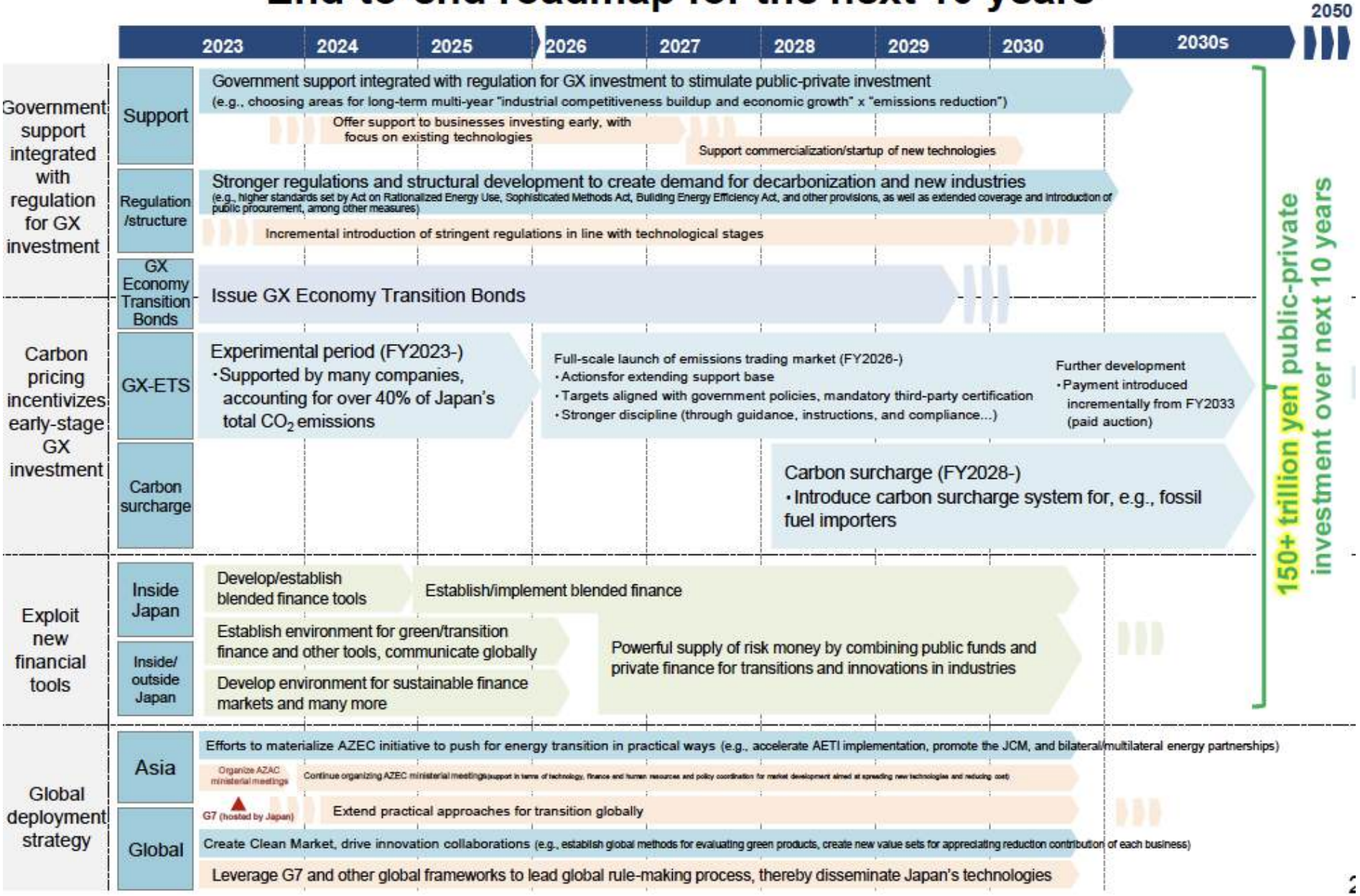
Patent applications for renewables (2010-2019)

Japan and Europe are strong in renewable and fuel cell technologies.

	Top Origins	Total Renewables	Solar	Fuel Cell	Wind Energy	Geothermal
1	**Japan**	9,394	5,360	3.292	702	40
2	**U.S.**	6,300	3,876	1,391	927	106
3	**Germany**	3,684	1,534	813	1,309	28
4	**Republic of Korea**	2,695	1,803	506	360	26
5	**China**	2,659	1,892	189	555	23
6	**Denmark**	1,495	52	81	1,358	4
7	**France**	1,226	660	348	184	34
8	**U.K.**	709	208	271	218	12
9	**Spain**	678	341	29	300	8
10	**Italy**	509	316	57	123	13

Source: Economics and Statistics Division, WIPO, 2021

End-to-end roadmap for the next 10 years



Source: METI 2023

Thank you for your attention!

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