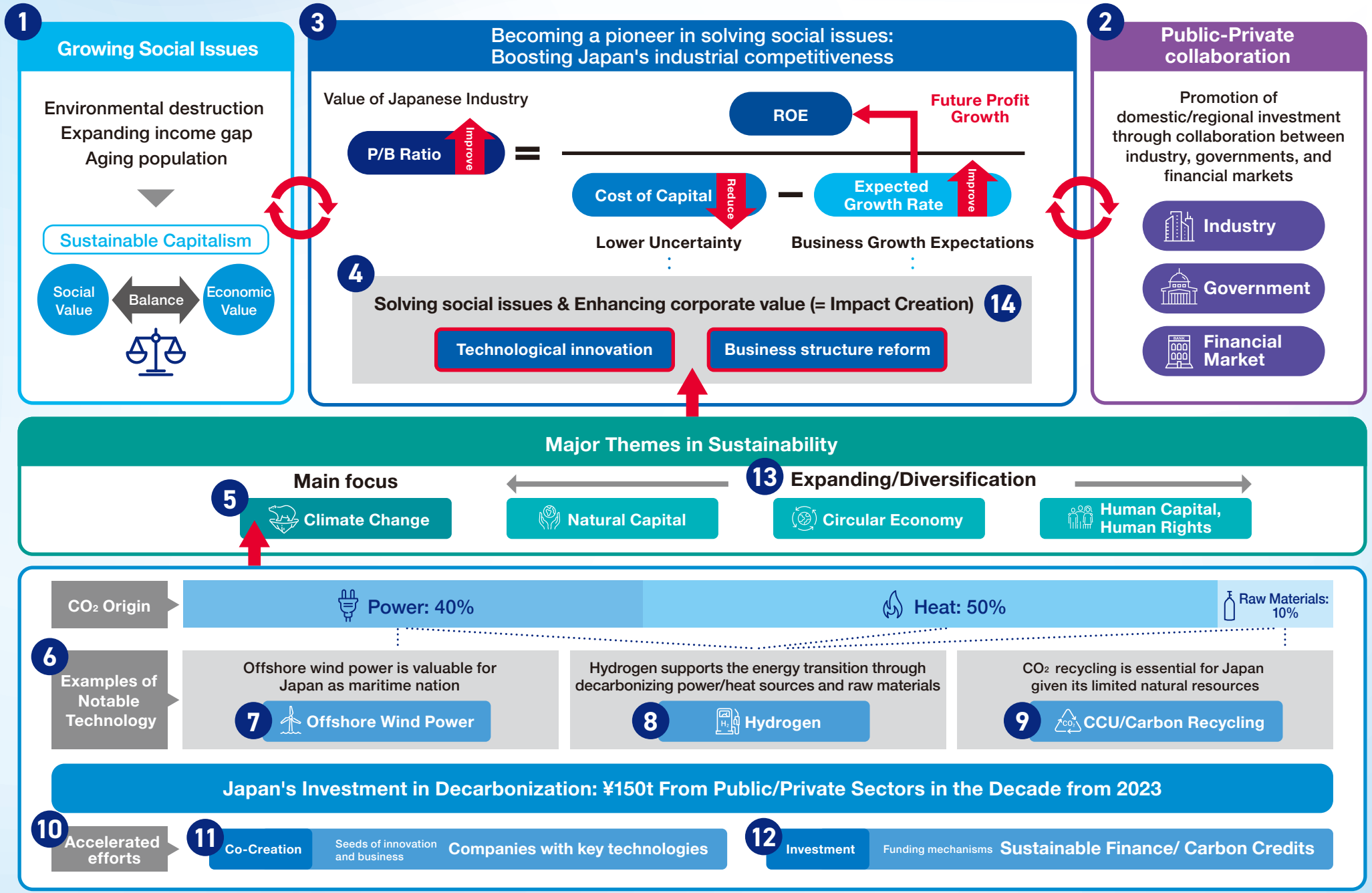
Mizuho Sustainability Focus

Sustainability:
Path to industrial competitiveness

MIZUHO

Innovating today. Transforming tomorrow.

— Report Structure —



(Source) Created by Mizuho Financial Group based on public materials

Sustainable Capitalism is an irreversible trend: Expansion of Capitalism

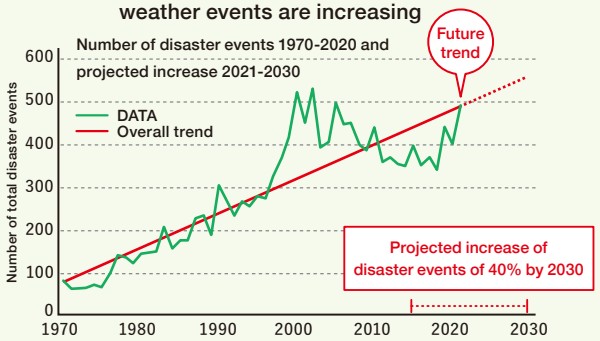
- Capitalism overly focused on economic value has given rise to social issues (negative externalities) such as environmental destruction and rising wealth inequality.
- This has led to a need for Sustainable Capitalism, which focuses on both economic value and social value (impact creation).
  - Long-term efforts around technological innovation and business structure reform are needed to achieve Sustainable Capitalism.

Conventional Capitalism

Emergence of Social Issues (Negative externalities)

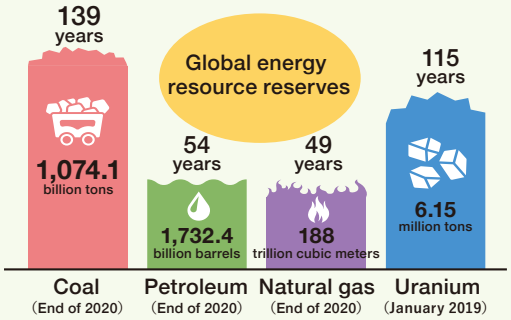
Environmental Destruction

Natural disasters caused by extreme weather events are increasing



(Source:Compiled by Mizuho Financial Group from data by UNDRR)

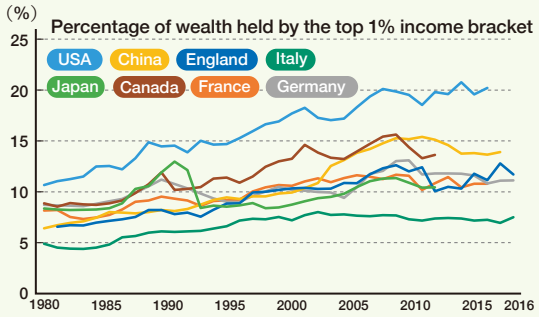
Future depletion of energy resources



(Source: Compiled by Mizuho Financial Group from data by the Japan Atomic Energy Cultural Foundation)

Expanding Income Gap

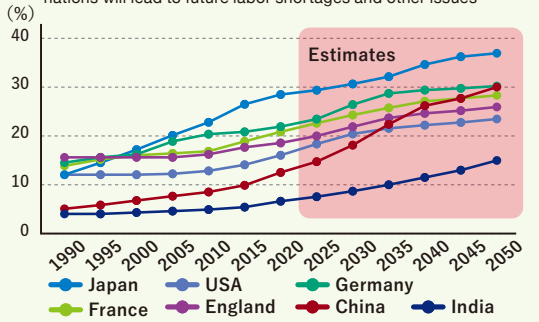
Wealth is becoming increasingly concentrated



(Source: Compiled by Mizuho Financial Group from data provided by the Ministry of Economy, Trade and Industry)

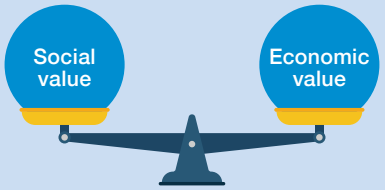
Aging Population/Declining Birthrate

Low birthrate/aging population in Japan and other developed nations will lead to future labor shortages and other issues



(Source:UN, World Population Prospects: The 2022 Revision)
However, for Japan, the source until 2020 is the Ministry of Internal Affairs and Communications' National Census, while estimates from 2025 onward are based on average hypothesized births and deaths according to the "Future Population Estimates of Japan (2023)" by the National Institute of Population and Social Security Research.

Sustainable Capitalism



Impact Creation

Long-Term Efforts

Technological Innovation

Business Structure Reform

Industry, Governments, and Financial Markets

work together to support sustainability efforts around the world

● By working together as one, industry, governments, and the financial sector are promoting sustainability efforts (technological innovation and business structure reform) through industrial policy and financial market development in the US, Japan, and Europe.

— Industrial policy: Main focus on financial support for climate change efforts (subsidies, investment) and carbon taxes.
— Financial markets: Requirements for enhanced disclosures, increase in sustainable finance and environmental value transactions (e.g., carbon credits).

Development of industrial policies and financial market infrastructure in Japan, US and Europe

Industrial Policy	
Japan	● The GX Promotion Act (May '23): ¥150t in public-private investment & **¥20t in government support** over next 10 years ● Asia Zero Emission Community (AZEC) concept
Japan	● Carbon Pricing ✓ **Fossil fuel levy**/FY 2028 onward ✓ **GX-ETS** (*1) /full-scale start in FY26
US	● **US Inflation Reduction Act** (Aug '22) : **$369 billion** for climate change measures : **Domestic investment** in EVs, etc.
US	● Carbon Pricing ✓ **ETS** at the state level (e.g., California)
EU	● EU Green Deal Industrial Plan (Feb '23) : **€270 billion** (over multiple fiscal years) : Securing clean technology **within the region** ● Circular Economy Action Plan (Mar '20) :Promoting transition to circular economy
EU	● Carbon Pricing ✓ Regional: **EU-ETS** *1 (€38.8b revenue); Country-level: **Carbon taxes**

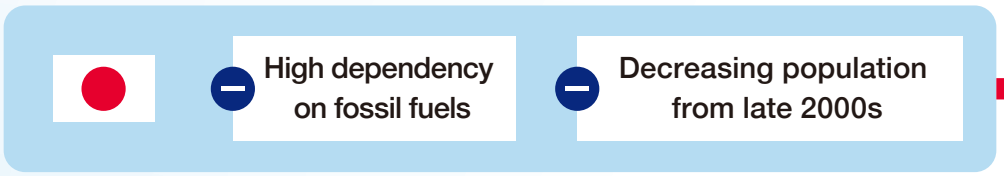
Financial Markets	
Financial Alliances/ Disclosure	● Collaboration between regulators and financial institutions aiming for carbon neutrality ✓ Network of central banks and financial supervisors: **NGFS** ✓ Financial alliance to achieve carbon neutrality by 2050: **GFANZ** ● **ISSB** publishes standards for sustainability disclosure (Jun '23)
Finance	● Sustainable finance as the new norm Restrictions on fund usage → No restrictions on fund usage Green Finance / Social Finance / Sustainable Finance / Transition Finance / Sustainability Linked Loan・Bond / Impact Finance
NEW Environmental Value	● **Trading of GHG reductions based on standards** set by government/private institutions **→Funding mechanism for new technologies** ✓ **ETS**[*1]: Standard = Caps (limits) set for each company or facility ✓ **Carbon credit**: Standard = Emissions based on BAU[*2] scenario

(Source) Created by the Mizuho Financial Group based on Ministry of Economy, Trade and Industry(METI) "Reference Materials for the Second Report of the Committee on New Direction of Economic and Industrial Policies" (27/6/2023), and other public documents

(*1) ETS: Emissions Trading Scheme (*2) BAU: Business As Usual

Changes in Global Economic Systems and Japan's Position

	1960～1990	1990～2020	2020～2050
Global Economic System	Division between Capitalist and Communist	Global expansion of Capitalism ▼ Environmental destruction & Expanding income gap **Negative externalities**	Balancing Economic Value & Social Value ▼ **Sustainable Capitalism**
Japan's Position	The high economic growth period: "Japan as Number One" High growth / high inflation/ high interest	The three lost decades Japan passed over Low growth / zero inflation/ zero interest	**A pioneer in solving social issues** Economic revival and resurgence of inflation and interest rates



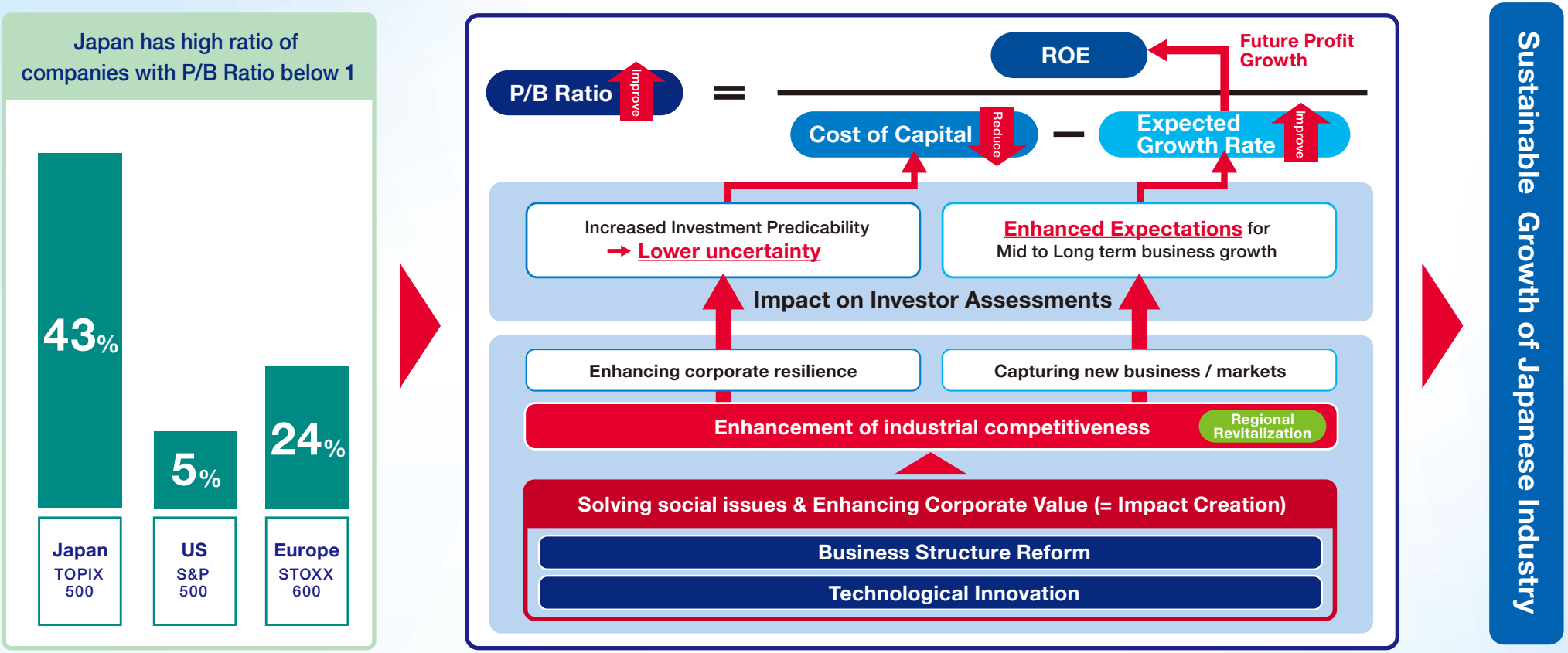
Economic revival through solving social issues

(Source) Created by Mizuho Financial Group based on public materials

Japan is in a position to become **a Pioneer in solving social issues**

- Japan must transform itself ahead of other countries to address a number of social issues, including its high dependency on fossil fuels and the shrinking working-age population.
- This puts Japan in a position to return to a growth trajectory as a pioneer in solving social issues.

The relationship between sustainability efforts, corporate value (P/B ratios), and industrial competitiveness



(Source)"Materials for the Follow-up of Market Restructuring" by the Tokyo Stock Exchange, Inc., created by Mizuho Financial Group

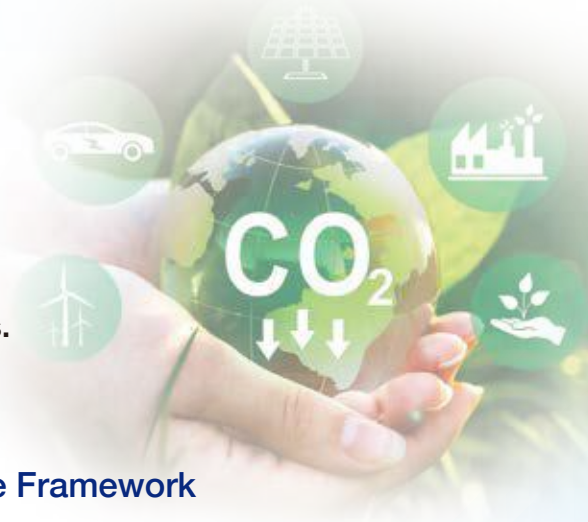
Enhancing Japan's industrial competitiveness and corporate value through

Technological innovation and Business structure reform

- Enhancing Japan's industrial competitiveness through technological innovation and business structural reform aimed at solving social issues.
- Improving Japanese companies' low corporate value (P/B ratios) with lower cost of capital and higher expected growth rates.

