Ministry of Economy, Trade and Industry

Japan's e-fuels policy

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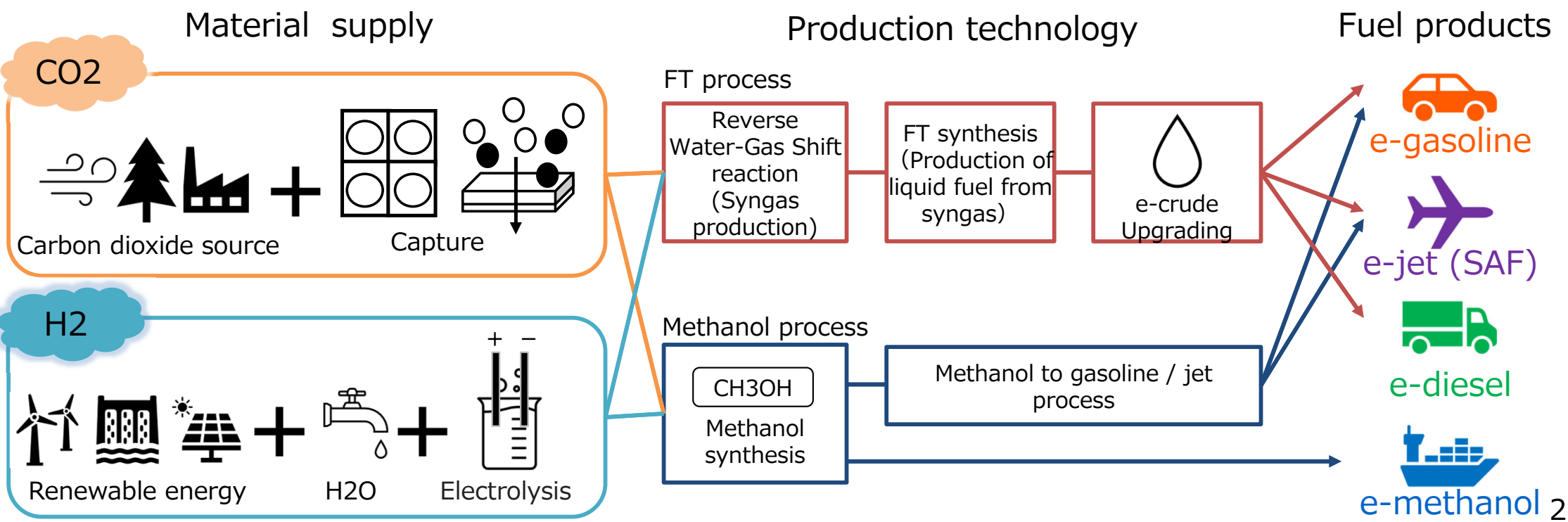
Mai YAGUCHI
Director, International Strategy on Energy Resources Office
Natural Resources and Fuel Department
Agency for Natural Resources and Energy, METI

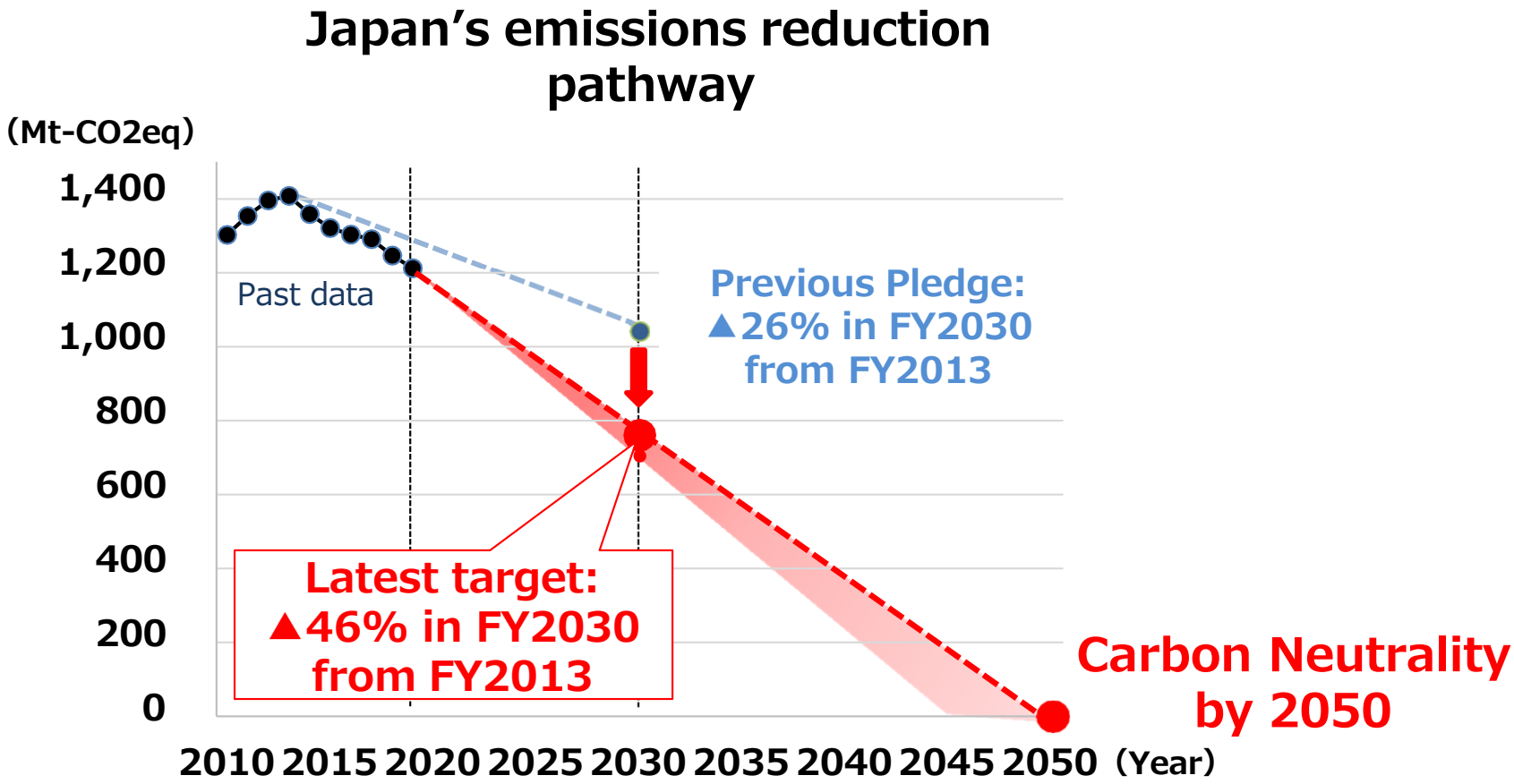
e-fuels（Synthetic fuels)

