Mizuho Industry Research No.67

The Impact of Carbon Neutrality

— How Japanese Companies Can Survive the Transition to a Carbon Neutral Society —

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Executive Summary

- **Will the accelerating trend toward carbon neutrality (CN) be a game-changer for business?**
  - The trend toward CN will bring many changes at companies. The following changes are anticipated. In terms of policy, advances in CP policy will expose GHG emission costs, and in terms of finance, companies that take insufficient CN measures will be impacted in financing and the exercise of voting rights. Competitive advantage will depend on the quality of the CN measures that companies' business partners take. Additionally in the future, a game-changer will occur when superficial CN measures are eliminated through advances in rule-making and mandatory corporate information disclosure, and this will lead to GHG emissions having a significant impact on corporate value.
- **What impact will achievement of the 2050 and 2030 targets have on Japanese industry?**
  - While monetizing the value of high energy-efficiency, which is one of Japan's strengths, Japan needs to expand CN power sources by developing and introducing innovative technologies. At the same time, Japan must actively work on the transformation of its industrial structure. The concept of connecting initiatives for CN to growth is a necessity. Measures are needed to achieve the accelerated 2030 target as well as to achieve growth, taking into account the impact of CN in 2050 on each industry.
  - To achieve CN in 2050, high CO2-emitting industries are required to transition their existing raw materials, products, and services from low emissions to zero emissions. Together with the requirement of a large investment, supply capacity is also expected to shrink in some industries. On the other hand, increased demand is expected for raw materials and products that contribute to emission reductions in other industries. So, there are many areas that will provide business opportunities.
  - In order to achieve the target of minus 46% in 2030, which is less than 10 years away, each sector must make heretofore unprecedented large leaps forward. Under the scenario in which only the measures currently incorporated are taken, the CO2 reduction is only minus 33% in 2030. So, it is necessary to further add stronger policies to achieve the minus 46% target. When implementing potential additional measures, companies need to be shown consideration due to the negative aspect, which is the impact on industrial competitiveness. It is also important to create a framework to properly evaluate companies which implement rational measures, with consideration for the time axis.
- **What kind of corporate strategy is required in the carbon neutral era?**
  - The achievement of CN is an important issue not only for companies that emit large amounts of CO2 but for all companies. For stakeholders, it is necessary to clearly set out a transition story that shows the direction and process to aim for. It is necessary to incorporate the achievement of CN into the strategy and to proceed coherently from management strategy to business strategy and tactics.
  - Pioneering European and US companies, in addition to talking about the path toward the achievement of CN as the growth story of the company and incorporating specific measures into the business strategy, are taking on the challenge of building a business model to win at the new game of CN competition. With the support of the government, they are headed toward achievement of CN.
  - For Japanese companies to survive the transition to a carbon-free society, a strategy is required to connect CN to growth.