Efforts to address climate change

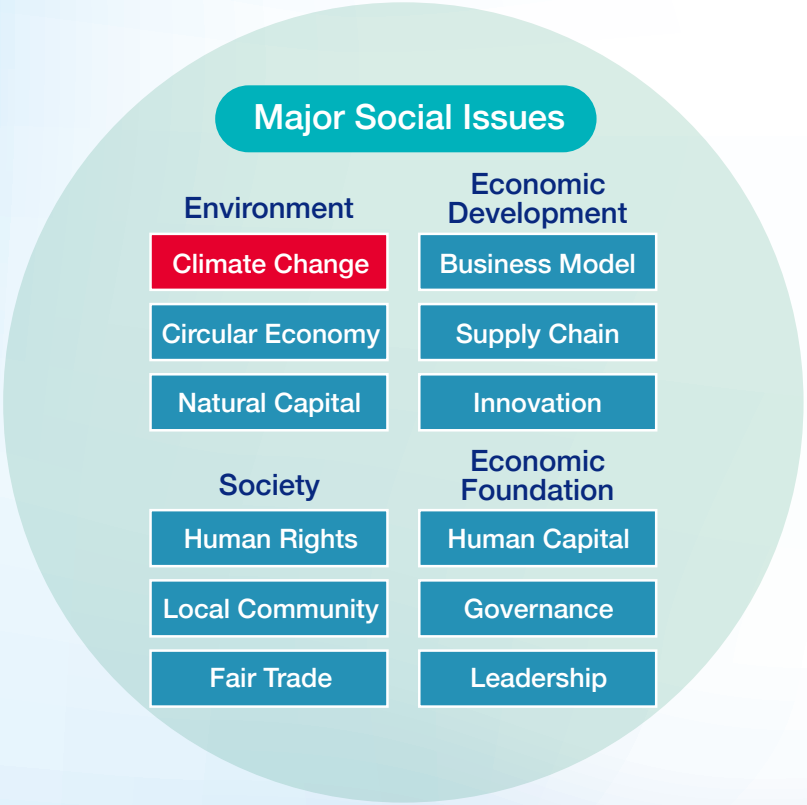
advance within a wide range of social issues



● Initiatives regarding climate change have accelerated ahead of other issues for the following reasons.

– ❶Time-sensitive targets have been set within a global framework; ❷Indicators such as GHG emissions make it is easy to have quantitative discussions on countermeasures.

Major Social Issues



(Source) Created by Mizuho Financial Group based on public materials

(Reference) SASB* Information Disclosure Framework

Phase	Procurement Category
Environment	GHG emissions
	Air quality
	Energy management
	Fuel management
	Water and wastewater management
	Waste and hazardous materials management
	Biodiversity impacts
Social capital	Human rights and community relations
	Access and affordability
	Customer welfare
	Data security and customer privacy
	Fair disclosure and labeling
	Fair marketing and advertising
Human capital	Labor relations
	Fair labor practices
	Diversity and inclusion
	Employee health, safety, and wellbeing
	Compensation and benefits
	Recruitment, development, and retention

Phase	Procurement Category
Business model and innovation	Lifecycle impacts of products and services
	Environmental and social impacts on assets and operations
	Product packaging
	Product quality and safety
Leadership and governance	Systemic risk management
	Accident and safety management
	Business ethics and transparency of payments
	Competitive behavior
	Regulatory capture and political influence
	Materials sourcing
	Supply chain management

(*) SASB stands for Sustainability Accounting Standards Board, a nonprofit organization that has developed disclosure standards for ESG factors expected to have high future financial impact

(Source) Created by Mizuho Financial Group based on SASB "SASB Conceptual Framework"(Feb'17)

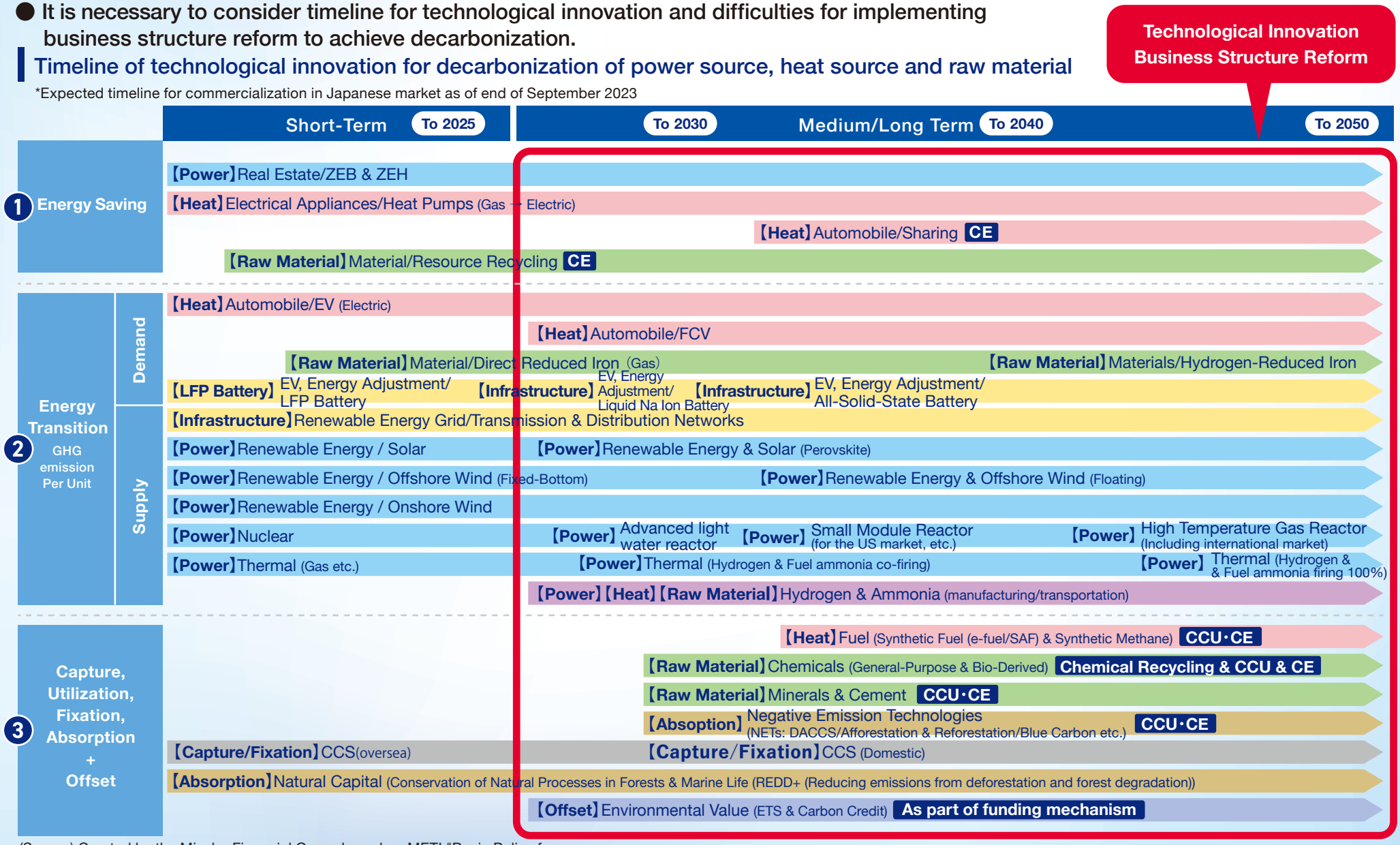
Decarbonization of Power sources, Heat sources, & Raw materials

is essential to address climate change

- It is necessary to consider timeline for technological innovation and difficulties for implementing business structure reform to achieve decarbonization.

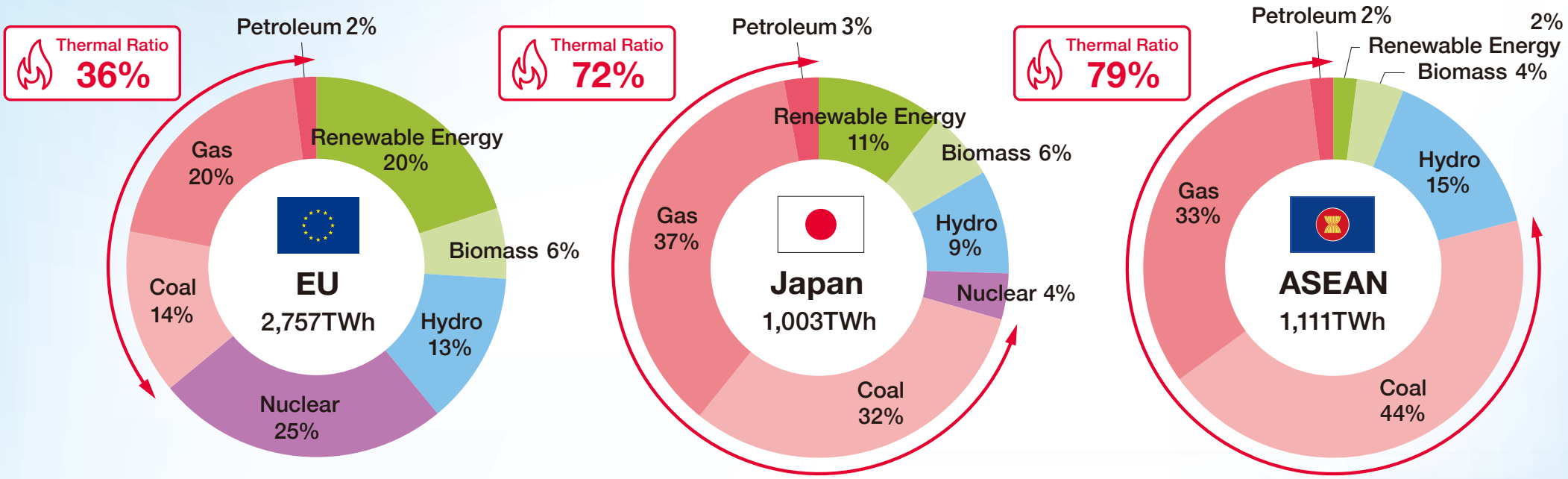
Timeline of technological innovation for decarbonization of power source, heat source and raw material

*Expected timeline for commercialization in Japanese market as of end of September 2023



(Source) Created by the Mizuho Financial Group based on METI "Basic Policy for the Realization of GX Reference Materials" (2/2023) and other public documents

Power generation electricity composition by energy source in the EU, Japan, and ASEAN (2020)



(Source) Created by Mizuho Financial Group from the IEA's "World Energy Outlook 2021", World Energy Statistics and Balances, etc.

Japan needs a

Decarbonization strategy that suits its characteristics

- Japan has limited suitable land for more easily developed solar power generation and onshore wind power generation due to its lack of flat land with good winds and frequent natural disasters. However, offshore wind power is a valuable option to increase Japan's renewable energy as a maritime nation with good offshore wind conditions.
- In Japan, it is difficult to build a cross-border electricity trade system similar to that of the EU. Given the high output variability of renewable energy, Japan must consider the use of hydrogen and CCU/carbon recycling to achieve stable power supply while increasing its ratio of renewable energy.

Significance of Offshore Wind Power, Hydrogen, and CCU/Carbon Recycling as decarbonization technology

CO_2 Emissions in Japan for FY 2021: 1.1 billion t CO_2

Power	Heat	Raw Materials
40%	50%	10%

1. Offshore wind power is valuable for Japan as maritime nation → **Offshore Wind Power**
2. Hydrogen supports the energy transition through decarbonizing power/heat sources and raw materials → **Hydrogen**
3. CO_2 recycling is essential for Japan given its limited natural resources → **CCU/Carbon Recycling**

Technological Innovation + Business Structure Reform → Enhancing industrial competitiveness

Solving social issues and enhancing corporate value (i.e, Impact Creation)

(Source) Created by Mizuho Financial Group based on public materials

Key technologies that suit Japan's attributes are

Offshore Wind Power, Hydrogen, and CCU / Carbon Recycling

- Considering Japan's geographical features and high dependence on overseas energy sources, offshore wind power, hydrogen, and CCU/carbon recycling are three key technologies.

Strengths and Challenges of Japanese Industry in Offshore Wind Power

Key point In Japan, with its limited shallow seas, floating wind turbines have greater potential than fixed-bottom wind turbines

Market Environment

Demand

Domestic

Operators selected through auctions for specific areas in the sea

Currently, auctions for fixed-bottom turbines are being held first as costs and other hurdles to commercialization of floating turbines are high

Only one project uses floating wind turbines in sea areas where an operator has been decided (as of October 2023)

Challenge: Creating demand for floating wind turbines requires lower power generation costs

International

Expectation of future growth in Asian markets

Asian weather/sea conditions are more similar to Japan than Europe

Strength: Japan's extensive experience with typhoons/lightning

Supply

EU, US, and China hold a high share of wind turbine manufacturers, but Japanese companies have withdrawn

Challenge: Stable procurement of imported parts

Strengths: Technologies outside of wind turbine manufacturing

Wind Turbines

Manufacturing	Parts
While EU, US, and China dominate the market, Japan has withdrawn	Japan also handles bearings and has high expectations for assembly companies

Buoy	Electric System	Operation & Maintenance (O&M)
Strengths in foundational shipbuilding technology	Large global market share for domestic cable manufacturers, strength in substation technology	Strengths in lightning protection technology

Floating wind turbines cost more than fixed-bottom wind turbines

Changes in each component design is under way for mass production

Challenge: Cost reduction requires mass production system backed by stable demand

Path to Industry Establishment

Short Term

- ▶ Accelerate demand creation by capturing both the domestic and Asian market
  - ✓ Work together with international wind turbine manufacturers to enter the market, leveraging technologies suitable for Asian weather/sea conditions

Medium/Long Term

- ▶ Expand use of floating wind power among domestic power generation companies
  - ✓ Reduce power generation costs by establishing a mass production system and supply chain backed by increasing demand

(Source) Created by Mizuho Financial Group based on public materials

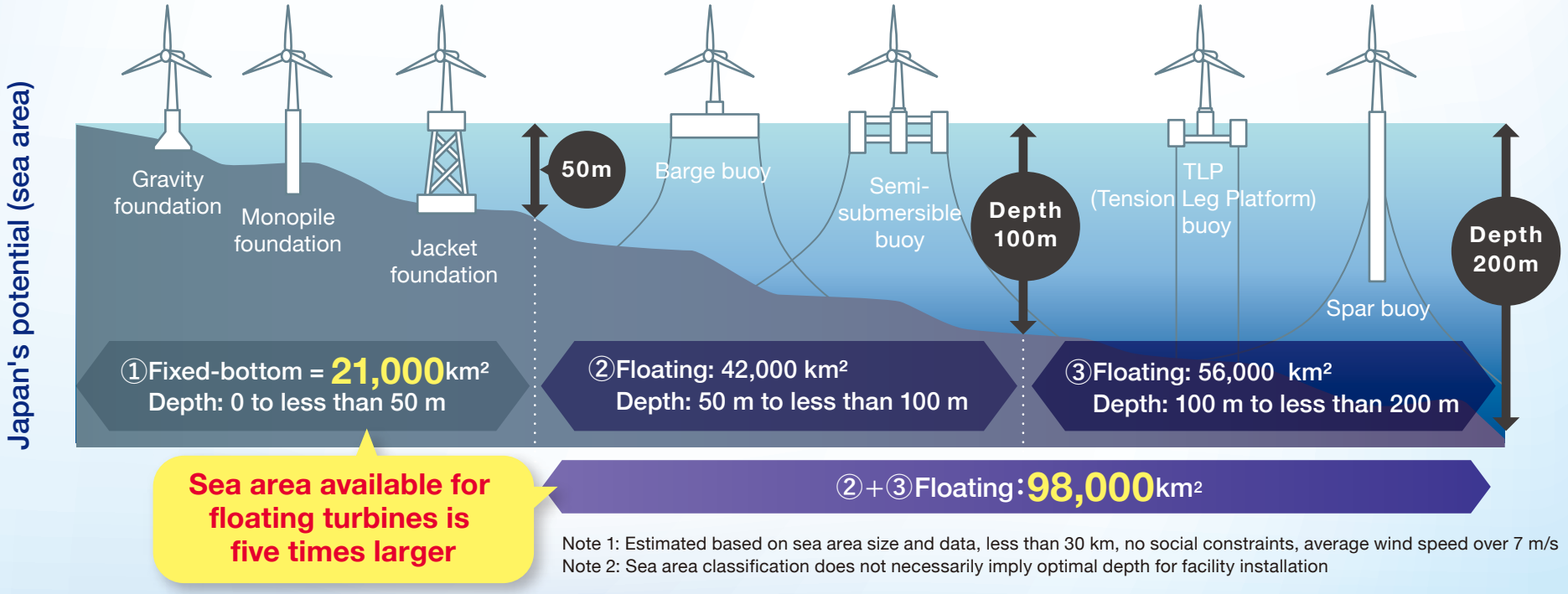
Given Japan's limited shallow seas,

Floating wind turbines have greater potential than fixed-bottom types

- There are two types of offshore wind turbines, fixed-bottom and floating, and currently commercialization through fixed-bottom turbines is underway.
  - As of October 2023, only one project with floating type has been adopted in the areas designated as "Promoting Zone" by METI and MLIT*.
- Due to the scarcity of shallow seas, suitable locations for fixed-bottom turbines in Japan are limited. There is greater potential for technological development of floating wind turbines to increase offshore wind power in Japan as there is 5x the sea area available for floating wind turbines compared to fixed-bottom.