- **e-fuels** are synthetic fuels produced by the synthesis of **captured carbon dioxide** and **green hydrogen**.
- e-fuels have **high volumetric and mass density** relatively on par with conventional fossil fuels, providing technology options to reduce GHG emissions in hard-to-abate sectors. e-fuels can also **utilize existing fuel infrastructure**, helping to reduce infrastructure-related costs in its deployment phases.
- Further efforts to **improve conversion efficiency**, **scaling up production** and **reduce production costs**, while also **ensuring environmentally responsible practices** is necessary for wide-scale adoption of e-fuels.



Japan's commitment to Carbon Neutrality (CN)

- On **October 2020**, former PM Suga announced that Japan will aim to achieve **carbon neutrality by 2050**.
- On **April 2021**, former PM Suga further announced to set an interim target of **reducing GHG emissions by 46% in FY2030** from FY2013.
- Various policies have since been set to materialize these goals.



Japanese Climate Targets for Low-carbon Liquid and Gaseous Fuels(Outside power sector)

- To achieve carbon neutrality, Japan envisions to utilize low-carbon gaseous and liquid fuels in various sectors.

➢ Automobile

- ✓ new passenger car sales: **100% electrified vehicles* by 2035**
- ✓ For light-duty vehicles weighing 8 tons or less
  : aim for 20-30% of new vehicle sales to be electric vehicles by 2030, and **100% of new vehicle sales to be electric vehicles and vehicles suitable for the use of synthetic fuels and other decarbonized fuels by 2040**
- ✓ For heavy-duty vehicles over 8 tons
  : aim to introduce 5,000 units in the 2020s in advance, and by 2030, set a target for the widespread use of electrically powered vehicles in 2040

***Electrified vehicles: HEV, PHEV, BEV, FCV**

➢ Aviation

Replacing 10% of the fuel consumption by Japanese airlines with SAF in 2030

➢ City Gas

1% e-methane by 2030, 90% e-methane by 2050 into existing infrastructure

G7 Hiroshima Leaders' Communiqué (May 20, 2023)

19: Road sector

We reaffirm our commitment to a highly decarbonized road sector by 2030, and recognize the importance of reducing GHG emissions from the global fleet and the range of pathways to approach this goal in line with trajectories required for keeping a limit of 1.5°C within reach.

We are committed to the goal of achieving net-zero emissions in the road sector by 2050.

In this context, we highlight the various actions that each of us is taking to decarbonize our vehicle fleet, including such domestic policies that are designed to achieve 100 percent or the overwhelming penetration of sales of light duty vehicles (LDVs) as zero emission vehicles (ZEV) by 2035 and beyond; to achieve 100 percent electrified vehicles in new passenger car sales by 2035; to promote associated infrastructure and sustainable carbon-neutral fuels including sustainable bio- and synthetic fuels.

We note the opportunities that these policies offer to contribute to a highly decarbonized road sector, including progressing towards a share of over 50 percent of zero emission LDVs sold globally by 2030.

Considering the findings of the International Energy Agency (IEA)'s Energy Technology Perspective 2023, we also note the opportunity to collectively reduce by at least 50 percent CO2 emissions from G7 vehicle stock by 2035 or earlier relative to the level in 2000 as a halfway point to achieving net zero and to track the progress on a yearly basis.

G7 Climate, Energy and Environment Ministers' Communiqué (April 16, 2023)

G7 2023 HIROSHIMA SUMMIT Sapporo
G7 Ministers' Meeting on Climate, Energy and Environment

68: Carbon Management

Considering the evolving nature of these technologies, we recognize that CCU/carbon recycling and CCS can be an important part of a broad portfolio of decarbonization solutions to achieve net-zero emissions by 2050, and Carbon dioxide Capture, Utilization(CCU)/carbon recycling technologies, including recycled carbon fuels and gas (RCFs) such as e-fuels and e-methane, also can reduce emissions with existing infrastructure from industrial sources that cannot be avoided otherwise by displacing fossil-derived commodities and by using CO2.