Source: Compiled by Mizuho Bank Industry Research Department

Contents

Abbreviations

- ✓ BEV: Battery Electric Vehicle
- ✓ CCS: Carbon Dioxide Capture and Storage
- ✓ CCUS: Carbon Dioxide Capture, Utilization and Storage
- ✓ CN: Carbon Neutrality
- ✓ COP: Conference of the Parties
- ✓ CP: Carbon Pricing
- ✓ ETS: Emission Trading Scheme
- ✓ EV: Electric Vehicle
- ✓ FC: Fuel Cell
- ✓ FCV: Fuel Cell Vehicle; also abbreviated FCEV
- ✓ FIT: Feed in Tariff
- ✓ GHG: Greenhouse Gas
- ✓ HEV: Hybrid Electric Vehicle; also abbreviated HV
- ✓ IC: Integrated Circuit
- ✓ ICE: Internal Combustion Engine
- ✓ IEA: International Energy Agency
- ✓ JV: Joint Venture
- ✓ LCA: Life Cycle Assessment; a method for quantitatively evaluating the environmental load of a certain product/service in its entire life cycle or at a specific stage thereof.
- ✓ LiB: Lithium-ion Battery
- ✓ MaaS: Mobility as a Service
- ✓ MHEV: Mild Hybrid
- ✓ NEV: New Energy Vehicle; refers to FCEV, BEV, and PHEV
- ✓ NDC: Nationally Determined Contribution; contributions determined by each country submitted under the Paris Agreement
- ✓ OEM: Original Equipment Manufacturing (Manufacturer); production of a product under the consigner's brand or the producing manufacturer
- ✓ PHEV: Plug-in-Hybrid Electric Vehicle; also abbreviated PHV
- ✓ SAF: Sustainable Aviation Fuel
- ✓ SBT(i): Science Based Targets (initiative); Greenhouse gas reduction targets set by companies for the medium to long term, consistent with the standards required by the Paris Agreement, and the framework that encourages the setting of targets that contribute to the realization of a society as indicated by the GHG reduction targets.
- ✓ SC: Supply Chain
- ✓ Scopes 1, 2, and 3: Supply chain emissions amounts; Scope 1: Direct emissions of greenhouse gases by the business (combustion of fuel, industrial processes); Scope 2: Indirect emissions due to use of electricity and heat supplied by other companies; Scope 3: Indirect emissions other than those in Scope 1 and Scope 2 (emissions from other companies related to businesses activities)
- ✓ TCFD: Task Force on Climate-related Financial Disclosures
- ✓ VC: Value Chain
- ✓ xEV: All types of electric vehicles, including MHEV, HEV, PHEV, BEV, and FCEV
- ✓ ZEB: Net Zero Energy Building; a building that can reduce annual primary energy consumption to zero or a negative amount
- ✓ ZEB Ready: An advanced building equipped to be a ZEB; it is a building equipped with high heat insulation in the outer skin and highly efficient energy-saving equipment.
- ✓ ZEH: Net Zero Energy House; a house that can reduce annual primary energy consumption to zero or a negative amount
- ✓ ZEV: Zero Emission Vehicle; refers to BEV and FCEV

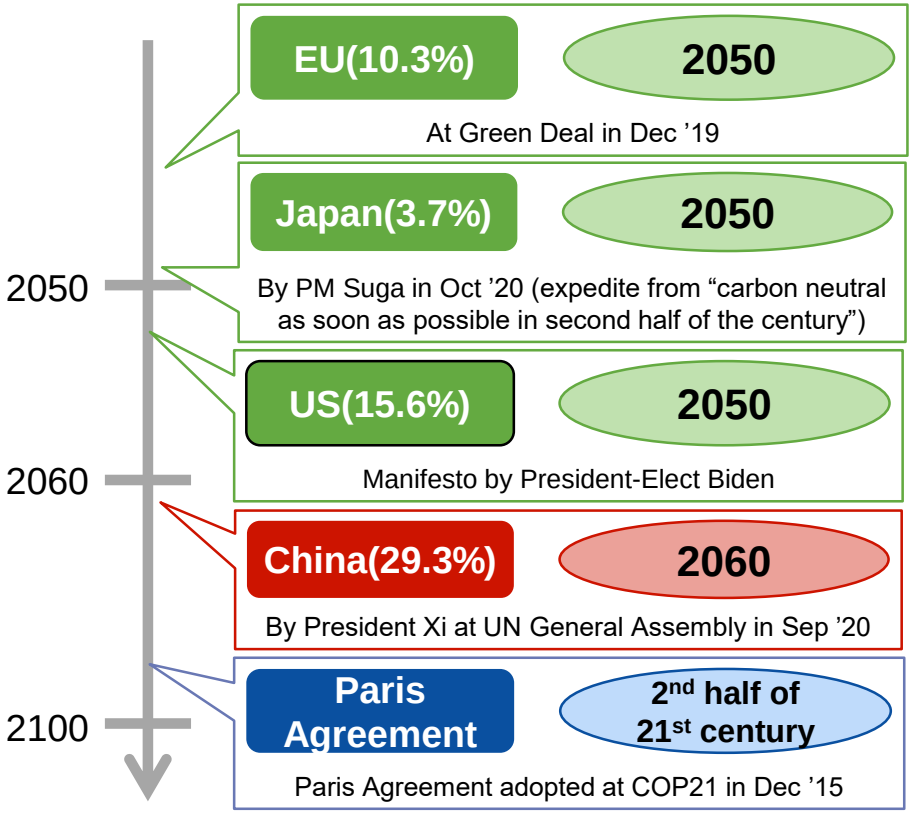
Source: Compiled by Mizuho Bank Industry Research Department