*From "Area Designation and Public Solicitation Process Based on the Act on Promoting the Utilization of Sea Areas for the Development of Marine Renewable Energy Power Generation Facilities & State of Project Formation" on the Agency for Natural Resources and Energy website

Fixed-bottom and floating wind turbines



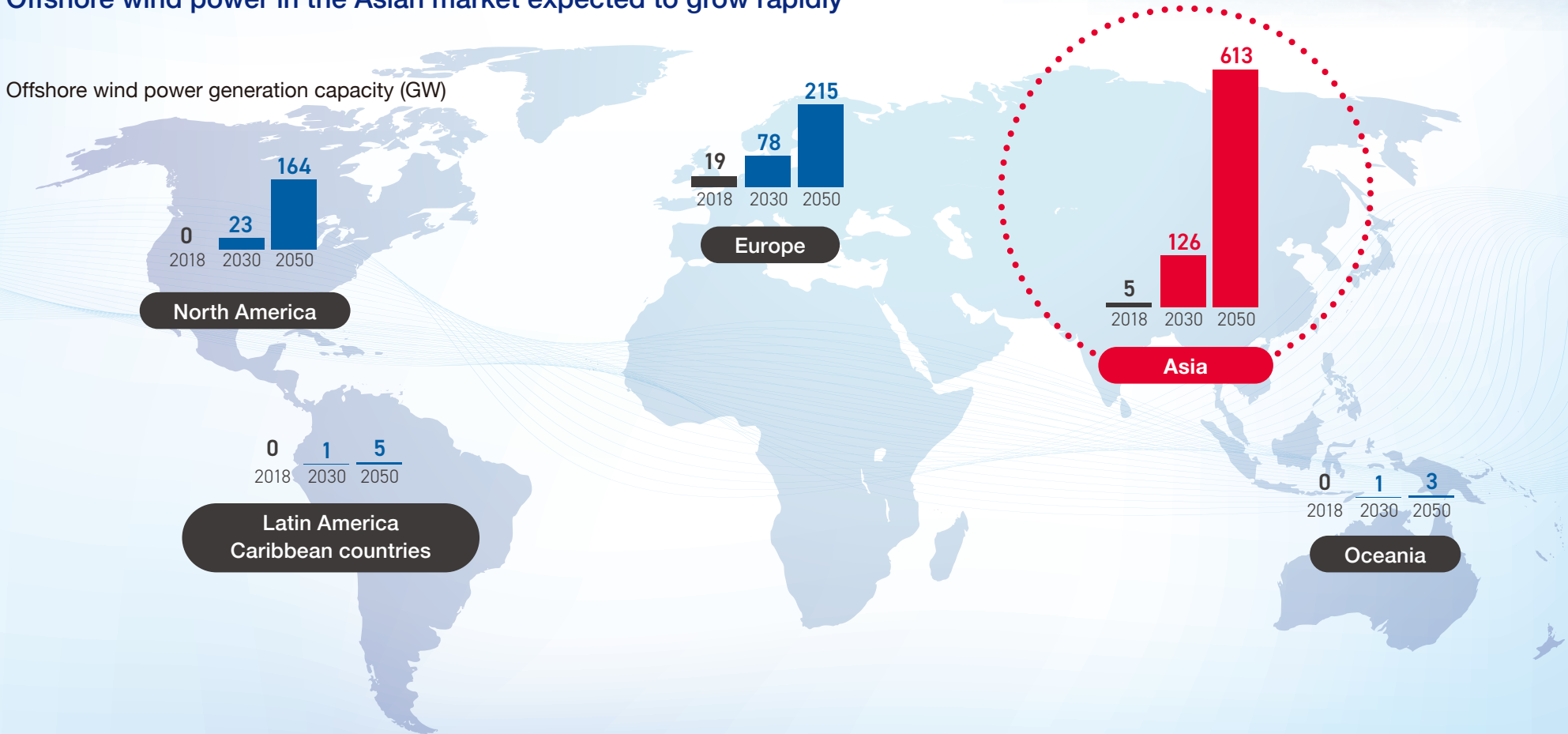
Note 1: Estimated based on sea area size and data, less than 30 km, no social constraints, average wind speed over 7 m/s
Note 2: Sea area classification does not necessarily imply optimal depth for facility installation

(Source) Created by Mizuho Financial Group based on "TSC Foresight Vol 111" New Energy and Industrial Technology Development Organization (NEDO)

As the Asia market grows , Japan's experience to become a strength

- Offshore wind power is currently expanding primarily in Europe, but the International Renewable Energy Agency (IRENA)'s "Future of Wind" report (October 2019) anticipates future growth in the Asian market.
- Asia's oceanographic and meteorological conditions are more similar to Japan than Europe, which should make Japan's experience in dealing with lightning and typhoons a strength.

Offshore wind power in the Asian market expected to grow rapidly



(Source) Created by Mizuho Financial Group from the IRENA's "Future of Wind" (October 2019)

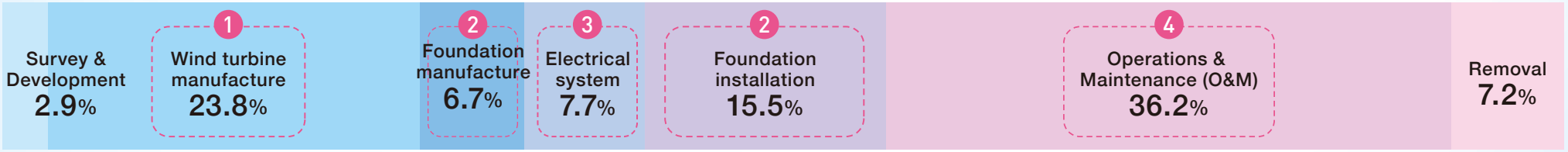
(Note) The copyright of this figure belongs to IRENA.

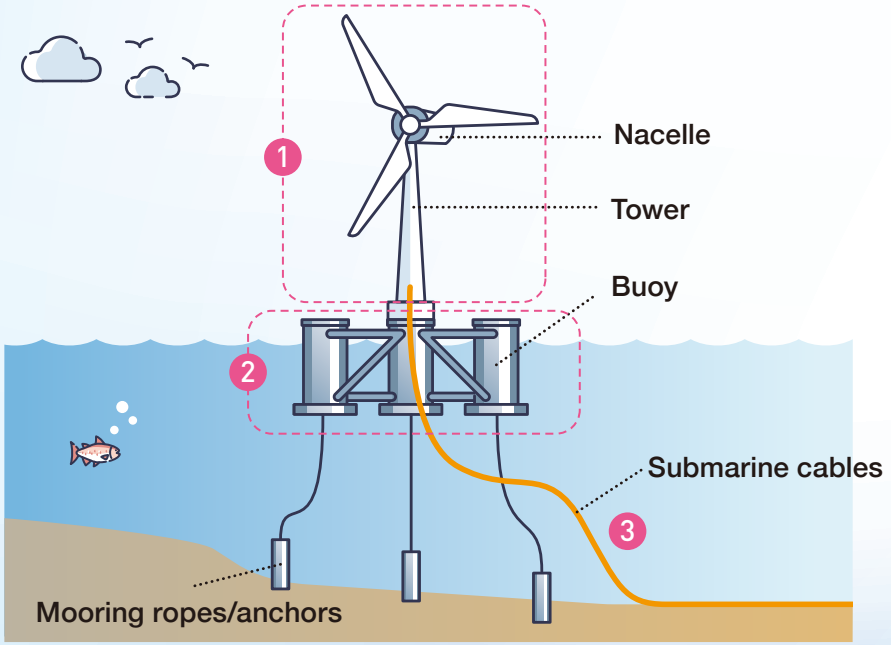
Creating domestic demand for floating types requires

Lower power generation costs

- In Japan, offshore wind power operators are selected by public tender for specific areas in the sea. Due to the high costs and other high hurdles for commercializing floating wind turbines, fixed-bottom wind turbines are leading the way.
- Most offshore wind power generation costs incur in the following four areas: (1) wind turbines, (2) floating (manufacture/installation), (3) electrical systems, (4) operation and maintenance (O&M). Reducing power generation costs requires mass production of components and lower installation costs.

Offshore wind power supply chain cost structure (for fixed-bottom wind turbines)





(*) For floating turbines, "(2) Foundation manufacture" is expected to occupy a higher proportion.

1. Wind turbines (wind turbine design, blades, nacelle components, towers, etc.)
2. Manufacturing & installation of floating (buoys, mooring ropes, anchors, etc.)
3. Electrical systems (submarine cables, offshore substations, etc.)
4. Operation & Maintenance (O&M)

(Source) Created by the Mizuho Financial Group based on "Domestic and International Trends in Floating Offshore Wind Power Generation"（「浮体式洋上風力発電に関する国内外の動向について」）(published in Japanese) by the Agency for Natural Resources and Energy " (December 2022) and the Ministry of Land, Infrastructure, Transport and Tourism website.

Development of technology for offshore wind power generation cost reduction (phasel) (NEDO, Green Innovation Fund)

	Technical areas	Japan's strengths	Participating companies in the demonstration
1	**Next-generation wind turbine technology development** ● Development of low-cost part designs ● Development of high-efficiency production technology for towers	Technical capacity of parts manufacturers, domestic manufacturing base, production quality/quality assurance, factory automation and other robotics technologies as strengths	DAIDO METAL, NTN, KOMAIHALTEC
2	**Development of cost-reduction technology formanufacturing and installation of floating foundations** ● Mass production/cost-reduction technology for buoy ● Development of mooring systems and construction technology	Strength in infrastructure such as docks and technical foundations for shipbuilding that could establish mass-production technology for floating structures	Hitachi Zosen, KAJIMA CORPORATION, MODEC, TOYO CONSTRUCTION , Furukawa Electric, JERA, Japan Marine United, Nihon Shipyard, “K” Line Wind Service , TOA CORPORATION, TEPCO Renewable Power, Tokyo Electric Power Company Holdings , TODA CORPORATION , Tokyo Gas
3	**Development of electrical system technology** ● Development of dynamic cable technology ● Development of technology for offshore substations and converters	Substantial global market share of domestic cable manufacturers	TEPCO Renewable Power, Tohoku Electric Power, Hokuriku Electric Power, Electric Power Development , Chubu Electric Power, The Kansai Electric Power, Shikoku Electric Power, Kyuden Mirai Energy, Sumitomo Electric Industries, Furukawa Electric, Toshiba Energy Systems & Solutions Corporation, Mitsubishi Electric
4	**Advanced operations and maintenance** ● Inspection and preservation using digital technology ● Development of dedicated ships (maintenance, cable laying)	Smart maintenance technology developed preemptively in onshore wind power (especially lightning protection technology)	The Kansai Electric Power, Kanden Plant, Furukawa Electric, CLV Development, TEPCO Renewable Power, Toshiba Energy Systems & Solutions Corporation, SOV Development ,Hokutaku, NTN, TODA CORPORATION

(Source) Created by the Mizuho Financial Group based on "R&D and Social Implementation Plan for the "Cost Reductions for Offshore Wind Power Generation" Projects (Outline) " from the Agency for Natural Resources and Energy (June 2021) and website of NEDO

Japan has strengths in

Technologies outside of large wind turbine manufacturing

- While EU, US, and China have a large share of large wind turbine manufacturing, Japanese companies have withdrawn and possess expertise in technologies outside of wind turbine manufacturing.
- Japan is focusing on technological development aimed at reducing costs (e.g., mass production technology for components) and optimization for the Asian market (e.g., countermeasures for lightning and typhoons).

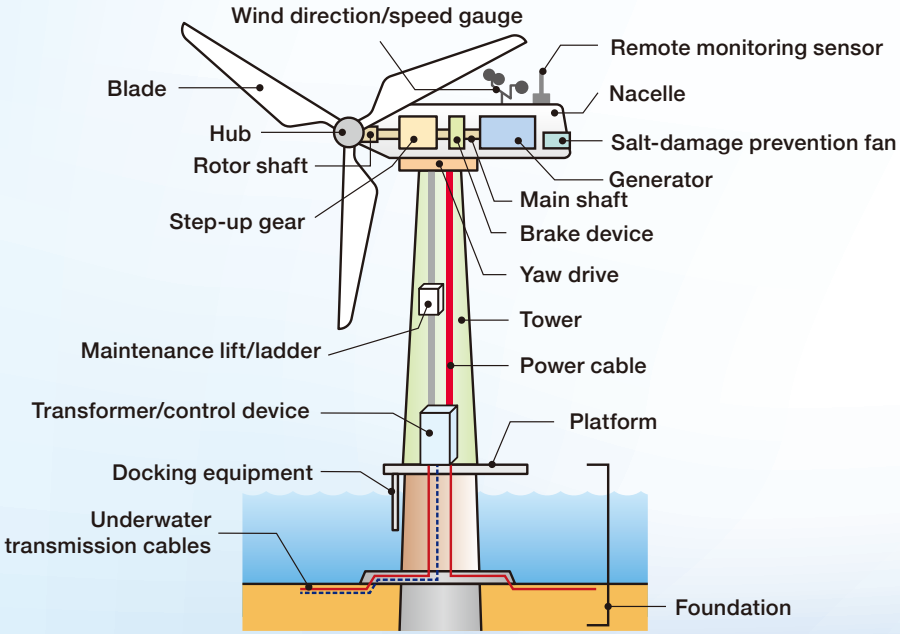
Accelerating demand creation requires

Participating in oversea projects

- Establishing an industry for offshore wind power, which requires over 30,000 parts*, would have a huge impact on all related industries beyond offshore wind power itself.
  - Domestic production of some components is already planned, leveraging Japan's competitiveness in steel, heavy electrical equipment, and machinery industries.
- Collaboration with globally established wind turbine manufacturing companies is crucial when participating in oversea projects.
  - In October 2023, the Agency for Natural Resources and Energy concluded a basic agreement regarding floating wind turbines with Denmark, which has a global offshore wind industry.
  - By collaborating with industry, academia, and government and exchanging policy and technical information, Japan aims to make floating wind turbines an economically viable solution.

*"Domestic and International Trends in Floating Offshore Wind Power Generation" by the Agency for Natural Resources and Energy " (December 2022)

Offshore wind power consists of numerous parts



(Source) Created by Mizuho Financial Group based on "NEDO Renewable Energy Technology White Paper"(「NEDO再生可能エネルギー技術白書」) (published in Japansese) by NEDO (February 2014)

Trend in domestic production of components

Company Name	Product	Project Location
Toshiba Energy Systems & Solutions	Wind turbine component (nacelle)	Kanagawa
NTN, NTN Houdatsushimizu	Power generator component (bearing)	Ishikawa
thyssenkrupp rothe erde Japan	Power generator component (bearing)	Fukuoka
Yamada Manufacturing	Power generator component (shaft)	Aichi
TDK	Power generator component (magnet)	Chiba
Yamayo	Power generator component (black dye)	Toyama
FUKUI FIBERTECH	Blade hub	Aichi
JFE Engineering	Foundation (monopile, etc.)	Okayama
JFE Steel, JFE LOGISTIC , JFE SETOUCHI LOGISTICS	Foundation (steel)	Okayama
NIPPON STEEL ENGINEERING, NIPPON STEEL STEEL STRUCTURE	Foundation (jacket)	Fukuoka
Mitsubishi Nagasaki Machinery Mfg	Foundation	Nagasaki
Toko Tekko	Foundation (girders), davit	Akita
WADAYAMASEIKI	Other (molds)	Gifu

(Source) Created by Mizuho Financial Group based on "Next-Generation Technologies for Renewable Energy"(「再生可能エネルギーに関する次世代技術について」) (published in Japansese) by the Agency for Natural Resources and Energy (September 2023)

Strengths and Challenges of Japanese Industry in Hydrogen

Key point Potential to support the energy transition to decarbonize power and heat sources as well as raw materials

Market Environment

Demand

Establishing a supply chain requires expansion of demand

Early development demand-side technologies is key

Japan

Major demand sector

- Short Term: Power, Synthetic methane, Commercial vehicles
- Medium/Long Term: Steel, Ships, Synthetic fuel

Major demand sector

- Europe: Gas alternative
- China: Passenger vehicles

Challenge
Improved cost predictability promotes investment

Strengths
Potential in power and commercial vehicles

Supply

Manufacturing methods	Water electrolysis by renewable energy	Fossil fuels + CCUS	
Situation in Japan	Few suitable locations for renewable energy	Few suitable locations for CCS	CCU under development

Japan focuses on international manufacturing & imports

Now

Manufacturing
Sogo Shosha participating in international manufacturing projects

Transportation
At the commercialization stage, companies strive to reduce costs

Challenge
Diversification of sources is key (for energy security)

Strengths
Competitive in transport technologies such as liquefied hydrogen

Challenge
Development of port facilities and pipeline networks is crucial

Path to Industry Establishment

Short Term

Demand **Create demand through technological development**

Policy support aimed at improving predictability (compensation for price differences, etc.)

Supply **Efforts toward securing upstream interests overseas**

(1) Diversification of interests
(2) Accumulation of experience by Japanese manufacturing companies

Medium/Long Term

- **Supply** **Demand** **Increase domestic demand/establish supply chain**
- **Supply** **Initiate green hydrogen production in Japan**
- **Supply** **Demand** **Industry restructuring centered around hydrogen**
- **Supply** **Demand** **Expansion into Asian countries**

(Source) Created by Mizuho Financial Group based on public materials

Hydrogen energy helps to decarbonize

Power sources, Heat sources, and Raw materials

- Hydrogen, which does not emit CO_2 when burned, can help reduce carbon emissions in a wide range of sectors such as electric power, industrial sectors, and transportation.
  - The advantages offered by hydrogen in terms of being able to store and transport large amounts of electricity smoothly through water electrolysis may help solve problems associated with renewable energy expansion.
- Hydrogen adoption has a significant impact not only on industries on the supply-side but also the demand-side as its use requires technical development and capex.
  - For instance, when a thermal power plant switches to hydrogen fuel, turbines must be replaced to use hydrogen.