(・・・)

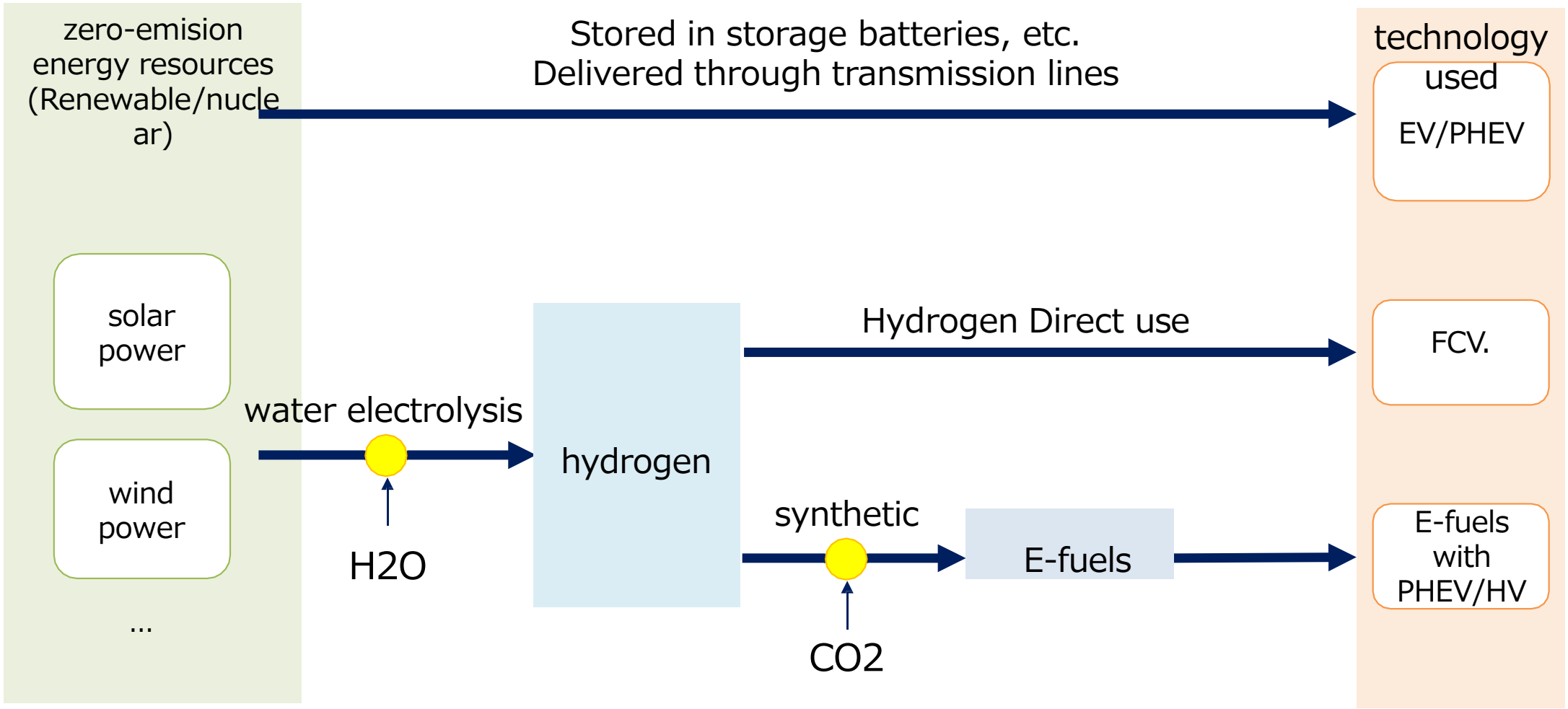
We will accelerate international cooperation to promote harmonization of MRV of CDR and exchanges including through collaborative workshops among industry, academia, and government on CCU/carbon recycling technologies, such as RCFs.

Pathways for carbon neutrality in automobile sector

- To achieve carbon neutrality in the automobile sector, it is important to pursue **the range of pathways.**

Energy sources		Powertrain		Infra-structure	Problem
CO2 Free electricity (renewable energy, nuclear power, etc.)	×	EV、PHEV	×	➢ Charging infra-structure ➢ V2X	Resource constraints CO2-free electricity Infrastructure Cost reduction
CO2 Free Hydrogen	×	FCV	×	Hydrogen stations	Infrastructure CO2-free hydrogen Cost reduction
Carbon neutral fuels (biofuels, e-fuel)	×	PHEV,HEV	×	SS	CO2-free hydrogen Cost reduction Mass production technology