1. Global Trend Toward Carbon Neutrality

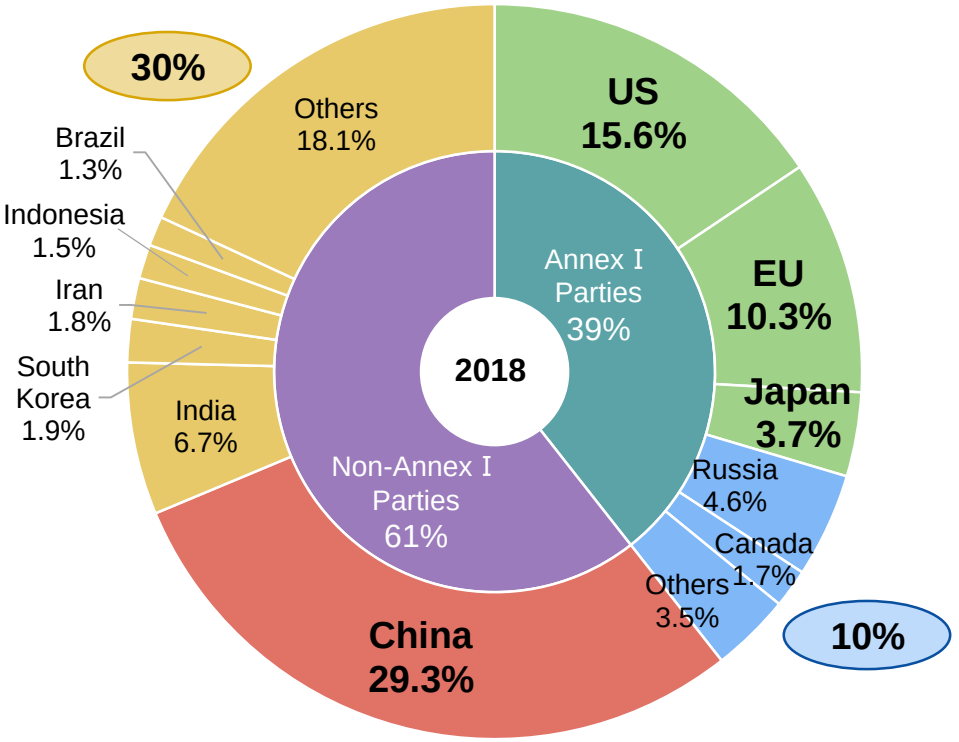
2020 becomes a turning point where climate change measures accelerate

- US, EU, China and Japan, which account for 60% of global CO2 emissions, are targeting a carbon-free society.
  - With EU leading in compliance to the Paris Agreement, China and Japan also setting decarbonization goals, and Mr. Biden being elected in the US, the global trend has changed significantly.
  - This promotes the replacement of legacy assets and also the acquisition of new technologies and demand.