Characteristics and expected role of hydrogen

Characteristics of hydrogen

Hydrogen (H_2)

- Can be used as clean energy with high efficiency that does not emit CO2 when burned
- Can be manufactured from different resources and made carbon-free using renewable energy/CCS
- Can be stored long-term, large-scale by converting surplus electricity from renewable sources into hydrogen
- Can transport large amounts of energy over long distances through liquification and other such changes to its state/properties

Power

Effective method for solving energy issues that come with expansion of renewable energy power sources

Heat

Viable power source for modes of transportation that are difficult to electrify (e.g., trucks, buses, ships, railways)

Raw materials

Effective measure to meet industrial demand such as oil refining, chemicals, and steel

Hydrogen is the Key to Achieving Carbon Neutrality

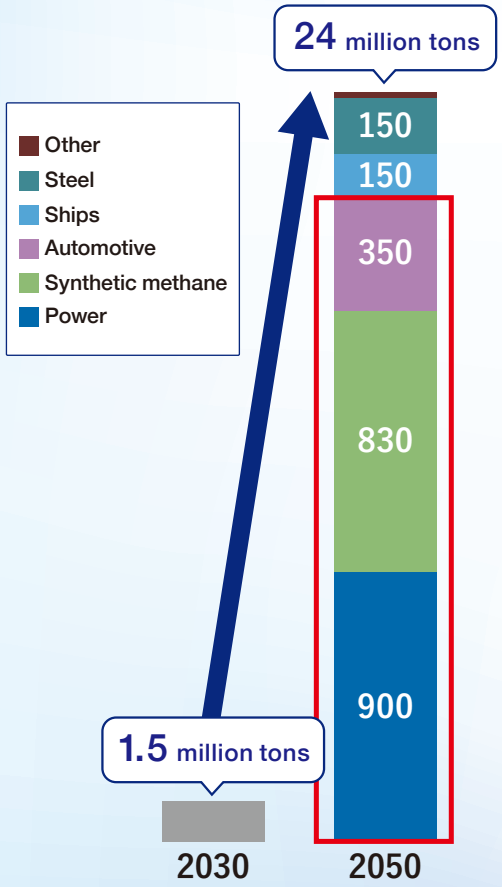
(Source) Created by the Mizuho Bank Industrial Research Department

Power generation and Synthetic methane

are expected to be the largest sources of hydrogen demand in Japan by 2050

- Domestic demand, primarily for power generation, synthetic methane, automobiles, steel, and ships, expected to be 24 million tons by 2050.
- Power generation, synthetic methane, and automobiles are keys to early expansion of hydrogen demand by 2030.

2050 Domestic Hydrogen Demand Forecast as of Feb.2023 (Mizuho Bank, Industrial Research Department.)



Sector	Key demand forecast takeaways
Steel	A shift from coal blast furnaces to Super COURSE50 carbon-recycling blast furnaces and hydrogen-reduction steelmaking will create demand for externally sourced hydrogen
Ships	Hydrogen is expected to be used in small domestic ships and ammonia in large international shipping vessels presuming technical development, infrastructure creation, and cost reduction
Automotive	Commercial FCEVs are expected to spread in 2030 onward, with the assumption of further spread of hydrogen stations and reduction in vehicle prices
Synthetic methane	Small amounts of synthetic methane will be introduced experimentally in some areas by 2030. Large scale implementation are expected to be introduced by 2050
Power	Commercial operation of hydrogen/ammonia co-firing will start by 2030. Expected that all power generation will be replaced by single-fuel hydrogen/ammonia burning or utilizing CSS by 2050

(Source) Created by the Mizuho Bank Industrial Research Department based on public materials

Note 1: Ammonia is classified as a form of hydrogen and demand for ammonia is converted to hydrogen equivalent and included in the total Note 2: Ships include both domestic and international vessels

Technological development for hydrogen usage

is a key for creating early demand

● With the Japanese government support such as the Green Innovation Fund, many Japanese companies are working on various technological development.

Development of technology for hydrogen usage (supported by NEDO)

Sector	Technical challenges	Support programs (example)	Partner Companies
Steel	• Establishment of hydrogen reduction steelmaking technology	(Green Innovation Fund) Hydrogen utilization in iron and steelmaking processes	NIPPON STEEL, JFE Steel, Kobe Steel, The Japan Research and Development Center for Metals
Ships	• Development of hydrogen fuel ships, fuel cell ships, and ammonia fuel ships • Expansion of hydrogen refueling facilities in ports	(Green Innovation Fund) Next-generation ship development	Kawasaki Heavy Industries, YANMAR POWER TECHNOLOGY, Japan Engine, Nippon Yusen, Nihon Shipyard, ITOCHU corporation, IHI Power Systems, MITSUI E&S , Kawasaki Kisen, NS UNITED KAIUN
Automotive	• Early commercialization of FC trucks and buses • Development and maintenance of hydrogen stations (for commercial vehicles)	Development of technology related to cost reductions for hydrogen refueling stations / Technology related to cost reduction and advanced functionality of hydrogen station	Kawasaki Heavy Industries, the Association of Hydrogen Supply and Utilization Technology, ENEOS, JFE Steel, JFE Container, Chiyoda Corporation, Japan Petroleum Energy Center, The High Pressure Gas Safety Institute of Japan, The University of Tokyo, Kyushu University, Chemicals Evaluation and Research Institute,Japan, NOK, Takaishi Industry, NIPPON PILLAR PACKING , KITZ, Fujikin, Tatsuno, Tokico System Solutions, The Japan Rubber Manufacturers Association, Honda R&D, The Japan Research and Development Center for Metals, NIPPON STEEL, Nuvoton Technology Corporation Japan, Shikoku Research Institute, National Institute of Advanced Industrial Science and Technology, Japan Metals & Chemicals, Iwatani corporation, Japan Automobile Research Institute
Synthetic methane	• Early establishment of methanation technology • Large-scale manufacturing through methanation	(Green Innovation Fund) Development of technology for producing fuel using CO_2	Osaka Gas, National Institute of Advanced Industrial Science and Technology, Tokyo Gas, IHI, Japan Aerospace Exploration Agency
Power	• Early practical application of hydrogen power generation technology	(Green Innovation Fund) Establishment of technology to achieve hydrogen power generation technology (co-combustion and single-fuel combustion)	JERA, The Kansai Electric Power, ENEOS

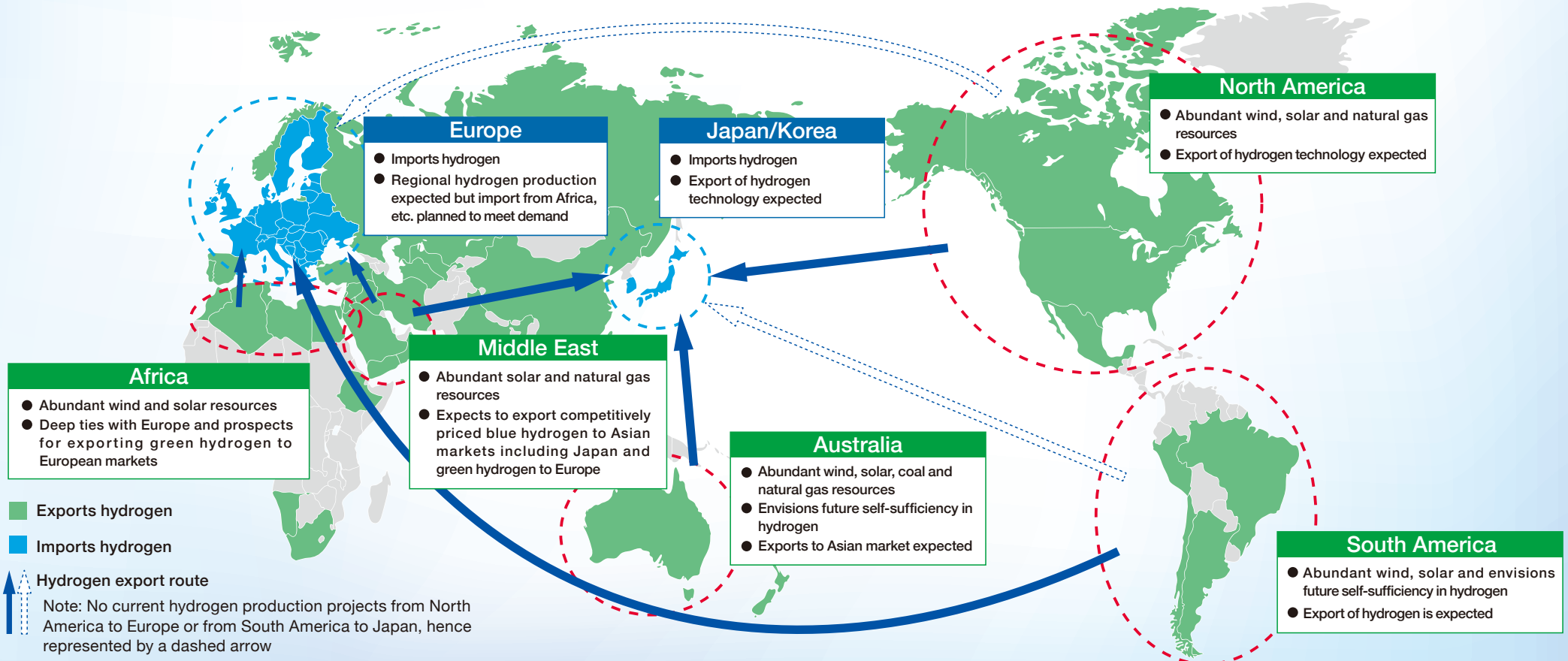
(Source) Created by Mizuho Financial Group from the website of NEDO

As Japan mainly imports hydrogen,

Diversification of sources is crucial for energy security

- Since Japan faces resource constraints and limitations in renewable energy utilization, hydrogen procurement is centered on imports.
- When considering Japan's hydrogen procurement strategy in terms of energy security, it is necessary to form a balanced procurement portfolio from countries with hydrogen surpluses, taking into account the cost of supply and the geographic distribution of suppliers.

Hydrogen procurement routes



(Source) Created by the Industrial Research Department of Mizuho Bank from Canada government "Hydrogen Strategy for Canada" and other public materials

Transportation technology

is already at the stage where commercialization is being considered

- For Japan, which mainly import hydrogen for its supply, reducing the cost of transportation technology is essential.
  - — Working on demonstrations aimed at achieving a hydrogen supply cost of ¥30/Nm3 by 2030 and ¥20/Nm3 or less (equivalent to fossil fuels) by 2050 under the Green Innovation Fund.

Development of technology for hydrogen transportation(NEDO, Green Innovation Fund)

Theme	Project Overview	Companies
Liquefied Hydrogen Supply Chain Commercialization Demonstration	Implement the scale up of developed maritime transportation technology to meet the 2030 delivery cost targets	**Japan Suiso Energy, ENEOS, Iwatani Coroporaiton**
Large-scale demonstration of an MCH* supply chain	Establish dehydrogenation technology using oil refinement equipment to meet the 2030 supply cost targets	**ENEOS**
Establish material assessment infrastructure to support research and development of liquid hydrogen equipment	Establish foundational facilities that unified evaluation of the mechanical properties of materials to reduce costs for equipment for the production, transportation, storage, and use of liquefied hydrogen	**National Institute for Materials Science**
Developing a foundation for material evaluations to support R&D on liquefied hydrogen-related equipment	Develop innovative technologies to further increase in liquefaction efficiency to meet the 2050 supply cost targets	**Kawasaki Heavy Industries**
Direct MCH* electrosynthesis technology development	Develop Direct MCH* electrolysis synthesis, a technology that will meet 2050 supply cost targets	**ENEOS**

(Source) Created by Mizuho Financial Group from the website of NEDO (*)Methyl Cyclo Hexane

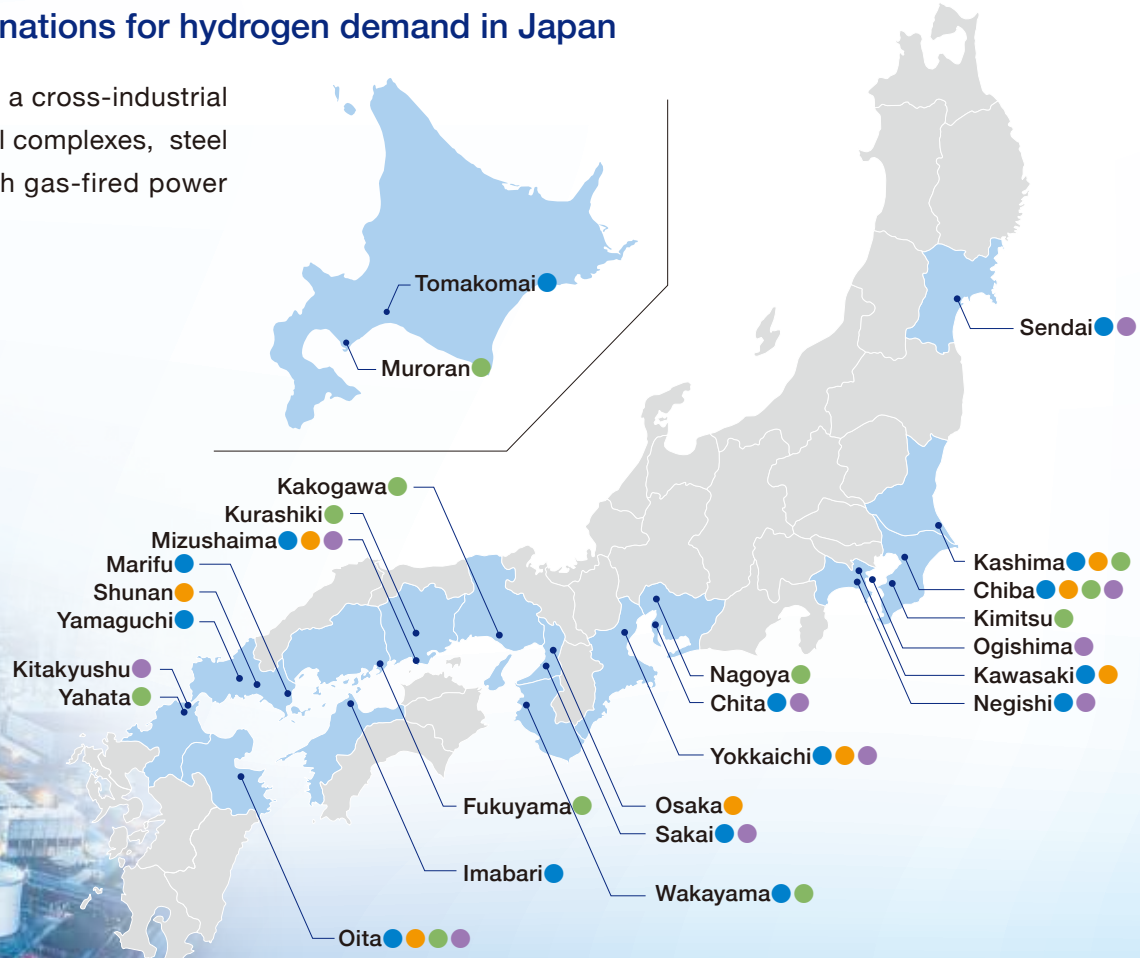
Cross-industrial collaboration among domestic manufacturers

is needed to scale up hydrogen demand

- Considering the state of infrastructure, including port facilities and pipelines, it is necessary to create a hydrogen demand base centered on facilities where large-scale demand can be expected (e.g., petrochemical complexes near refineries, steel plants).
- Based on increase in domestic demand, expanding to Asian countries and domestic hydrogen production may become pathway to further growth.

Anticipated major destinations for hydrogen demand in Japan

Discussions are needed around a cross-industrial grand design with petrochemical complexes, steel plants, and LNG terminals (with gas-fired power plants) near refineries plotted out



- Refinery
- Petrochemical complex
- Steelworks
- LNG Base

※ Only LNG bases near refineries shown
※ Gas-fired power plants typically near LNG bases

(Source) Created by the Mizuho Bank Industrial Research Department based on public materials

Strengths and Challenges of Japanese Industry in CCU & Carbon Recycling

Key point It is important to accelerate decarbonization and maintain economic security, regional CO_2 circulation (CCU/carbon recycling)

Market Environment

Demand

Major carbon recycling products

Chemicals	Fuel	Minerals
2050 Potential global market size **Trillion dollars(Plastic)**	**2030** Potential global market size **USD10Bil～USD250Bil**	**2030** Potential global market size **USD100Bil～USD265Bil (Concrete)**
• Methanol • Olefin • Polycarbonate	• Synthetic fuel • Biofuel (SAF) • Synthetic methane	• Concrete • Cement • Carbonate

*Some products utilize not only CO_2 but hydrogen as raw materials

Ways to lower hurdles for social implementation

1. **Existing infrastructure can be used**
2. **Fuel can be used as high-energy-density fuel through liquefaction**

Challenge

Challenges for widespread adaptation: reducing prices

Currently more expensive than existing products
(Example: SAF biofuel at ¥1,600/L versus existing jet fuel around ¥100/L)

Supply

Mid- to long-term technological development

Artificial photosynthesis	Negative emission technologies
Technology to create chemicals (e.g., olefin) from sunlight and CO_2	Technologies to capture atmospheric CO_2 in plants, soil, oceans, underground,etc.