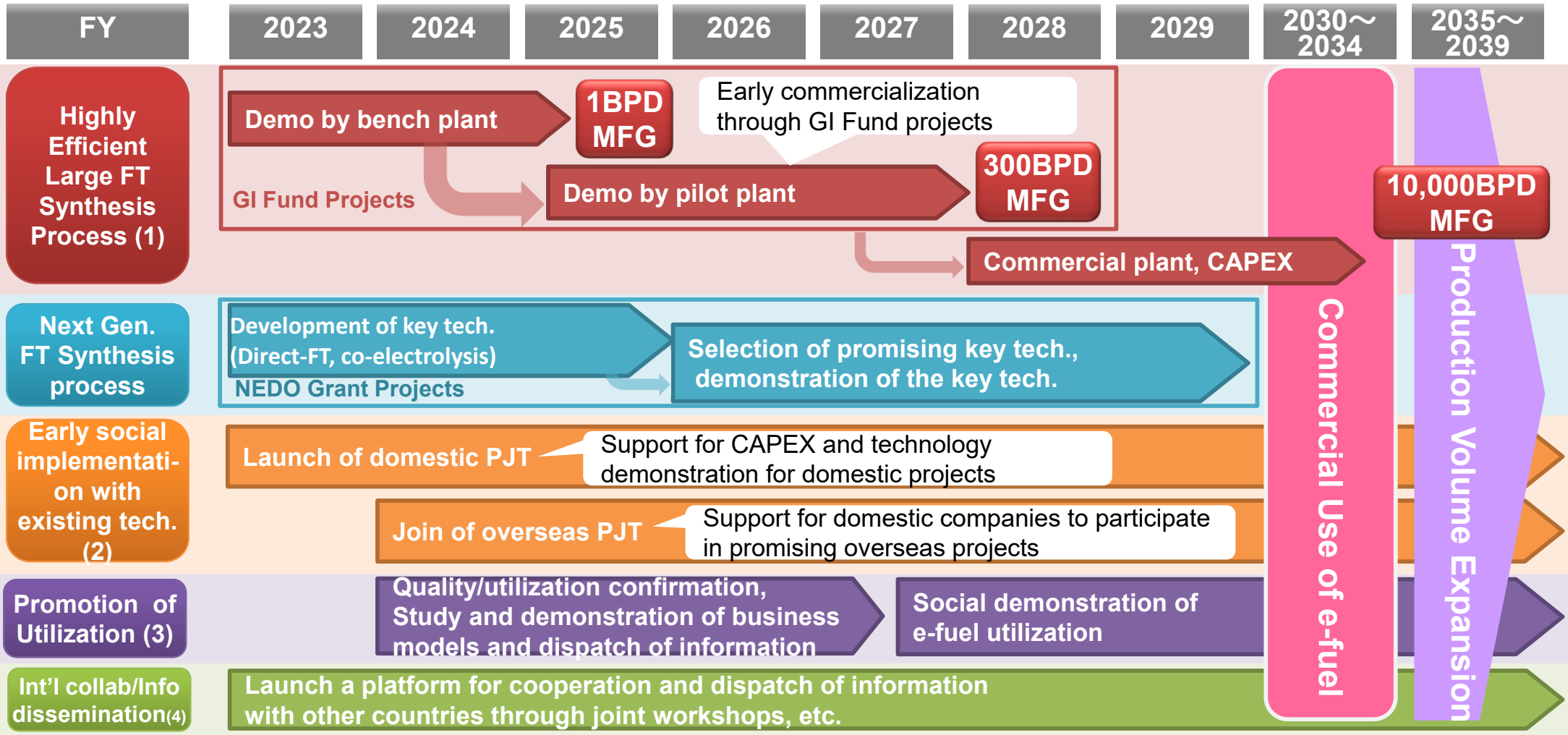
Relation of form of energy and powertrain



	electricity	hydrogen	E-fuels
Production	○	△	×
Storage	×	△	○
Delivery	△	×	○

Roadmap towards Commercialization of E-fuels in Japan

- **Expand support for current Green Innovation (GI) Fund projects (large scale FT synthesis process)** – (1).
- **Support capital investment to initiate supply of e-fuels using existing technologies (e.g. MTG process) – (2)**, and **pilot projects to establish business models – (3).**
- Simultaneously, **collaborate with other countries and launch an information hub in Japan to promote e-fuels** (4).

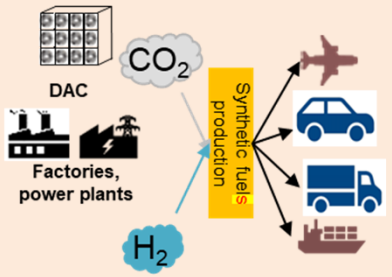


Start production in 2025 and "Aim to commercialize e-fuels by the early 2030s".

Government Supported R&D Projects for "Carbon Recycling Fuels" in the Green Innovation Fund (up to USD 0.85 billion)

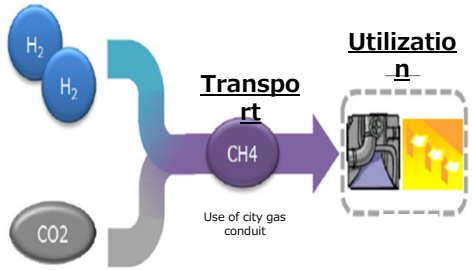
e-fuels: Develop production technology with improved yield rate (80%, pilot scale ca. 300bbl./day)

- Develop a various process of synthetic fuel at high efficiency on a large scale
  - -- reverse water-gas shift
  - -- Fischer-Tropsch synthesis
  - -- other technologies that combine them
- Achieve a liquid fuel yield rate of 80% on a pilot scale (planned 300 bbl./day) by 2030 with the goal of making the process independently commercialized.