Timeline of decarbonization goals and major policies

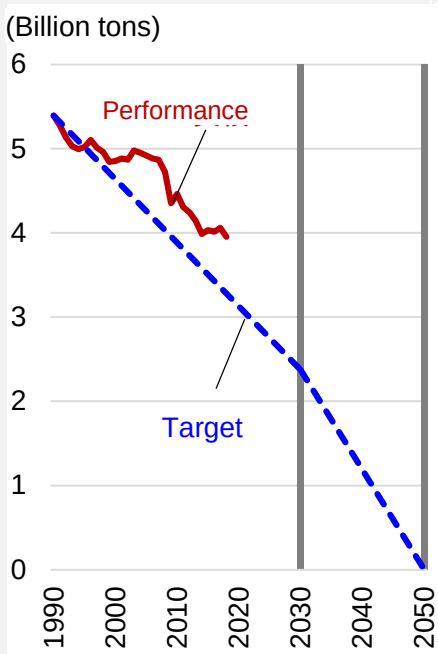
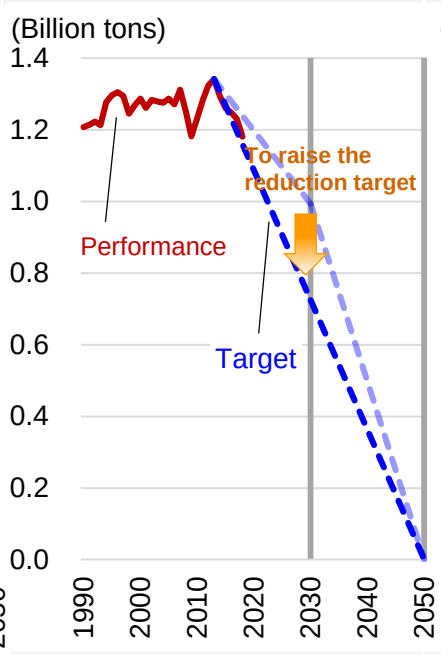
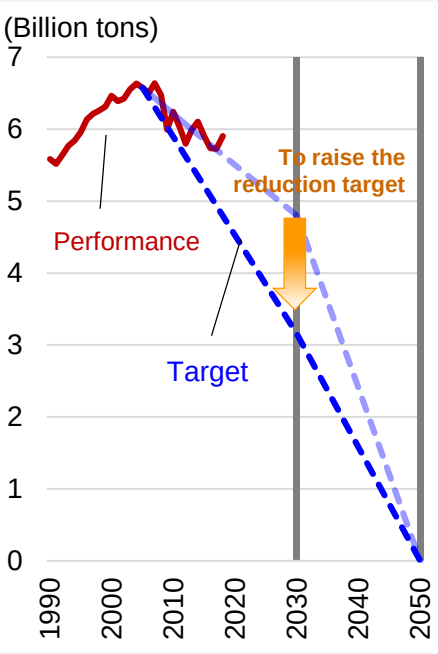
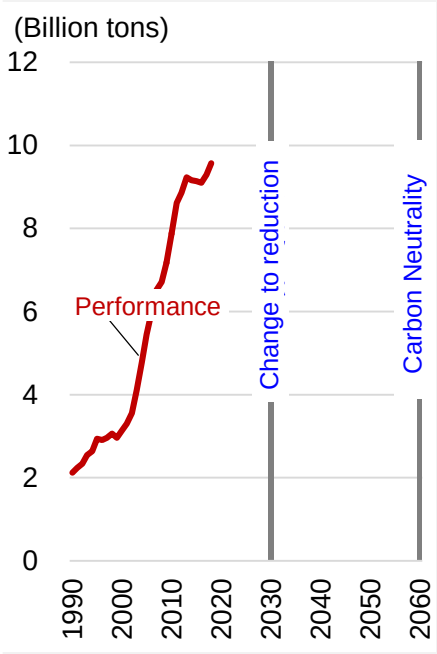


CO2 Emission by region / country



Source: Compiled by Mizuho Bank Industry Research Department based on Ministry of Economy, Trade and Industry