What is required to reduce prices

Improve production efficiency	Reduce hydrogen procurement cost
Improve manufacturing processes/increase energy conversion efficiency	Establish stable supply chain (see "Hydrogen" on the previous slides)

Reduce CO_2 procurement cost

①Scale CO_2 circulation volume ②Reduce capture costs

↓ ↓

Strengths: Capture technology is Japan's strength (top global share for capture devices)

Path to Industry Establishment

Short Term

- **Development of technology focused on products that do not use hydrogen as a raw material (such as polycarbonate, carbonate)**
- **Building CO_2 supply chains between cross-industries (e.g., industrial complexes) to scale CO_2 circulation volume**

Medium/ Long Term

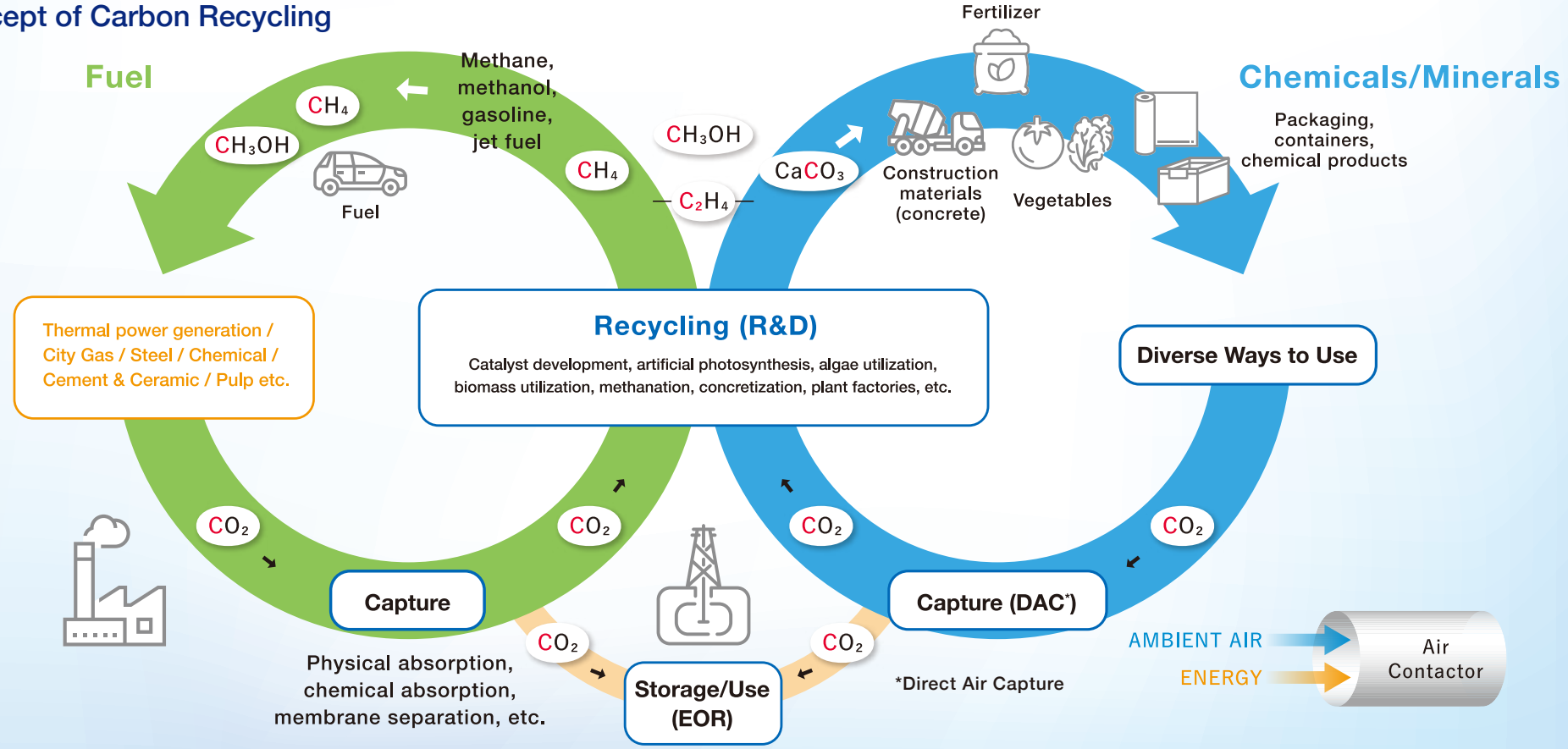
- **Gradual commercialization of products that use hydrogen as raw material, such as synthetic fuels, once stable and affordable hydrogen supply chain is established**
- **Practical application of artificial photosynthesis and introduction of negative emission technologies to begin storing CO_2**

(Source) Created by Mizuho Financial Group based on public materials

CCU & Carbon Recycling are essential for accelerating decarbonization

- Capturing and reusing CO_2 is an essential approach in sectors where decarbonization cannot be achieved through electrification / hydrogen.
  - There are also the options such as "capturing CO_2 and storing it underground (CCS)," but in Japan, suitable storage locations are limited, and technological development for carbon recycling is advancing ahead.
  - Developing energy generation technology made from CO_2 as a raw material is important in terms of economic security as well.
- Products made from carbon recycling can be broadly categorized into three types: (1) Chemicals, (2) Fuel,and (3) Minerals.
  - Methanol and some other products use hydrogen in addition to CO2 as raw materials.

The Concept of Carbon Recycling



(Source) Created by Mizuho Financial Group from the website of Agency for Natural Resources and Energy

A wide range of R&D and demonstrations

is progressing in carbon recycling technology

● Various products can be manufactured using CO_2 as a raw material, such as biofuels like SAF (Sustainable Aviation Fuel) derived from algae cultured with CO_2, and mineral-based products like concrete made by absorbing CO_2.

— Fuels such as synthetic fuels, unlike hydrogen, have the advantage of being able to leverage existing infrastructure, and can be liquified to serve as high-density energy source, including aviation fuel.

Usage of recycled CO_2

1	Chemicals	General-purpose products	Olefin, BTX, etc.	2050 Potential global market size*1 **Trillion dollars** (Plastic)
		Oxygen-containing compounds	Polycarbonate, etc.	
		Other	Bio-derived chemicals	
2	Fuel	Liquid fuel (synthetic fuel)	E-fuel, methanol	2030 Potential global market size*2 **USD10Bil～USD250Bil**
		Liquid fuel (biofuel)	SAF	
		Gas fuel	Synthetic methane, LPG, etc.	
3	Minerals		Concrete, cement, carbonate, carbon, carbides, etc	2030 Potential global market size*3 **USD100Bil～USD265Bil** (Concrete)
4	Other		Microalgae, blue carbon, etc.	——

(*1)METI “R&D and Social Implementation Plan for the "Development of Technology for Producing Raw Materials for Plastics Using CO_2 and Other Sources" Projects”(Oct.2021)(converting 150JPY per 1USD)
(*2)Created by the Mizuho Financial Group from the ICEF's "Global Roadmap for implementing CO_2 Utilization"
(*3)METI “R&D and Social Implementation Plan for the "Development of Technology for Producing Concrete and Cement Using CO_2" Projects”(Oct.2021)(converting 150JPY per 1USD)
(Source) Created by Mizuho Financial Group based on METI "Roadmap for Carbon Recycling Technologies" (June 2023)

Pricing reduction is required for widespread use of carbon recycling products

- Currently, many carbon recycling products are being produced on a demonstration basis, but prices are significantly higher than existing products.
- Lower price for widespread usage requires improvement in production technology (efficiency) as well as reduction in procurement costs of CO_2 and hydrogen as main raw materials.

Price comparison:major carbon recycling products vs existing products

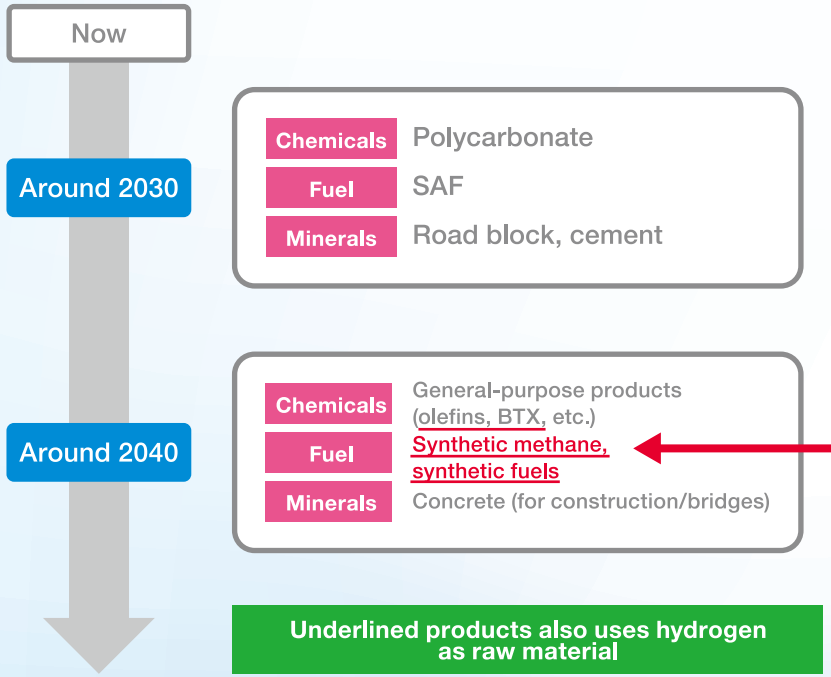
Fuel	SAF	¥1,600/L	Jet fuel	≈¥100/L	16x
Fuel	Synthetic fuel	¥300 - ¥700/L	Gasoline	≈¥170/L	2-4x
Minerals	CN road blocks	Hundreds of yen/kg	Road blocks	¥30/kg	10-20x

(Source) Created by Mizuho Financial Group based on METI "Roadmap for Carbon Recycling Technologies" (June 2023)

It is important to promote technical development in each product area, taking into account Hydrogen procurement environment

- Products made from carbon recycling that do not require hydrogen supply and have a high degree of technical maturity are expected to spread around 2030, while those that require stable hydrogen supply and technical advancement are expected to start prevailing around 2040.
- While technical development for commercializing products not made from hydrogen is underway, considering the timeline for stable hydrogen supply, technical development for producing fuels made from hydrogen, including synthetic methane and synthetic fuels, has already begun.

Timeline for widespread of Major Carbon Recycling Products



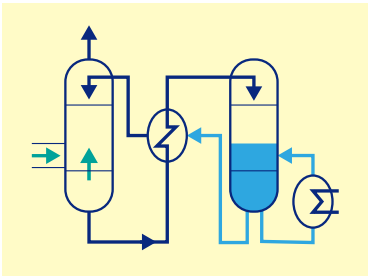
(Source) Created by Mizuho Financial Group based on METI "Roadmap for Carbon Recycling Technologies" (June 2023)

Development of carbon recycle technologies(NEDO, Green Innovation Fund)

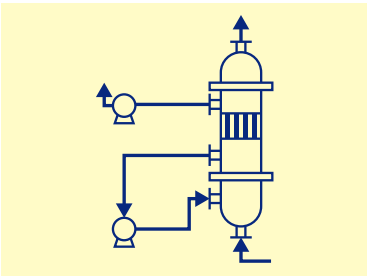
Project	R&D Content & Organizer
Development of Technology for Producing Fuel Using CO_2, etc. (FY 2023 to FY 2030)	● Development of a high-efficiency production process for liquid fuels from CO_2 with a synthetic reaction: **ENEOS** ● Development of technology to increase the efficiency of synthetic fuel utilization and reduce backfiring in passenger cars and heavy-duty vehicles: **Research Association of Automotive Internal Combustion Engines (AICE)** ● Development and deployment of Alcohol to Jet (ATJ) demonstration facilities using state-of-the-art ATJ process technology: **Idemitsu Kosan** ● SOEC (Solid Oxide Electrolysis Cell) methanation technology innovation project: **Osaka Gas, National Institute of Advanced Industrial Science and Technology** ● Development of innovative methanation technology using low-temperature processes: **TOKYO GAS, IHI, Japan Aerospace Exploration Agency** ● Development and demonstration of green LP gas synthesis technology using innovative catalysts and processes: **Furukawa Electric**

(Source) Created by Mizuho Financial Group from the website of NEDO

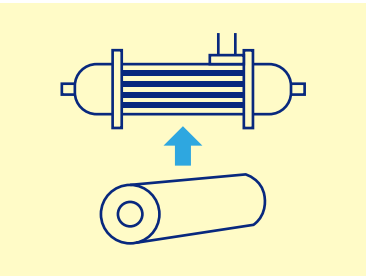
Major Forms of CO_2 Separation and Capture



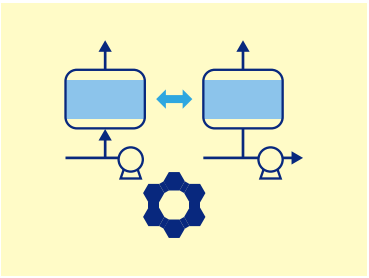
Absorption



Absorption – Membrane Hybrid



Membrane Separation



Adsorption

Development of CO_2 separation and Capture, technology (NEDO, Green Innovation Fund)

❶Commercialization of low-cost CO_2 separation and recovery process from natural gas combustion exhaust gas:	Chiyoda Corporation, JERA, Research Institute of Innovative Technology for the Earth
❷Development and Demonstration of CO_2 separation and capture technology from low CO_2 concentration exhaust gas of dispersed facilities:	DENSO
❸Development and demonstration of low-concentrated CO_2 separation and capture system using innovative absorbent materials:	Resonac, NIPPON STEEL
❹Development and demonstration CO_2 separation and capture system from factory exhaust gas using membrane separation technology:	SUMITOMO CHEMICAL, OOYOO
❺Development and demonstration of novel CO_2 capture technology using inorganic solid state “Na-Fe Oxides”:	AIR WATER, TODA KOGYO, Saitama University
❻Development and demonstration of CO_2 separation and capture technology using unutilized LNG cryogenic energy:	Toho Gas, Nagoya University
❼Establishment of a common evaluation standard for CO_2 capture materials:	National Institute of Advanced Industrial Science and Technology, Research Institute of Innovative Technology for the Earth

(Source) Created by Mizuho Financial Group from the website of NEDO

Japanese companies hold substantial market share in

CO_2 separation and capture

- Japanese companies possess technological potential in terms of CO_2 separation and capture, which is crucial for achieving CCU and carbon recycling, particularly in the separation and capture of CO_2 from gases with various compositions.
  - — Regarding CO_2 separation and capture plants, Mitsubishi Heary Industries has already built 15 plants, which leads to the top of global markets share (As of April,2023/Based on the capacity of the CO_2 capture facility)*.

(*)Website of Mitsubishi Heavy Industries

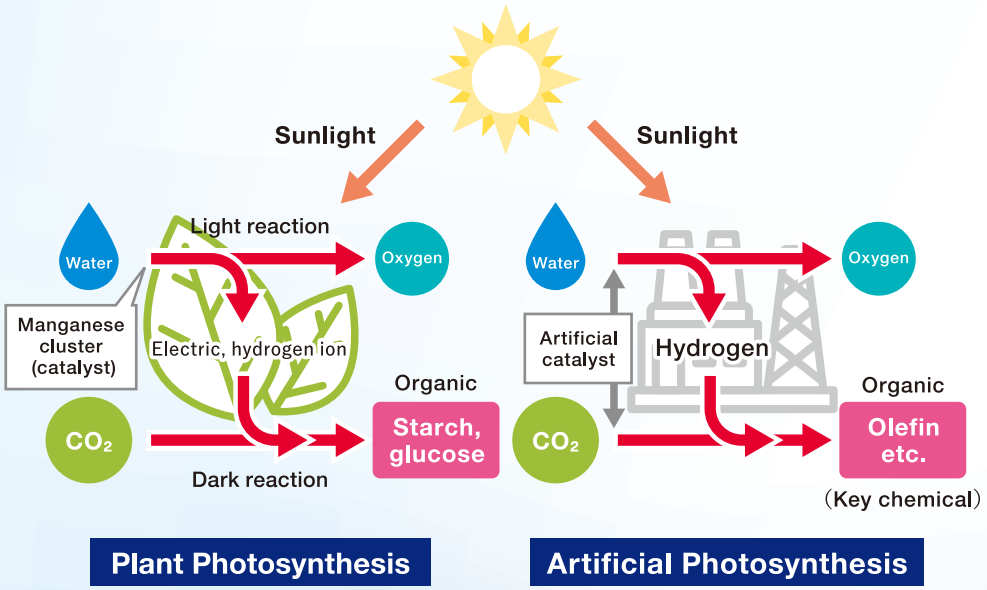
(Reference) Mid to long-term technological development targets

● Development of ❶ Artificial photosynthesis and ❷ Negative emission technologies.

—❶ Artificial photosynthesisis : A technology that synthesizes chemicals from CO_2 and water using solar energy. Hydrogen and oxygen are efficiently produced from water using photocatalysts. The extracted hydrogen by using separation membranes is then reacted with CO_2 using synthetic catalysts to produce olefins.

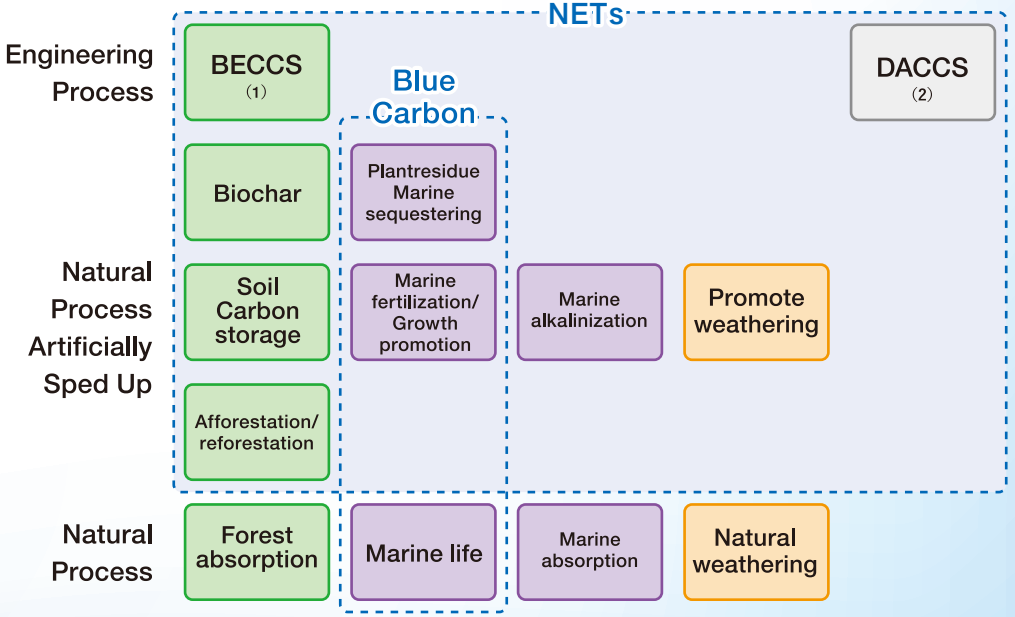
—❷ Negative emission technologies : Negative emission technologies help remove and sequestering CO2 from the atmosphere. It includes engineered processes like BECCS (1) and DACCS (2), and artificial acceleration of natural processes such as biochar, reforestation/afforestation, marine fertilization/growth promotion.