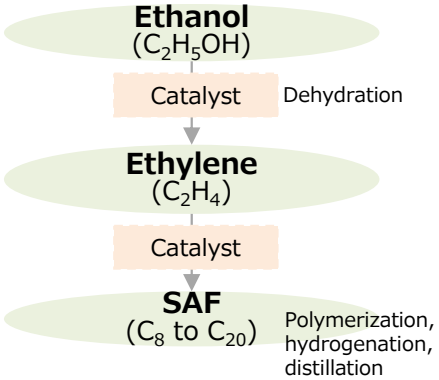
e-methane : Develop methanation technology with high energy conversion efficiency rate (≧60%)

- Establish technology for methanation from H_2 produced from renewable energy sources etc., and CO_2 captured at power plants etc..
- Achieve an energy conversion efficiency rate of 60% or higher by 2030.



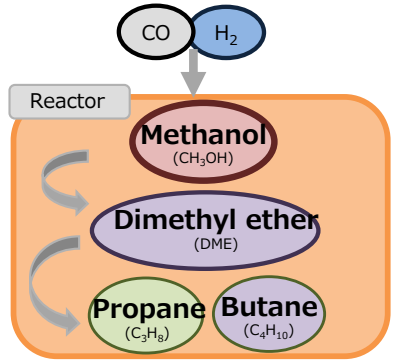
SAF : Develop production technology (ATJ) with high yield rate (≧50%), and lower cost (100-200 yen/L)

- Establish **ATJ (Alcohol to JET) technology to produce SAF from ethanol** which will allow large production volumes (hundreds of thousands of kiloliters).
- Achieve a liquid fuel yield rate of 50% or higher and a production cost of 100-200 yen/L level with the aim of having the fuel used by aircraft by 2030.



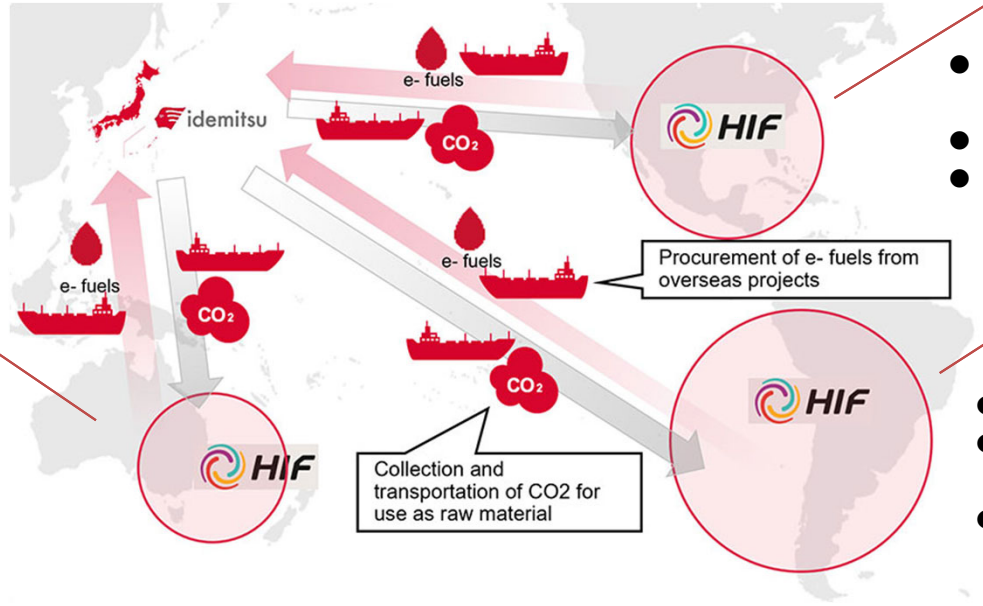
Green LP gas : Develop LP gas production technology with a production rate of 50%

- Establish technology for synthesizing LP gas (green LPG), which is synthesized from H_2 and CO through methanol and dimethyl ether.
- Aim to establish synthesis technology with a production rate of 50% and have it commercialized by 2030.



Cooperation between HIF Global and Idemitsu Kosan

- On April 2023, **Idemitsu Kosan** signed a **strategic partnership MOU with HIF Global** to accelerate the production, practical application, and diffusion of e-fuels in Japan, by focusing on the following areas:
  - Procurement and domestic supply of e-fuels from overseas projects
  - Joint investment in e-fuels production facilities in Japan and overseas
  - International transportation and utilization of CO2 collected in Japan
- Idemitsu Kosan will obtain samples of e-gasoline produced by HIF to confirm factors such as its environmental impact and performance for the practical application and diffusion in Japan, with a vision of aiming to establish a system for the production and supply of e-fuels in Japan by the late 2020's.