Each countries/region raised its 2030 reduction target

	EU	Japan	US	China
Long-term Goal	2050 carbon neutral	2050 carbon neutral	Net zero by 2050	2060 carbon neutral
Mid-term Goal	In 2030, At least 55% below 1990 levels NDC Submitted in December 2020	By FY 2030 **46%** (compared to 2013) Declared at Climate Summit In April 2021	By 2030, **50-52%** (compared to 2005) Declared at Climate Summit In April 2021	The government will reduce the amount by 2030. Reduce CO2 emissions per unit of GDP by 65% from 2005 levels In September 2020, President Xi announced at the United Nations General Assembly
GHG amount of emission *CO2 emissions in China				

Source: Compiled by Mizuho Bank Industry Research Department based on UNFCCC GHG Data Interface, Ministry of Economy, Trade and Industry

Europe: Leading policies aimed at balancing climate neutrality and economic growth in 2050

- EU announced a EUR 1trn investment plan to realize Green Deal policy in achieving both climate change countermeasures and economic growth.
- Promoting diverse climate change policies that contribute to EU industrial competitiveness while utilizing of large investment.

Overview of Climate Change Policies in the EU

European Green Deal Policy (announced in December 2019)

Policy to realize economic growth while achieving zero GHG emission in 2050 (2030 reduction targets raised)

GHG reduction Goal (compared to 1990)

【2030】 -40% → Goal increase → -50～-55% (Agreed at least 55%)

【2050】 -80~-90% → Net zero

Seven policy areas to focus on in order to achieve ambitious targets

Large investment required to achieve goals

European Green Deal Investment Plan (announced in January 2020)

Investment target of at least EUR 1 trillion for both public and private sectors over the next 10 years

EU Long-term Budget: 2021 – 2027 (Final Agreement, December 2020)

With a total value of over EUR 1.8 trn to 30% of the mid-term budget assigned to climate change action

~EUR 550 billion

Next Generation EU (Reconstruction Fund)

Of the total EUR 750 bn, 37% of the Recovery and Resilience Facility will be allocated to climate change measures

~EUR 250 bn

Major Cross-Sectoral Policies in the EU

EU-ETS (Emissions Trading System)	✓ Phase 4 began in 2021, and stricter regulations were implemented. ✓ In view of raising the 2030 target and securing financial resources, further tightening is under consideration.
Carbon border adjustment mechanism	✓ In addition to preventing carbon leakage, new sources of revenue ✓ Plan to draft system by July 2021 ✓ Aim to introduce by January 2023 at the latest
EU taxonomy	✓ Criteria for sustainable economic activity ✓ Expected to be applied in Corporate disclosure etc. from 2022
Industrial support measures (IPCEI, etc.)	✓ EU Industrial Strategy: Promoting Green and Digital ✓ IPCEI: Exceptions to allow state subsidies for key policies (Certified: Semiconductors, batteries, hydrogen)
Just transition mechanism	✓ Support for regions and industries that have a significant impact on the transition to a low-carbon society through a fair transition fund (Training Programs for Low-Carbon Industries)

Note: IPCEI(Important Project of Common European Interest)
Source: Compiled by Mizuho Bank Industry Research Department based on European Commission

US: Biden Announces Plan to Invest $2.3 trillion in Infrastructure

- On March 31, 2021, the Biden administration announced the "American Jobs Plan," an infrastructure investment plan worth about $2.3 trillion.
  - Extensive content ranging from infrastructure investment such as roads, bridges, water supply, and high-speed broadband to support for R&D on advanced technologies.