❶ Artificial photosynthesis



(Source) Created by Mizuho Financial Group from METI "Negative Emission Technology" (February 2022)

❷ Negative emission technologies



(Note 1) BECCS: Technology to capture/store CO2 from biomass combustion
(Note 2) DACCS: Technology to directly capture/store CO2 from the atmosphere
(Source) Created by Mizuho Financial Group based on the website of Agency for Natural Resources and Energy

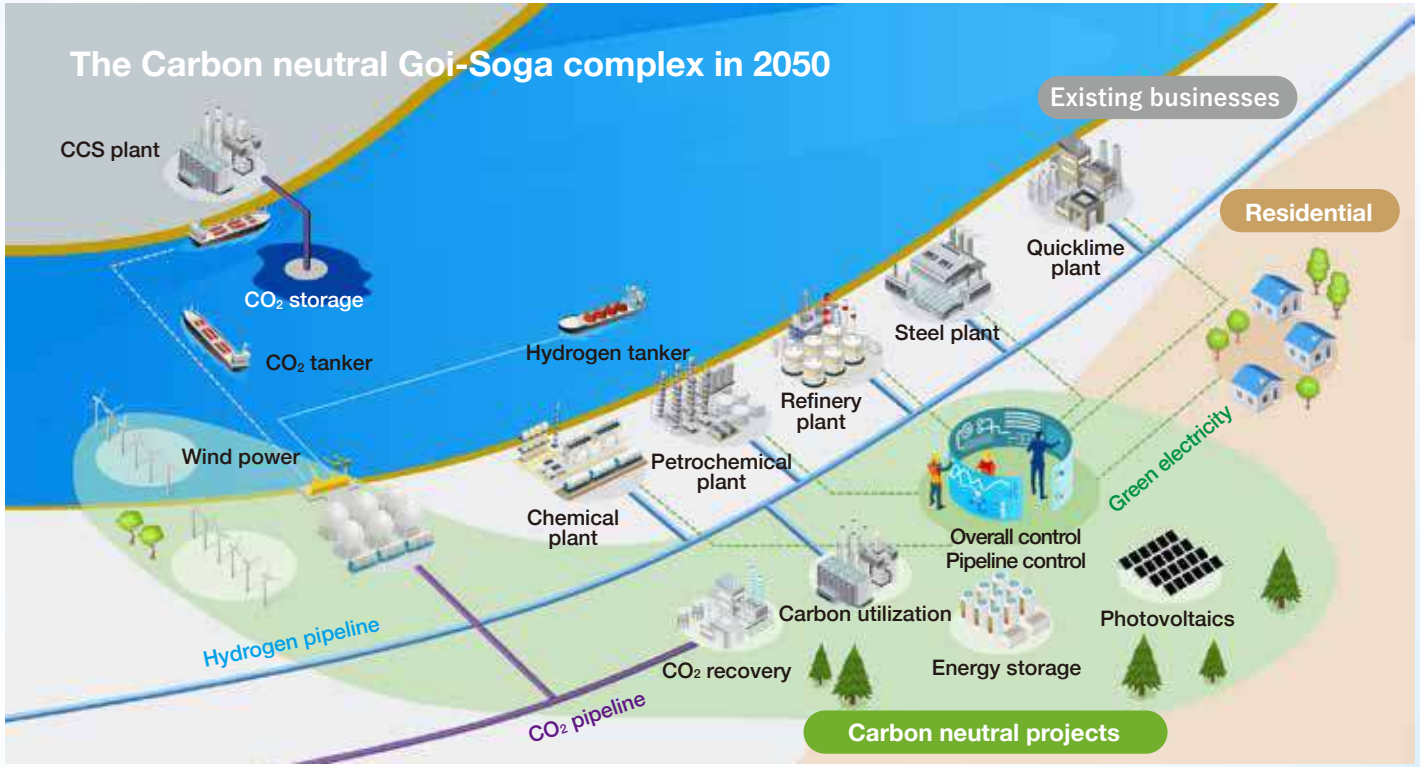
Example : Cross-industry collaboration for CCU and carbon recycling (industry collaboration in the Soga and Goi areas in Chiba)

Overview

- Collaboration between Yokogawa Electric + 11 diverse companies located in the Soga and Goi area in Chiba
- Consideration given to the introduction of a CO_2 management system through cross-industry collaboration, CO_2 capture and effective use, and effective utilization of hydrogen/by-product gases from existing processes
- NEDO has conducted a cross-industry collaboration study and is currently considering commercialization

Participating companies

AGC, JFE Steel, JNC, KH Neochem, Ube Elastomer, Iwatani Corporation, Ube Material Industries, Air Water, Cosmo Oil, Denka, Maruzen Petrochemical, Yokogawa Electric



(Image Source)Yokogawa Electric

(Source) Created by Mizuho Financial Group from METI"Roadmap for Carbon Recycling Technologies Supplement 2: Examples of Cross-Industry Collaboration"(「カーボンリサイクルロードマップ別冊2産業間連携の事例」)(published in Japanese) (June 2023) and public materials

Building a CO_2 supply chain for cross-industry collaboration

is the key to achieve social implementation

- Expanding the scale of CO_2 distribution through inter-industry collaboration contributes to lower costs for CCU and carbon-recycling products.
- Especially in large industrial clusters such as industrial complexes, efficient infrastructure development is possible, and in waterfront areas, hydrogen supply can also be efficiently implemented.

Accelerating decarbonaization is essential to enhance industrial competitiveness

- Speeding up the realization of decarbonization is necessary to strengthen the competitiveness of industry through "technological innovation" and "business structure transformation" efforts centered on high-profile technologies (offshore wind, hydrogen, and CCU/carbon recycling).
- There are two major initiatives to speed up the process:
  - (1) "Co-creation, " sharing knowledge with diverse players.
    (2) Promotion of “investment” as a risk-sharing mechanism with diverse funding providers.

Offshore Wind Power | **Hydrogen** | **CCU/Carbon Recycling**

Social implementation of tech/businesses necessary for decarbonizing power sources, heat sources, and raw materials, apart from those mentioned above

↓

Enhancement of industrial competitiveness through **Technological Innovation** & **Business Structure Reform**

↓

Acceleration towards decarbonization is essential

Connecting knowledge with diverse players:Co-creation	Risk-sharing among diverse fund providers: Investment		
	Finance		Carbon Credit
	Government	Private sector	
Collaboration with startups that possess key technologies	Government support to stimulate private investment	Expansion of sustainable finance	Funding mechanism

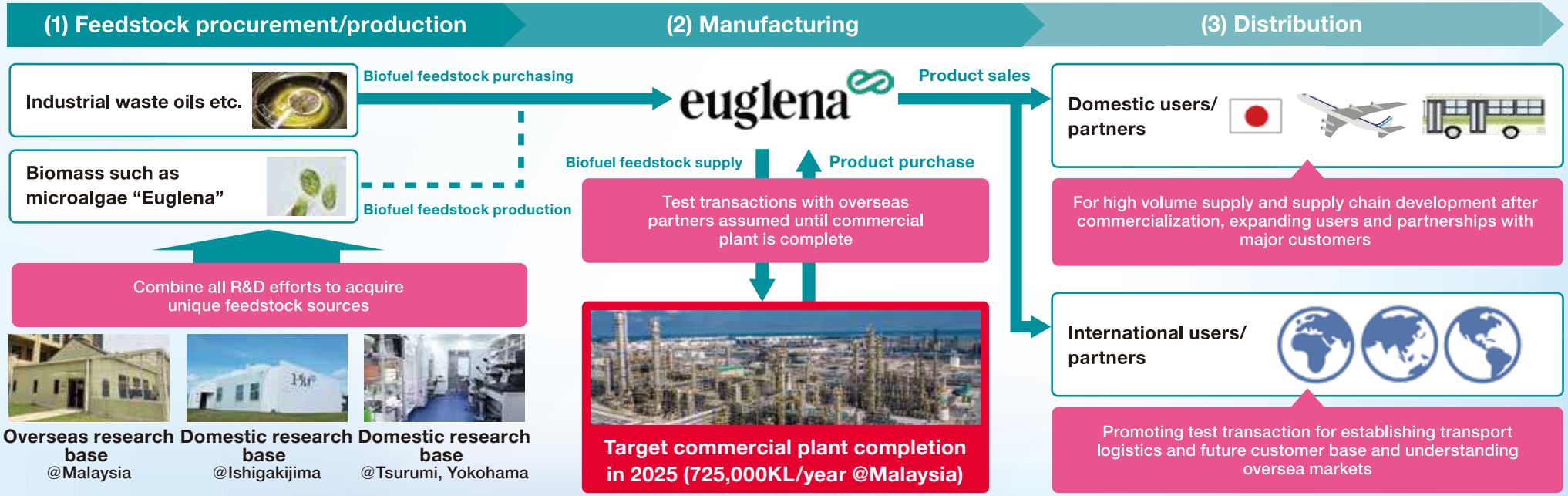
(Source) Created by Mizuho Financial Group based on public materials

Collaborating with diverse players including startups to accelerate technological innovation

● Co-creation through connecting knowledge with various companies and organizations, including startups possessing key technologies, is required to accelerate technological innovation and business structure reform.

(Case Study: Euglena Co.,Ltd) Efforts Toward SUSTEO Biofuel - Carbon Recycling

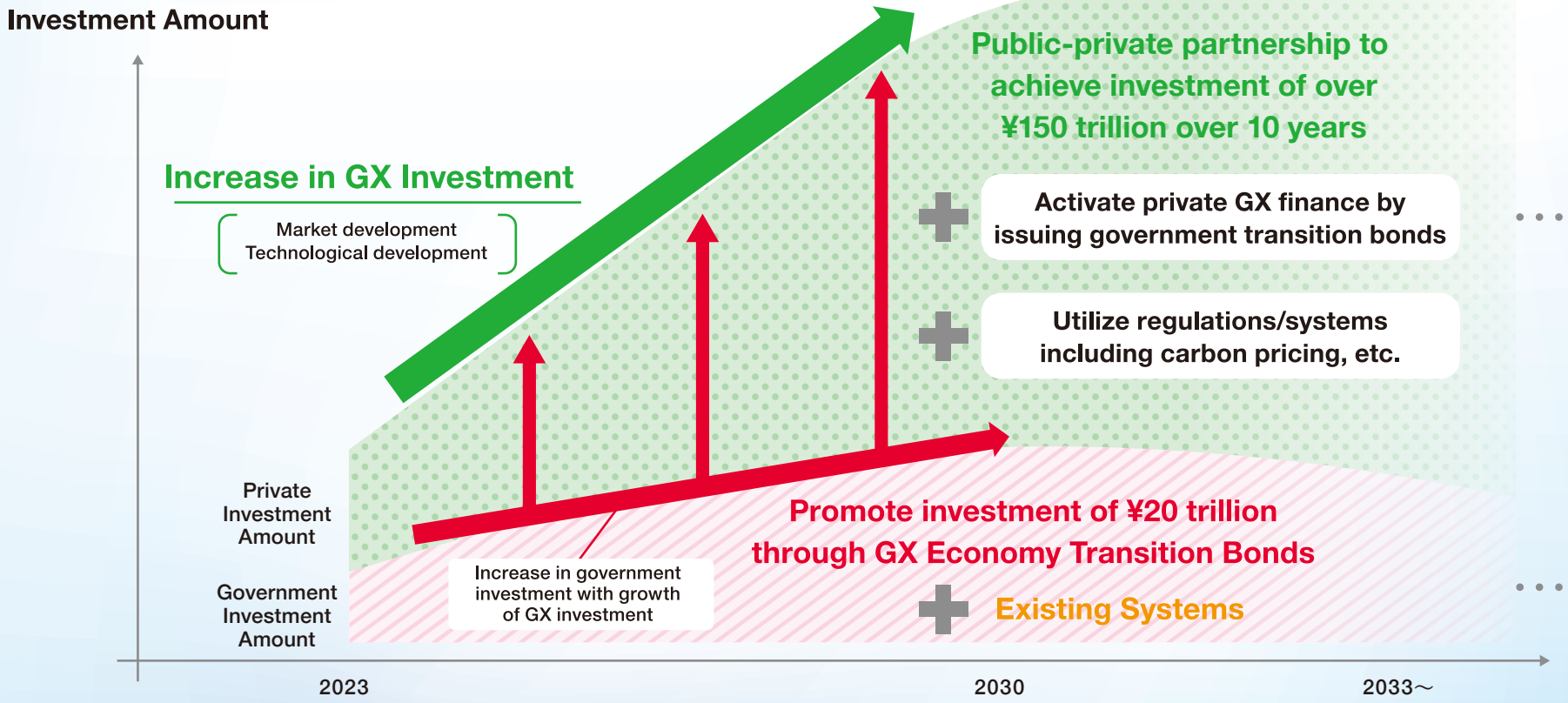
- Euglena Co., Ltd. a company known for mass cultivation of microalgae, is working to produce biofuel from biomass such as used cooking oil and oils extracted from microalgae
- Although the fuel emits CO_2 when burned, the plants and microalgae used as feedstock absorb CO_2 through photosynthesis as they grow, effectively neutralizing CO_2 emissions from fuel use and contributing to carbon neutrality
- Japan's first bio-jet and diesel fuel production demonstration plant was completed in 2018 in cooperation with the city of Yokohama, Chiyoda Corporation, ITOCHU ENEX, Isuzu Motors, and All Nippon Airways, and began supplying biodiesel fuel in 2020 and SAF in 2021
- R&D for mass cultivation of microalgae as feedstock for commercializing biofuel is ongoing. Raises funds to promote commercial plant construction and future expansion of biofuel supply, issues climate convertible bonds to partner companies including Mazda and Dai-ichi Life Insurance



(Source) Created by Mizuho Financial Group based on public materials

An investment of ¥150 trillion yen is required over the next 10 years for Japan to achieve carbon neutrality

- The government estimates that an investment of ¥150 trillion will be required in cooperation with the private sector over the next 10 years from 2023 in order to strengthen industrial competitiveness and economic growth and achieve carbon neutrality by 2050.
- The government plan to stimulate private investment by deploying ¥20 trillion through GX Economy Transition Bonds.

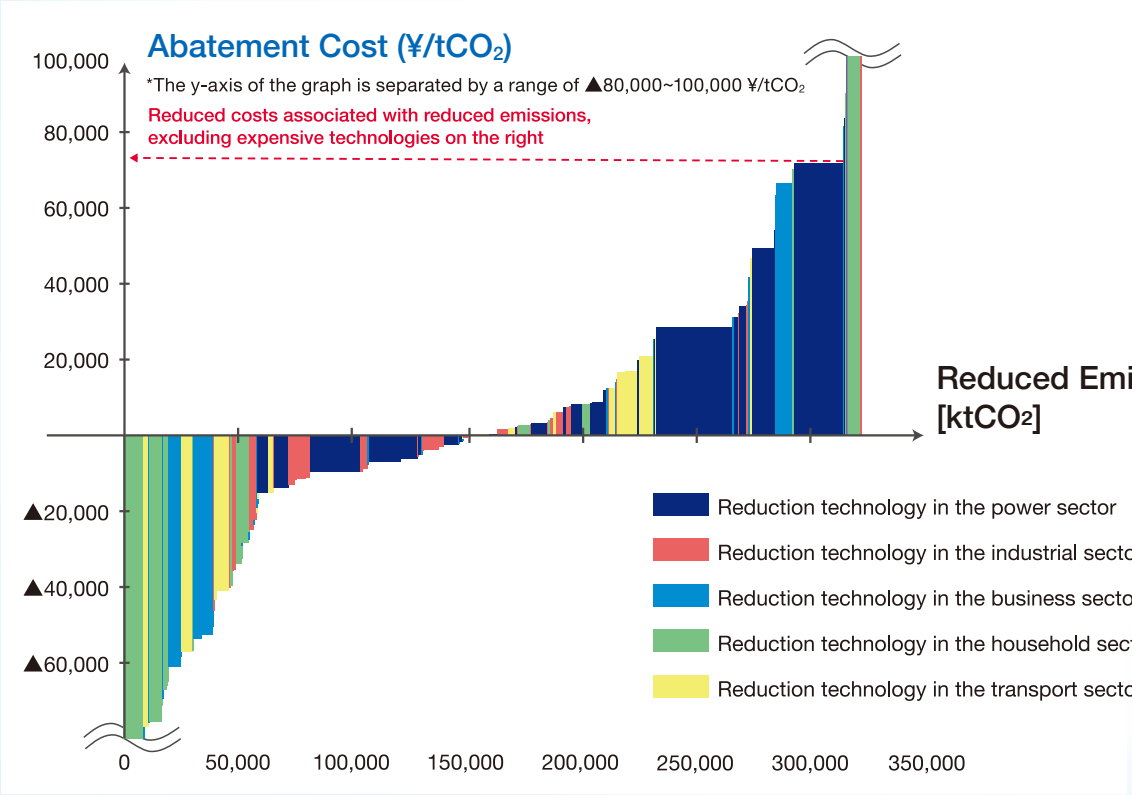


(Source) Created by Mizuho Financial Group based on the Cabinet Office "Achieving the Green Transformation in Japan" (「我が国のグリーントランスフォーメーション実現に向けて」) (published in Japanese) (August 2023)

(Reference) Prioritizing investments in decarbonization

- Given the substantial investment required, it is necessary to prioritize the implementation of decarbonization technologies by ROI (cost-effectiveness).
- Marginal abatement cost analysis is one of the method for measuring ROI (cost-effectiveness) of new energy-saving and decarbonization technologies. It helps calculating the investment amout needed to achieve reduction targets of CO_2 emissions.