HIF USA (Houston)

- Uses wind power (15GW potential capacity)
- Abundant in CO2 feedstock
- Begins construction of commercial-level plants in 2023 and plans to commence e-fuel production in 2024 (4.7mb/y)

HIF Asia Pacific (Tasmania)

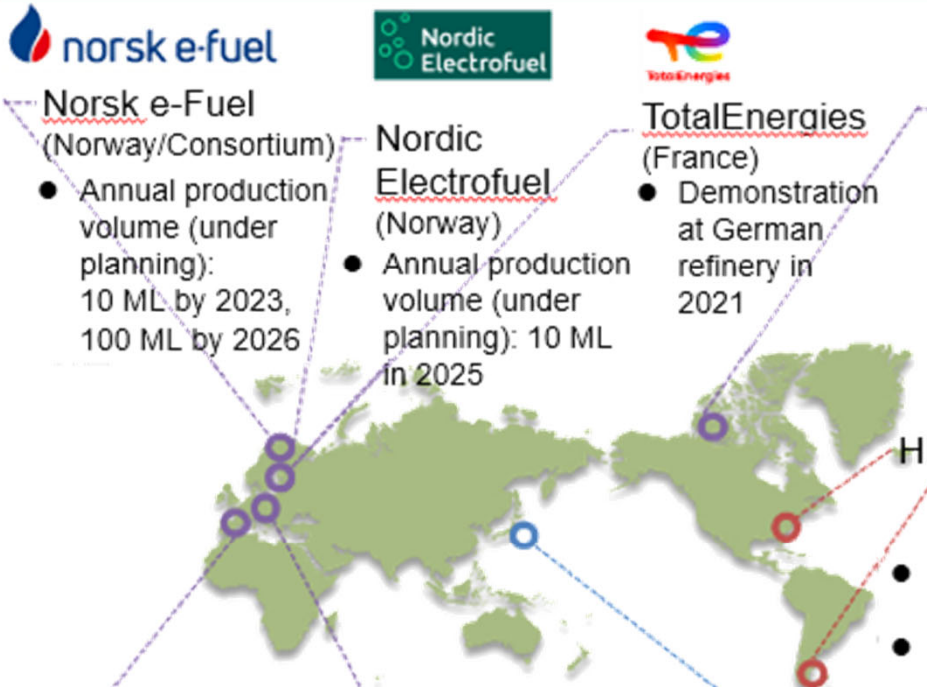
- Uses PV (with 250MW capacity of electrolyzers)
- Begins construction of commercial-level plants in 2024, with plans to produce 36,000bpd (1.3mb/y) by 2030

HIF Chile (Magallanes)

- Uses wind power (2.5GW capacity)
- Commenced e-fuel production in December 2022 (310kb/y)
- Plans for commercial-scale plants (3.5mb/y) by 2027

Example: E-fuels Projects around the world

- **R&D and demonstration projects for e-fuel are being promoted around the world.**
- Demonstration projects are taking place in regions where **low cost renewable energy and hydrogen are available.**



Norsk e-Fuel (Norway/Consortium)
- Annual production volume (under planning): 10 ML by 2023, 100 ML by 2026

Nordic Electrofuel (Norway)
- Annual production volume (under planning): 10 ML in 2025

TotalEnergies (France)
- Demonstration at German refinery in 2021

Infinium (U.S./Canada)
- Studying for market development
- MHI (US) invested

HIF USA (U.S.)
- Utilize tech from HIF Global (main body or Haru Oni PJ)
- Plant will be constructed from 2023, annual production volume: 757 ML in 2026

Repsol (Spain)
- Annual production volume (under planning): 2.67 ML in 2024 (*converted1t=1.16kL)

Westkuste 100 (Germany/Consortium)
- Demonstration project for offshore wind power generation, hydrogen production and fuel production, budgeting €890 Mill.

ENEOS (Japan)
- Adopted by GI Fund in 2022
- Target annual production volume (under planning): 17 ML by 2028

Haru Oni Project (Chile)
- "Haru Oni" means *strong wind* in the native language
- Methanol produced from RE hydrogen generated from wind power and CO2 from DAC are converted into gasoline by MTG (Methanol to Gasoline) process
- Plant construction started from Sep 2021 (pilot volume: 130 kL (annual), production volume will be expanded step by step to 550 ML (annual) by 2026
- Supported €8 Mill by German government
- AME (main body/Chile's national energy company), Porsche, Siemens, ExxonMobil, etc. are joining

(Source: Siemens Energy "Haru Oni")