Biden's "The American Jobs Plan"

Field	Major investment destinations and amounts (mainly related to climate change)
Infrastructure	• Infrastructure investment to replace aging infrastructure, create jobs, and promote racial equality ✓ Roads and bridges ($115 billion), public transport ($85 billion), rail networks ($80 billion), airports ($25 billion), ports and waterways ($17 billion), water supply ($111 billion), high-speed broadband ($100 billion), etc.
Automotive	• **$174 billion in EV-related investments** ✓ **Investment in promoting domestic EV-related supply chains from raw materials to parts, measures to support purchase of US-made EVs such as tax credits, 500,000 EV charging stations by 2030, electrification of at least 20% of school buses, etc.**
Power	• **Aiming to achieve zero-emissions in the power sector by 2035, the company will invest $100 billion in power infrastructure** to create a resilient power grid, lower energy prices, improve air pollution, and create jobs.
Buildings and houses	• Invested $213 billion to provide sustainable housing at more than 2 million affordable prices • $100 billion invested in safer, more energy efficient and resilient modern schools
Innovation	• The US will invest $50 billion in the National Science Foundation and $40 billion in research infrastructure to provide leadership in advanced technologies such as semiconductors, advanced computing, information and communications technologies, **advanced energy technologies,** and biotechnology. • $50 billion investment in semiconductor manufacturing and R&D • **$35 billion invested in climate change-related research and development enhancements, including the creation of a cross-agency research institute (ARPA-C: Advanced Research Projects Agency for Climate)** • **$46 billion to strengthen domestic clean energy manufacturing with federal funding**

Source: Compiled by Mizuho Bank Industry Research Department based on The White House, various reports

China: Promoting Initiatives in Key Fields to Achieve Carbon Neutrality in 2060

- In September 2020, China declared its goal of achieving carbon neutrality by 2060, and promoted efficiency and decarbonization through the 14th Five-Year Plan and industry type's five-year plan for the same period.
  - Targets and measures for 2025 ~ 2035 in the areas of primary power, industrial and manufacturing, and transport GHG emissions were announced.
  - Promoting greening of financial markets by promoting green bonds and formulating a Chinese version of taxonomy.

Major Initiatives by the Chinese Government to Achieve Carbon Neutrality

Energy policy

- ✓ Target of increasing non-fossil energy ratio to around 20% by 2025 and 25% by 2030
- ✓ In addition to the promotion of large-scale wind and solar power generation, a policy to promote sound development by setting a subsidy cap in 2020
- ✓ Although the target for nuclear power generation in 2020 of 58 million kW was not achieved (about 50 million kW), the policy is to continue to promote active investment.

Emissions Trading Scheme

- ✓ Since 2013, model projects have been implemented in 5 cities in 2 provinces, including Beijing and Guangdong.
- ✓ In February 2021, a nationwide emissions trading system was launched.
- ✓ Initially, only the electric power sector was selected, but 8 sectors and 15 industry type were designated as target industries, and expansion is planned by 2025.

8 divisions: Petrochemicals, Chemicals, Building Materials, Steel, Non-ferrous Metals, Paper, Electric Power, Aviation

Automotive regulation

- ✓ Target for new vehicle sales in 2035 to be 50% of new energy vehicles and the remaining 50% to be energy efficient vehicles
- ✓ Continuation and deepening of double credit regulation between CAFC (corporate average fuel efficiency) regulation and NEV (new energy vehicles) regulation
- ✓ Easing of subsidies and license plate regulations for purchases of new energy vehicles (increase in the number of licenses, etc.)

Development of financial markets (sustainable finance, etc.)

- ✓ Since the introduction of green finance in 2014, China has grown into the world's largest "green bond market" under the leadership of the government.
- ✓ In March 2019, 7 governmental organizations jointly released the Chinese version of the Taxonomy "Green Industry Guidance Catalog".
- ✓ Participated from the beginning in the International PF (IPSF) for the promotion of sustainable finance launched under the initiative of the EU in October 2019

Source: Compiled by Mizuho Bank Industry Research Department based on Data published by the Chinese Government

Japan: Design of Green Growth Strategy

- On December 25, 2020, the Japanese government announced its Green Growth Strategy Through Achieving Carbon Neutrality in 2050 (revised June 18, 2021).
- The strategy includes an action plan that sets high goals for each of the 14 priority sectors and activates all possible policies to achieve them.