Marginal abatement cost analysis: Cost-effectiveness comparison of decarbonization technologies



Additional cost per unit for new technology (¥/tCO_2)

CO_2 reduction by new technology (tCO_2)

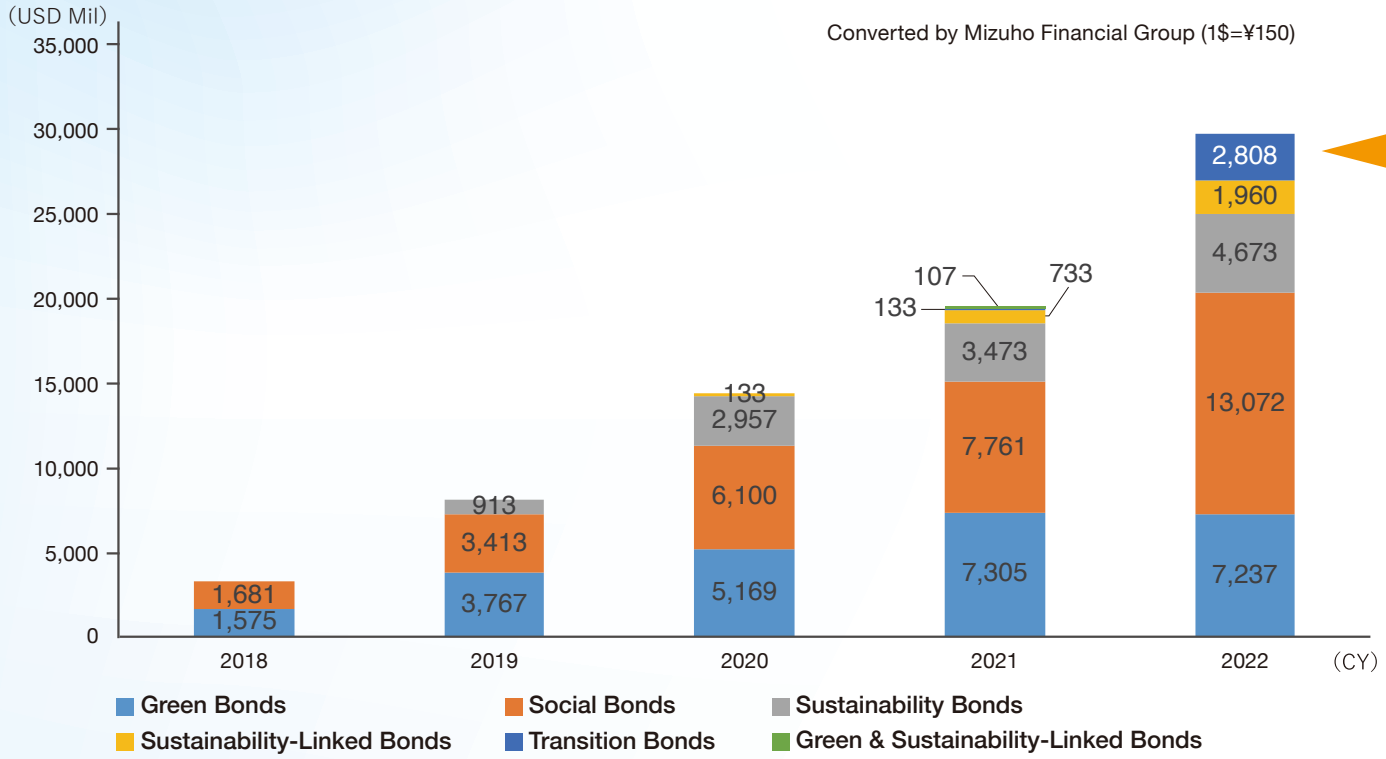
Marginal abatement cost curve

Plot each technology in order of additional cost (technologies with higher ROI plotted on the left)

Analysis of decarbonization technology ROI and calculation of investment amount needed to achieve reduction targets

(Source) Created by Mizuho Financial Group and Mizuho Research & Technologies based on public materials

Japanese public bond market: SDG bond issuance track record



Increase in transition bonds compliant with ICMA guideline

Transition finance

- Finance for companies that are committed and aligned with decarbonization strategy
- Possible to communicate decarbonization strategy externally with third-party verification

(Source) Created by Mizuho Financial Group based on the website of Japan Securities Dealers Association
(Note) SDG bond : Generic term for green bond, social bond, sustainability bond etc.

Financial market developments - Sustainable Finance in Japan is expanding

- There is an increasing trend of companies raising funds through sustainable finance.
- Transition finance is also becoming an emerging source of funds for the transition to a decarbonized society.
  - This type of financing can be applied to phased reduction efforts in industries that have had difficulty decarbonizing in the short term (e.g., steel, gas, chemicals) and for which green finance could not be applied in the past, thus accelerating funding for decarbonization.

Transition Finance plays a crucial role to accelerate efforts towards net-zero of industrial and financial sector

- When industries in GHG-intensive sectors shift to lower-emitting operations, there is a time lag in switching from existing to new operations, which inevitably increases "financed emissions" (GHG emissions of the financial institution's investee) from the financial institution's perspective.
- Transition finance aims to support the efforts of all industries, green or not, toward net zero.

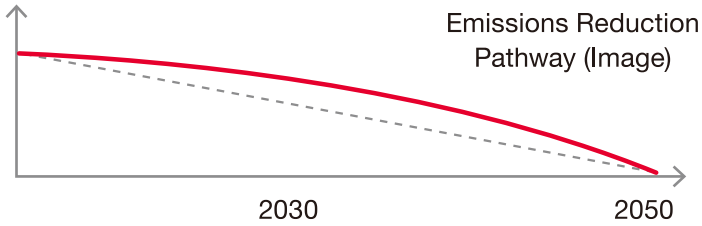
Transition finance is crucial for both industrial and financial sectors to facilitate smooth transition

Industrial sector

Decarbonization of GHG-intensive sectors require substantial funds

Funding through green finance is challenging

Create a pathway to decarbonization



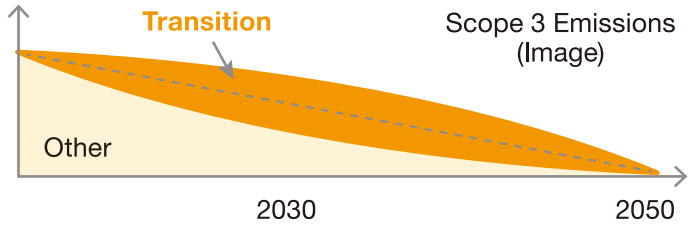
Funds needed for decarbonization

Financial sector

Higher support for GHG-intensive sectors leads to temporary increase in Scope 3

Affects assessments from financial institutions' own investors

Check alignment between pathway of customers and own reduction targets



Consider temporary financed emission increase as part of the efforts

Industrial and financial sectors to achieve transition to carbon neutrality with close communication

(Source) Created by Mizuho Financial Group based on Mizuho Short Industry Focus "Significance of the Expansion of Transition Finance in Japan"（「日本におけるトランジションファイナンス拡大の意義」）（published in Japanese）(October 18, 2022, Mizuho Bank)

Carbon credit as funding mechanism for decarbonization projects

Carbon credit use — Demand

Carbon credit users
(primarily private sector)

Objectives

A) Response to government regulations/systems
- Response to carbon pricing
- Response to other regulations

B) Stakeholder engagement
- Achieve own net-zero targets
- Contribute to net-zero emissions across society

Virtuous cycle that may accelerate decarbonization

Carbon credit creation — Supply

Carbon credit creators
(private sector, local governments, etc.)

Objectives

- Fund raising through carbon credit creation and sales
- Contribution to net-zero emissions across society by developing/running decarbonization projects

(Source) Created by Mizuho Financial Group based on public materials

Carbon credit can function as a funding mechanism

- Carbon credit can function as a funding mechanism to accelerate development of decarbonization technologies.
  - Demand Side: Purchasing carbon credit can be used to demonstrate the offsetting effect against one's own emissions.
  - Supply Side: Selling reduced emissions as carbon credit enables early recovery of technology development costs.

- Tokyo Stock Exchange officially has opened the “Carbon Credit Market” and begun trading in October 2023. The establishment of a carbon credit market is expected to activate funding mechanisms through the development of carbon credit market place as a distribution infrastructure.

Focus on Carbon credit from removal / sequestration that will contribute to the supply of the funds to NETs

- Focus on removal and sequestration type carbon credit to accelerate funding for negative emissions technologies (=NETs).
  - — Issuance of removal and sequestration type carbon credit is currently low due to cost and lack of established assessment methods for removed / sequestered CO_2.
  - — Establishing assessment methods is currently discussed in the GHG Protocol. The impact on supply and demand of carbon credit regarding removal / sequestration after the establishment of assessment method is attracting attention.

Issuance of voluntary carbon credit by type (2022)

Credit Type	Property	Business Type	Amount Issued in 2022 (Mt)
Avoidance/ Reduction	Naturally Derived	Agriculture	8.6
		Forestry/Land Use	31.5
		REDD+ (Prevention of Forest Destruction)	59.8
	Derived From Technology	Chemical/ Industrial Processes	48.3
		Carbon Capture and Storage(CCS)	0.0
		Household	7.1
		Cookstoves	18.7
		Renewable Energy	101.7
		Other	7.6
Removal/ Sequestration	Naturally Derived	Afforestation/Reforestation	8.2
	Derived From Technology	DACCS	-
		BECCS	-
		Biochar	-
		Enhanced Weathering	-

Current areas with high volumes of credits issued

Currently available removal/sequestration credits

Not currently issued

Assessment methods for removed/sequestered CO_2 under consideration in the GHG Protocol

(Note) Total of VCS, GS, ACR, and CAR

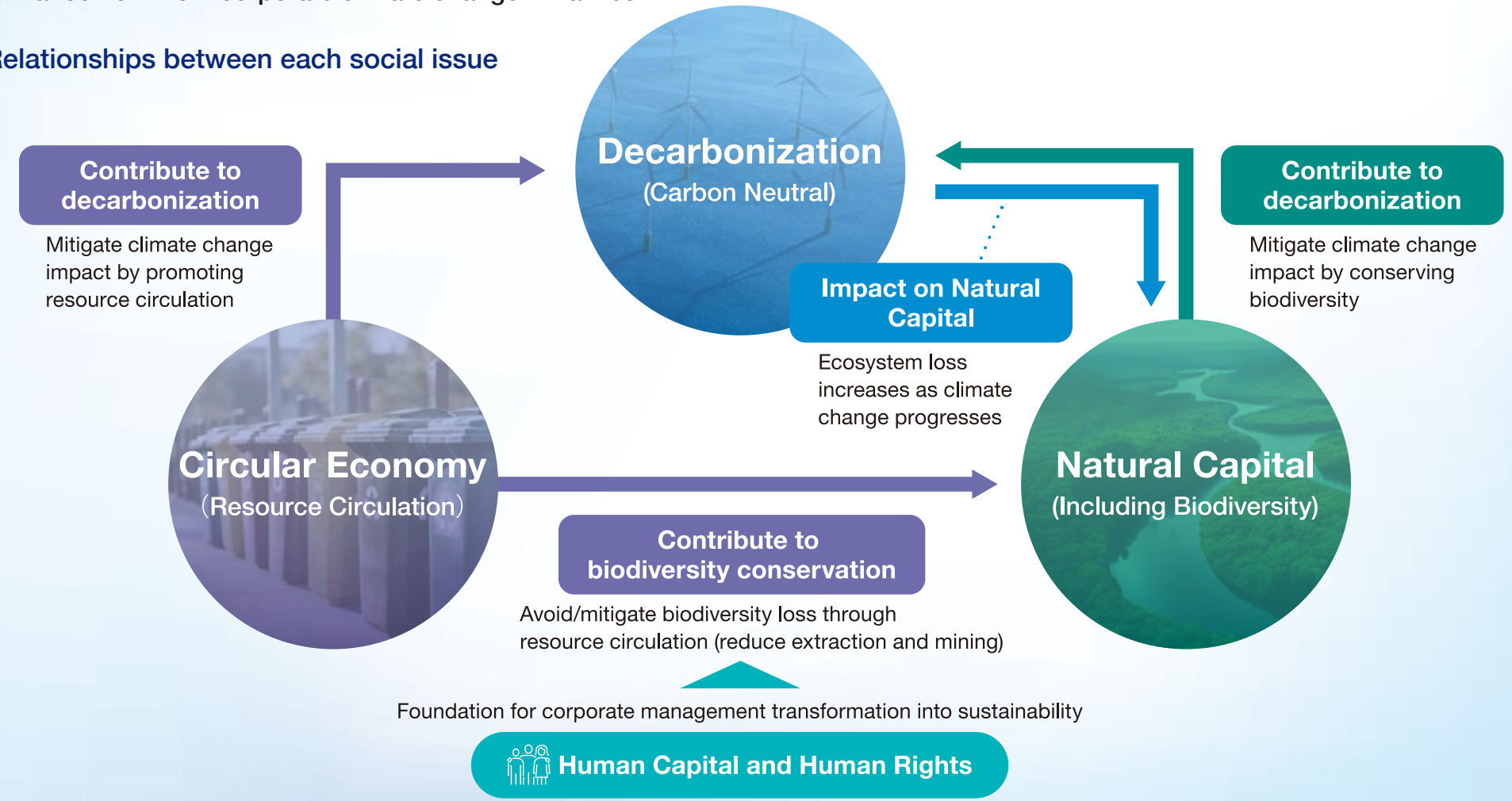
(Source) From, Ivy S. So, Barbara K. Haya, Micah Elias. (2023, May). Voluntary Registry Offsets Database, Berkeley Carbon Trading Project, University of California, Berkeley.
Created by the Mizuho Bank Industrial Research Department

Strengthening industrial competitiveness requires

Other initiatives in addition to decarbonization

- Circular economy and protection/restoration of natural capital are mutually linked to decarbonization. Legal frameworks for human rights, and initiatives on human capital, are also progressing.
- Insufficient efforts to address social issues other than decarbonization may offset the effects of sustainable corporate value enhancement from corporate climate change initiatives.

Relationships between each social issue



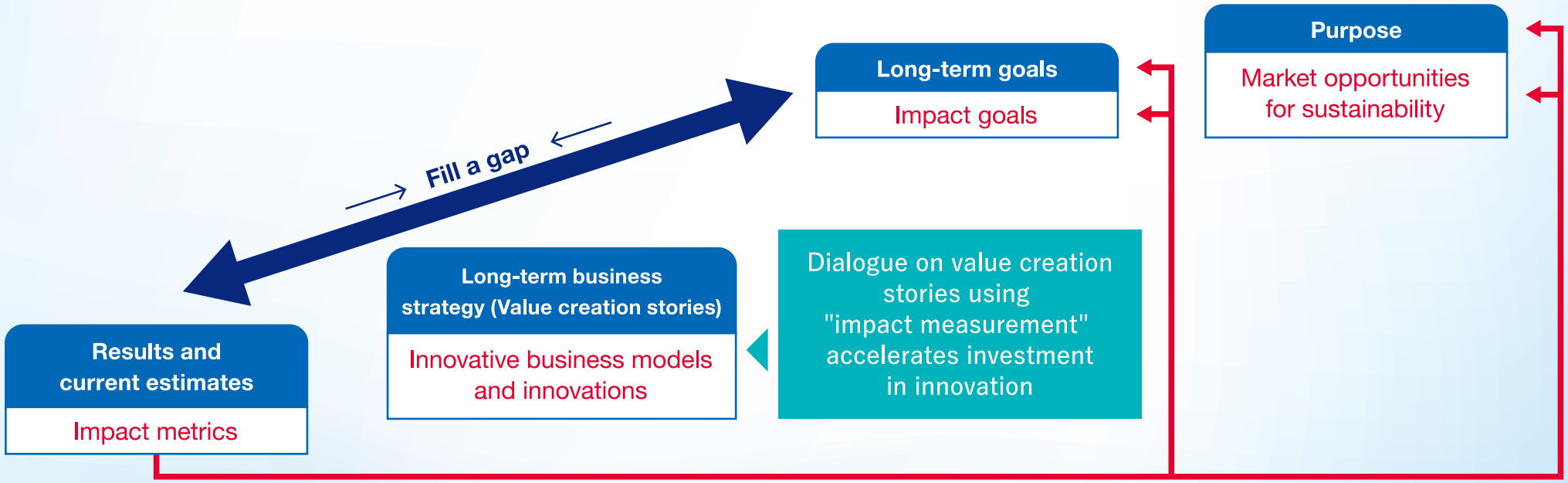
(Source) Created by Mizuho Financial Group based on public materials

Management strategy focused on impact measurement

that comprehensively measures the impact on the environment and society becoming necessary

- As various social issues are interrelated with each other, companies need to seek to both solve social problems and enhance corporate value by comprehensively assessing the impact coming from their business models and integrate it into their business strategies.
  - — Companies can accelerate investment in innovation (technological innovation and business structure reform) by communicating with investors about value creation stories using impact metrics as a common language of stakeholders.