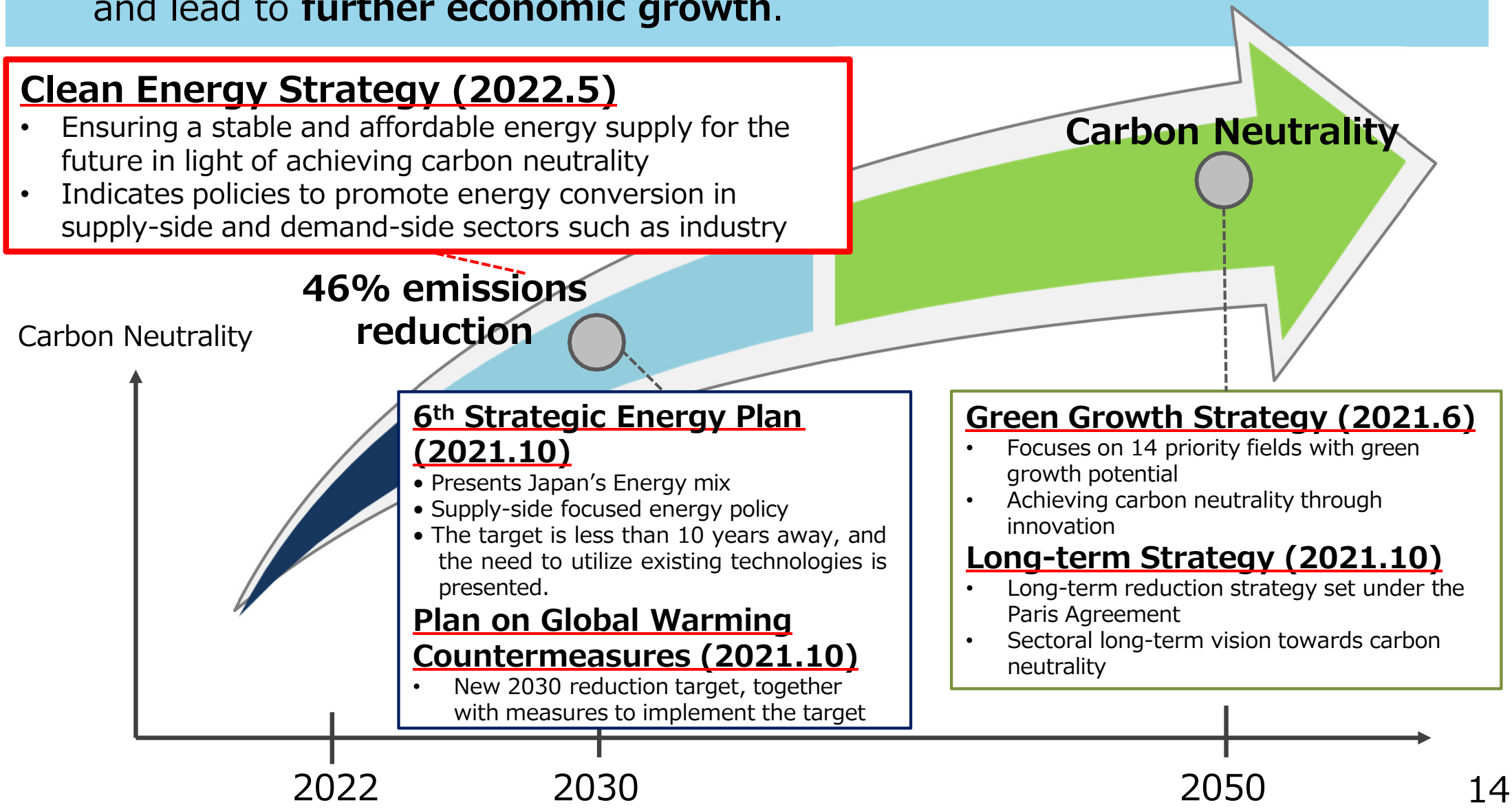
References

Japan's Climate Policies and "Clean Energy Strategy"

- To achieve carbon neutrality in 2050 and 46% emissions reduction in 2030, **the Clean Energy Strategy will draw a comprehensive and feasible pathway** to **ensure a stable and affordable energy supply** in the future and lead to **further economic growth**.

Clean Energy Strategy (2022.5)

- Ensuring a stable and affordable energy supply for the future in light of achieving carbon neutrality
- Indicates policies to promote energy conversion in supply-side and demand-side sectors such as industry



6th Strategic Energy Plan (2021.10)

- Presents Japan's Energy mix
- Supply-side focused energy policy
- The target is less than 10 years away, and the need to utilize existing technologies is presented.

Plan on Global Warming Countermeasures (2021.10)

- New 2030 reduction target, together with measures to implement the target

Green Growth Strategy (2021.6)

- Focuses on 14 priority fields with green growth potential
- Achieving carbon neutrality through innovation

Long-term Strategy (2021.10)

- Long-term reduction strategy set under the Paris Agreement
- Sectoral long-term vision towards carbon neutrality

Basic Policy for Realization of GX(Green Transformation)

To rebuild a stable supply of energy, measures including promoting drastic shift to decarbonized power sources will be taken.

- **Renewable Energy**: To expand the introduction of renewable energy, **a grid development plan** has been established. **Investment in the next 10 years will be 8 times** as much as that in the past 10 years.
- **Nuclear power** : **Replacement** of reactors decided to be decommissioned with next generation innovative reactors. **Review of operating period** (40 years + 20-year extension + shutdown period such as inspection)

Government support will be provided for **upfront investment of 20 trillion yen** to achieve carbon neutrality by 2050 while strengthening industrial competitiveness and realizing economic growth, **aiming for more than 150 trillion yen of public and private investment over the next 10 years.**

To promote the GX investment as described above, a **"Growth Oriented Carbon Pricing Concept"** will be embodied and implemented as soon as possible.