Characteristics, Priority Sectors, and Policy Effects of Green Growth Strategy

Green Growth Strategy
(3 points)

1. Selects 14 priority sectors (including roadmap up to 2050)
2. Presents 2050 energy mix reference case
   → **Renewable energy 50%~60%**
3. Shows cross-sector policy tools
   Budget: 2 trillion yen fund
   Tax system: Investment promotion tax system
   Finance: Japanese version of transition finance
   Others: Promoting other regulatory reforms, international cooperation, etc.

Industries where growth can be expected: 14 sectors

Energy	1. Offshore wind, solar, geothermal	2. Hydrogen, fuel ammonia	3. Next-generation thermal energy	4. Nuclear power
Transport, manufacturing	5. Automotive, Batteries	7. Ships	9. Food and agriculture, forestry, fisheries	11. Carbon recycling materials
	6. Semiconductors, telecommunications	8. Logistics, flow of people, civil engineering infrastructure	10. Aircraft	
Home and office	12. Residential/building next-generation resource management	13. Resource recycling	14. Lifestyle	

Economic Effect (annual amount): 2030: 140 trillion yen ⇒ 2050: 290 trillion yen

Note: In the Green Growth Strategy, the outlook for energy supply and demand will be "flexibly reviewed for various scenarios"
Source: Compiled by Mizuho Bank Industry Research Department based on the Green Growth Strategy Through Achieving Carbon Neutrality in 2050 (Revised June 18, 2021)

Various Issues Involved in Strengthening Carbon Pricing

■ When strengthening carbon pricing, appropriate system design is required, with awareness of the characteristics of each method and the issues to be considered.

Main Issues in Strengthening Carbon Pricing

Carbon Tax

- ✓ System design is relatively easy, and a wide range of emitting entities can be asked to bear the burden.
- ✓ Highly predictable future cost burden for companies.

Since each has its own characteristics, using an appropriate method for each field is also an option.

Emissions Trading System (ETS)

- ✓ Since it is possible to determine the total amount of emissions overall and for each industry, it is easy to promote measures in line with reduction targets.
- ✓ While flexible system design is possible for each field, there are many issues involved in designing.

Main Issues for Consideration When Strengthening Carbon Pricing

Promotion of Behavioral Changes

- ✓ Can the implementation of measures be appropriately evaluated?
- ✓ Is there business predictability?
- ✓ Is the timeline compatible with the transformation of the industrial structure?

Cost Burden and Fund Allocation

- ✓ Is the cost burden fairly borne by society as a whole?
- ✓ Are funds appropriately allocated to the sectors requiring support?
- ✓ Will it drive future growth and innovation?
- ✓ Are there domestic returns without an outflow of national wealth?

Coordination with Other Countries/Regions

- ✓ Is the burden distributed for an internationally equal footing?
- ✓ Will it contribute to global decarbonization?

— Concerns About Stronger Carbon Pricing as a National Decarbonization Strategy —

Threat to domestic market from imported goods from loosely regulated countries/regions → Production transferred to loosely regulated countries/regions (decrease in domestic production) → Home country's economic growth **Unachievable** Global climate change measures

There is growing interest in a **carbon border adjustment mechanism** to make a level playing field for international competitiveness.

Source: Compiled by Mizuho Bank Industry Research Department based on various materials

Progress in Transition Finance

- Transition finance is expected to attract more attention as a practical solution that avoids the dichotomy of green versus brown and encourages companies in carbon-intensive industries to make the transition from a long-term perspective.