Integrating impact measurement into management strategy becomes necessary

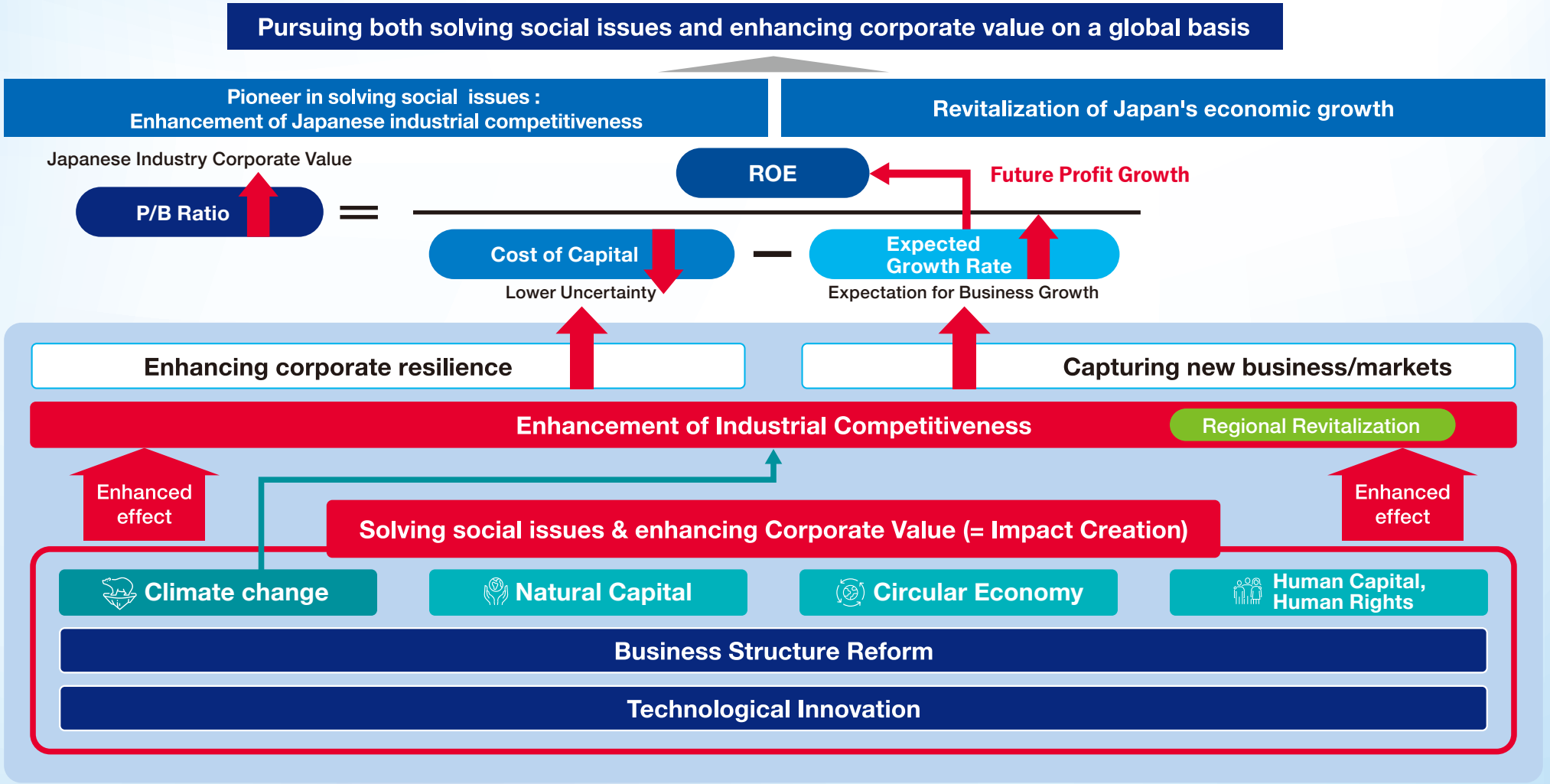


(Source) Created by Mizuho Financial Group based on KEIDANREN(Japan Business Federation) "Using Impact Metrics to Promote Dialgue with Purpose as Stating Point" (June 14, 2022)

Japan will stand as a leading country in addressing social issues by

Creating impact that will drive Japanese industrial competitiveness

- Japanese companies can lead other countries in both solving social issues and increasing corporate value by considering their impact on diverse social issues in an integrated manner, viewing threats as opportunities, and addressing sustainability (impact creation).
- The above will help Japan become an advanced "problem-solving" country, strengthen the competitiveness of Japanese industry, and return the Japanese economy to growth. In addition, Japan's accumulated experience in problem solving will contribute to solving global social issues while also creating economic value.



(Source) Created by Mizuho Financial Group based on public materials

Mizuho's role

Enhancing industrial competitiveness Regional revitalization

Solving Social Issues — Two wheels of a car — **Enhancing Corporate Value**

Impact Creation

Purpose Proactively innovate together with our clients for prosperous and sustainable future.

SX Vision Actionable solutions for a sustainable future

Imagination → Fully understanding issue and proposing a hypothesis → Support for strategic planning → Realizing strategies, support for commercialization → Financing Supporting M&A ,etc. → Finance

Industry & technological knowledge
Discovery and cultivation of new industries and technologies

Capability of Connecting the dots between Tech and Business
Public-Private networks
Participating in initiatives

Capability of Finance Arrangement
Development of new financial products

(Source) Created by Mizuho Financial Group based on public materials

Appendix:Mizuho's Achievements (1/6)

SX Vision Actionable solutions for a sustainable future

a Industry and technological knowledge　b Capability of Connecting the dots between Tech and Business　c Capability of Finance Arrangement

■ Example of Key Technology...Offshore Wind Power

- (a)(b)
  - Mizuho Research & Technologies (formerly the Mizuho Information & Research Institute), "Progress of the second phase of the Fukushima floating wind farm demonstration project" (October 30, 2014) (https://www.mizuho-rt.co.jp/company/release/2014/windfarm1030.html) (Japanese)
  - Mizuho Research & Technologies, "Mizuho Research & Technologies Technical Report Vol 2 No 1 07: Utilization of numerical simulation and our solution for floating offshore wind turbine" (March 2023) (https://www.mizuho-rt.co.jp/publication/giho/pdf/mhrt002_07.pdf) (Japanese)
  - Mizuho Bank Industrial Research Department, "Mizuho Short Industry Focus: Potential of regional industrial clusters based on offshore wind power" (September 12, 2023) (https://www.mizuhobank.co.jp/corporate/bizinfo/industry/pdf/msif_213.pdf) (Japanese)

- (c)
  - Mizuho Bank, "Mizuho Bank arranges project financing for the floating offshore windfarm project in France"（June 9,2022）（https://www.mizuhogroup.com/bank/news/2022/06/20220609release_eng.html）
  - Mizuho Bank, "Mizuho, MUFG and DBJ jointly arrange project financing for Kitakyushu-Hibikinada offshore wind farm"（April 25,2023）（https://www.mizuhogroup.com/bank/news/2023/04/20230425release_eng.html）

■ Example of Key Technology...Hydrogen

- (a)
  - Mizuho Research & Technologies (formerly Mizuho Information & Research Institute), "Basic survey for promoting use of new energy in FY 2018 - Progress report of hydrogen and fuel cell strategy roadmap and survey of hydrogen and fuel cell utilization status at home and abroad -" subcontracted from Ministry of Economy, Trade and Industry (March 29, 2019)（https://www.meti.go.jp/meti_lib/report/H30FY/000245.pdf）(Japanese)
  - Mizuho Bank Industrial Research Department, "Mizuho Industry Focus: How Japan can win the global competition for hydrogen -Mizuho's vision for a hydrogen supply and demand structure-" (February 2023) (https://www.mizuhobank.co.jp/corporate/bizinfo/industry/sangyou/pdf/mif_237_en.pdf)

Appendix:Mizuho's Achievements (2/6)

SX Vision Actionable solutions for a sustainable future

a Industry and technological knowledge | b Capability of Connecting the dots between Tech and Business | c Capability of Finance Arrangement

■ Example of Key Technology...Hydrogen (Continued)

- (a)
  - Mizuho Bank Industrial Research Department, "Mizuho Short Industry Focus: Innovative Technology Series: How Japan can establish a presence in the hydrogen industry – Using water electrolyzers" (July 25, 2023) (https://www.mizuhobank.co.jp/corporate/bizinfo/industry/pdf/msif_209.pdf) (Japanese)
- (b)
  - Mizuho Bank, "Mizuho joins global Hydrogen Council"(May 26, 2023)(https://www.mizuhogroup.com/bank/news/2023/05/20230526release_eng.html)
  - Mizuho Financial Group, "Publication of joint proposal on hydrogen for realizing GX by Mizuho and Development Bank of Japan" (October 6, 2023) (https://www.mizuho-fg.co.jp/release/pdf/20231006release_jp.pdf) (https://www.mizuho-fg.co.jp/sx/sxpress/articles-003/index.html?rt_bn=fg_sx_nr1006) (Japanese)

■ Example of Key Technology...Hydrogen & CCU/Carbon Recycling

- (a) (b)
  - Mizuho Research & Technologies, "Survey on integrated BECCS demonstration model for CO2 negative hydrogen production from domestic biomass adopted in NEDO project" (October 27, 2022) (https://www.mizuho-rt.co.jp/company/release/2022/beccs1027.html) (https://www.mizuho-fg.co.jp/sx/project-case/202305-004/index.html) (Japanese)

■ Example of Key Technology...CCU/Carbon Recycling

- (a)
  - Mizuho Research & Technologies (formerly Mizuho Information & Research Institute), "Mizuho Information & Research Institute Technical Research Report Vol. 20 2020: Domestic and liternational trends in CO2 utilization (CCU)" (October 30, 2020) (https://www.mizuho-rt.co.jp/publication/report/2020/pdf/mhir20_ccu.pdf) (Japanese)
  - Mizuho Bank Industrial Research Department, "Mizuho Short Industry Focus: Innovative Technology Series: Current development and future outlook of Japan's CCS projects" (October 24, 2023) (https://www.mizuhobank.co.jp/corporate/bizinfo/industry/sangyou/pdf/mif_242.pdf) (Japanese)

Appendix:Mizuho's Achievements (3/6)

SX Vision Actionable solutions for a sustainable future

a Industry and technological knowledge | b Capability of Connecting the dots between Tech and Business | c Capability of Finance Arrangement

■ Example of Key Technology...CCU/Carbon Recycling (Continued)

- (b)
  - Mizuho Financial Group, "Mizuho Financial Group joins Global CCS Institute"(May 27, 2022)(https://www.mizuhogroup.com/news/2022/05/20220527_1release_eng.html)
  - Mizuho Bank, "Joining ACT FOR SKY to work on commercialization and expansion of domestic SAF" (April 14, 2023)(https://www.mizuhobank.co.jp/release/pdf/20230414release_jp.pdf) (Japanese)
- (b)(c)
  - Mizuho Bank, "Mizuho Bank announces investment in MCi Carbon Pty Ltd"(March 31, 2023)(https://www.mizuhogroup.com/bank/news/2023/03/20230331release_eng.html)

■ Efforts to Accelerate Decarbonization: Carbon Credits (CC), Carbon Pricing (CP), Emission Measurement (GHG)

- (a)
  - (CP) Mizuho Research & Technologies, Global Environmental Research: "Japan's quantitative emission scenario of GHG net zero and its implications for Asian countries"(http://www.airies.or.jp/journal_GlobalEnvironmentalResearch_journal_26-1-2eng.html)
  - (CC) J-Credit Scheme Secretariat (Mizuho Research & Technologies), "About the J-Credit scheme" (July 2023)(https://japancredit.go.jp/data/pdf/credit_001.pdf) (Japanese)
  - (CP & CC) Mizuho Financial Group, "Mizuho Research & Analysis: Domestic and international trends in carbon pricing and carbon credits - Considering business management in light of increasing trends toward decarbonization-" (June 1, 2023)(https://www.mizuho-fg.co.jp/company/activity/onethinktank/pdf/vol029.pdf) (Japanese)
- (b)
  - (GHG) Mizuho Financial Group, "Mizuho appointed as chair of newly established PCAF Japan coalition"(November 12, 2021)(https://www.mizuhogroup.com/news/2021/11/20211112_2release_eng.html)
  - (CC) Mizuho Financial Group, Mizuho Bank "Mizuho Bank and KOKO Networks establish strategic partnership in the field of carbon credits "(August 4, 2023)(https://www.mizuhogroup.com/news_release/20230804release_eng.html)
  - (CC) Mizuho Financial Group, Mizuho Innovation Frontier "Mizuho and Climate Impact X join forces to scale international carbon credit market in Asia" (November 28, 2023)(https://www.mizuhogroup.com/binaries/content/assets/pdf/mizuhoglobal/news_release/2023/20231128release_eng.pdf)

Appendix:Mizuho's Achievements (4/6)

SX Vision Actionable solutions for a sustainable future

a Industry and technological knowledge　b Capability of Connecting the dots between Tech and Business　c Capability of Finance Arrangement

■ Efforts to Accelerate Decarbonization: Carbon Credits (CC), Carbon Pricing (CP), Emission Measurement (GHG) (Continued)

- (c)
  - (CC) Mizuho Financial Group, Mizuho Bank, Mizuho Securities, Mizuho Research & Technologies, "Mizuho signs MOU for business cooperation with International Finance Corporation in regard to establishment of carbon facility"(August 10, 2021)
    (https://www.mizuhogroup.com/news/2021/08/20210810release_eng.html)

■ Accelerating Efforts Toward Decarbonization… Support for Startup Companies

- (b)
  - Mizuho Bank, MIZUHO Startup WEEK (October 23 – November 1, 2023) (https://forbesjapan.com/feat/mizuhobank_startup_week/)
  - Mizuho Financial Group, "Mizuho enters strategic relationship with Decarbonization Partners"(January 31, 2023)
    (https://www.mizuhogroup.com/news/2023/01/20230131release_eng.html)
- (b)(c)
  - Mizuho Financial Group, Mizuho Bank, "Launch of a joint venture with UPSIDER and Mizuho Financial Group and establishment of a debt fund for growth-stage startups" (November 9, 2023) (https://www.mizuho-fg.co.jp/release/pdf/20231109_2release_jp.pdf) (Japanese)

■ Strengthening Industrial Competitiveness / Response to Growing Sustainability Issues - Resource Recycling (Circular Economy)

- (a)
  - Mizuho Research & Technologies, "Necessary corporate actions for plastic circular economy under carbon neutral constraints" (March 16, 2022)
    (https://www.mizuho-rt.co.jp/publication/report/2022/mhrt03_plastic_01.html) (Japanese)
  - Mizuho Bank Industrial Research Department, "Mizuho Industry Focus: The impact of the sharing economy on Japanese industry" (June 21, 2018)
    (https://www.mizuhobank.co.jp/corporate/bizinfo/industry/sangyou/pdf/mif_209.pdf) (Japanese)
- (c)
  - Mizuho Bank, "Signing of a green loan agreement with Yamada Holdings Co., Ltd." (January 31, 2023)
    (https://www.mizuhobank.co.jp/release/pdf/20230131_2release_jp.pdf) (Japanese)

Appendix:Mizuho's Achievements (5/6)

SX Vision Actionable solutions for a sustainable future

a Industry and technological knowledge　b Capability of Connecting the dots between Tech and Business　c Capability of Finance Arrangement

■ Strengthening Industrial Competitiveness / Response to Growing Sustainability Issues - Natural Capital

- (a)(b)
  - Mizuho Research & Technologies, "Pitfalls of Sustainability (2): Can decarbonization and biodiversity coexist?" (October 27, 2023) (https://www.mizuho-rt.co.jp/publication/column/2023/c0013.html) (Japanese)
  - Mizuho Research & Technologies, "Launch of the Mizuho nature positive design to support corporate's efforts related natural capital and biodiversity" (March 9, 2023) (https://www.mizuho-rt.co.jp/company/release/2023/r03-nature-positive.html) (Japanese)
- (c)
  - Mizuho Bank, "Mizuho Bank signs Japan's first "blue-sustainability loan" in a syndicated loan with Proximar" (March 31, 2023) (https://www.mizuhogroup.com/bank/news/2023/03/20230331_2release_eng.html)

■ Strengthening Industrial Competitiveness / Response to Growing Sustainability Issues - Human Rights & Human Capital

- (a)(b)
  - Mizuho Financial Group, "Publication of Human Rights Report 2022" (July 8,2022) (https://www.mizuhogroup.com/news/2022/07/20220708release_eng.html)
    Mizuho Financial Group, "Publication of Human Rights Report 2023" (July 27,2023) (https://www.mizuhogroup.com/americas/news/2023/07/publication-of-human-rights-report-2023.html)
  - Mizuho Financial Group, "Mizuho and LSEG to collaborate on the development of sustainability solutions" (November 11, 2022) (https://www.mizuhogroup.com/news/2022/11/20221111_2release_eng.html)
- (c)
  - Mizuho Bank & Mizuho Research & Technologies, "Launch of Mizuho human capital management impact finance" (May 30, 2023) (https://www.mizuhobank.co.jp/release/pdf/20230530_2release_jp.pdf) (Japanese)

■ Strengthening Industrial Competitiveness / Response to Growing Sustainability Issues - Impact (Balancing Economic and Social Value)

- (a)(b)
  - Mizuho Research & Technologies, "Pitfalls of Sustainability (1): Need for an integrated approach toward sustainability" (September 29, 2023) (https://www.mizuho-rt.co.jp/publication/column/2023/c0009.html) (Japanese)

Appendix:Mizuho's Achievements (6/6)

SX Vision Actionable solutions for a sustainable future

a Industry and technological knowledge　b Capability of Connecting the dots between Tech and Business　c Capability of Finance Arrangement

■ Strengthening Industrial Competitiveness / Response to Growing Sustainability Issues - Impact (Balancing Economic and Social Value)

- （b）
  - Mizuho Financial Group, Mizuho Bank, "Joining the General Incorporated Association Impact startup association" (February 20, 2023)（https://www.mizuho-fg.co.jp/release/pdf/20230220release_jp.pdf）(Japanese)
- （b）（c）
  - Mizuho Bank, "Investment in Oishii Farm Corporation" (September 12, 2023)（https://www.mizuhobank.co.jp/release/pdf/20230912release_jp.pdf）(Japanese)
- （c）
  - Mizuho Bank, Mizuho Research & Technologies, "Launch of Mizuho positive impact finance" (June 25, 2021)（https://www.mizuhobank.co.jp/release/pdf/20210625_2release_jp.pdf）(Japanese)

■ Sustainable Finance: A Compelling Presence in Finance

- （c）
  - Mizuho Financial Group, "FY2023 Interim Earnings Company Presentation, page 30" (November 16, 2023)（https://www.mizuho-fg.co.jp/investors/ir/briefing/pdf/20231116_1.pdf）(Japanese)
  - Mizuho Bank, "Mizuho Bank concludes agreement with Kawasaki Kisen Kaisha for the first transition-linked loan in Japan"（September 27, 2021）（https://www.mizuhogroup.com/bank/news/2021/09/20210927release_eng.html）
  - Mizuho Bank, "Launch of SDGs promotion support finance" (July 1, 2021)（https://www.mizuhobank.co.jp/release/pdf/20210701_2release_jp.pdf）(Japanese)
  - Mizuho Bank, "Launch of Mizuho green real estate non-recourse loan and Mizuho sustainability real estate non-recourse loan" (October 13, 2022)（https://www.mizuhobank.co.jp/release/pdf/20221013release_jp.pdf）(Japanese)