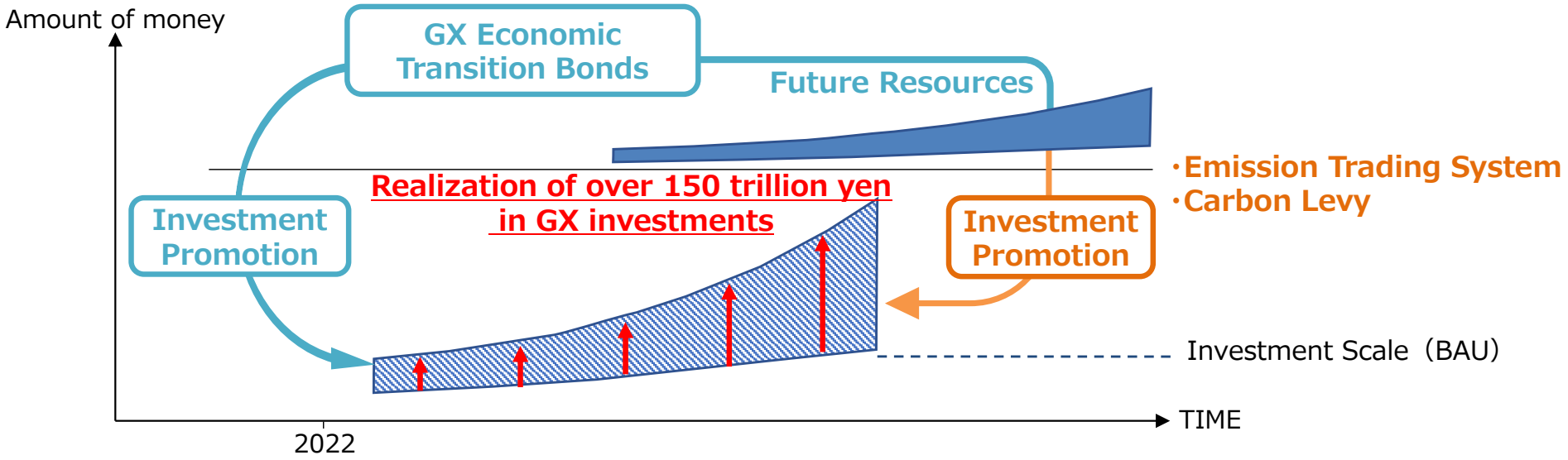
① **Government support for bold upfront investment** by issuing **"GX Economic Transition Bonds"** (20 trillion yen over the next 10 years)

② **Introduction of carbon pricing to give incentives for GX investment**

(1) Full-scale operation of **emissions trading system** in high emission industries [**from FY2026**].
+ Allowance auctioning is phased in gradually to **power generation companies** [**from FY2033**]

(2) Introduction of a **carbon levy** on fossil fuel importers [**from FY2028**]

③ Strengthen financial support through public-private partnership



A vision for Carbon Neutrality in Japanese Petroleum Industry

Now | 2030 | 2050

Strengthen existing measures, R&D | Challenge for the practical use

1 Reduction of CO_2 emissions from own business activities (Scope 1+2)

① Strengthening energy efficiency measures, promoting fuel transition
② Promoting the use and development of renewable energy and zero-emission power sources
③ Transforming refining processes (Development of CO_2-free hydrogen technology, etc.)* → Practical use
④ CCS/CCU (carbon recycling) technology development* → Practical use

CO_2 reduction

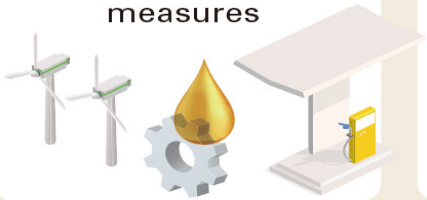
2 Reduction of CO_2 emissions associated with products supplied (Scope 3)

① Utilization of first-generation biofuels
② Development of fuels that contribute to improved fuel efficiency of ICEs
③ Introduction and technological development* of next-generation biofuels (SAF)
④ Development of CO_2-free hydrogen technology* → Practical use
⑤ Development of synthetic fuels "e-fuel" technology (carbon recycling)* → Practical use

CO_2 reduction

Change in user and public awareness, Transformation in the automotive industry

3 CO_2 emission reduction and sink measures



① A low carbonization of value chain (e.g. environmentally friendly products, lubricants)
② Infrastructure development of hydrogen stations, EV charging
③ Promoting the expansion and the development of renewable business
④ Development of technology for recycling waste plastics* → Practical use
⑤ Development of hydrogen supply chain technology* → Practical use
⑥ Feedstock conversion of petchem products (biomass/carbon recycling)* → Practical use
⑦ CCS/CCU (carbon recycling) technology development* → Practical use

Increased Reduction effect

Aiming for virtually zero CO_2 emissions associated with business activities (Scope 1+2)

Challenge to reduce CO_2 emissions of products supplied in the low carbonization (Scope 3)

Scope1: Direct greenhouse gas emissions by businesses themselves(Fuel combustion, Industrial process)
Scope2: Indirect emissions from the use of externally supplied energy, e.g. electricity, thermal or steam, etc..
Scope3: Indirect emissions in the supply chain outside of Scope 1,2 (Emissions of others)

*Innovative technology
Practical use includes e.g. global deployment

Green Innovation Fund

- The Japanese Government supports private companies' efforts to pursue **innovations and demonstrations of new carbon neutral technologies** through **¥2 trillion Green Innovation Fund**.

14 sectors that are expected to grow toward 2050.

1 Renewables

2 Hydrogen/ fuel ammonia

3 Next-gen. process heat

4 Nuclear

5 Automobile/ battery

6 Semiconductor /information and communication

7 Shipping

8 Logistics, transportation, civil engineering, infrastructure

9 Food, agriculture, forestry and fisheries

10 Aircraft

11 Carbon recycling/ material

12 Housing, building, electricity management

13 Resource circulation

14 Life style-related