Progress in Transition Finance

In response to climate change
Expansion of green financing

- Indiscriminate criteria for defining green
- Specious "Green Wash" Scattered
- Investors labeled "green." to be unable to make investment decisions

Concerns that are not essential climate change measures

To prevent the green wash
Progress in Taxonomy Development

- Green or Brown dichotomy
- The most CO2 high emission industry to deal with is positioned in Brown
- It will not be an effective support measure for industries with greater challenges

Concerns that are not essential climate change measures

To promote the transition of carbon-intensive industries
Transition gets attention

- Under discussion of transition definition

Issues in the transition of carbon-intensive industries

① Substitution is necessary because it is essential for maintaining the economy
② Because the technology has not yet been established, it is necessary to consider the timeline
③ Achieving decarbonization requires significant investment

On the other hand, companies that are not sufficiently decarbonized will face the risk of divestment

Significance of transition finance **Can be a realistic solution to decarbonization of CO2 high emission industries**

Develop an ambitious but realistic long-term strategy for decarbonization and provide financial support to companies that are making the necessary investments from now on

Source: Compiled by Mizuho Bank Industry Research Department

Overview of Japan's Basic Guidelines on Climate Transition

- In December 2020, the International Capital Markets Association (ICMA) released the Climate Transition Finance Handbook.
- In May 2021, the Basic Guidelines on Climate Transition Finance was developed as the Japanese version.

Main Additions in Japan's *Basic Guidelines on Climate Transition Finance*

Elements for Disclosure		ICMA Version	Main Additions in Japanese Version
1	**Transition strategy and governance**	• Long-term target consistent with the 2˚C /1.5 ˚C target in the Paris Agreement. • Medium-term goals that indicate the pathway to long-term goals. • Strategies and means for achieving decarbonization, and governance (frameworks such as TCFD can also be used for strategies). • Information on sustainability management (contribution to SDGs, avoidance of adverse effects on the environment and society).	✓ **Specific governance measures such as oversight by the board of directors (see TCFD).**
2	**Environmental materiality**	• The pathway to achieving the goals covers areas that have a high degree of environmental impact (materiality) on the business model	**(Essentially the same)**
3	**Scientific basis**	• Short-term, medium-term, and long-term greenhouse gas emission reduction targets consistent with the Paris Agreement. • Baselines • Scenarios used and techniques applied (e.g., ACT, SBTi, etc.). • The greenhouse gas emission reduction targets of Scope 1, Scope 2, and Scope 3 (Scope 3 is tentatively allowed to be estimated based on "best effort."). • Target value established by emission intensity and absolute value.	✓ **The NDC (national reduction target under the Paris Agreement) and the "roadmap by industry" which is being studied are also added to the scientific basis** ✓ **Not only a linear pathway but also a non-linear approach that presupposes technological innovation is acceptable.** ✓ **Also, explanation is recommended regarding the consistency of the short- and medium-term goals and strategies.** ✓ **Scope 3 is recommended for important reduction targets.**
4	**Transparency**	• Ratio of assets, income, expenditures and asset sales involved in transition strategies. • Investment planning consistent with transition strategies and scientific basis. • Outline of a just transition based on the impact on employment, etc. • Disclosure in annual report, online, and in sustainability reports, etc.	✓ **If quantification is difficult, qualitative evaluation by external certification is also acceptable.** ✓ **Also, refinancing based on a lookback period is also targeted.** ✓ **A just transition is merely recommended.** ✓ **For loans, disclosure to only the lender/screening body is permitted.**

Source: Compiled by Mizuho Bank Corporate Strategy Advisory Department based on *Climate Transition Finance Handbook* by ICMA and *Basic Guidelines on Climate Transition Finance* by Japan's Financial Services Agency, the Ministry of Economy, Trade and Industry, and the Ministry of the Environment

Lack of a Definition of Decarbonization May Be a Hurdle to Corporate Measures

- Expectations are rising for companies to declare themselves carbon neutral, but it is unclear specifically what companies need to do. At present, each company is working on its own definition of carbon neutrality, but in the future, one point of discussion will be how to resolve differences in the definition of "offset effect" and differences in the scope of the target (Japan only ⇔ including emerging countries, etc.).

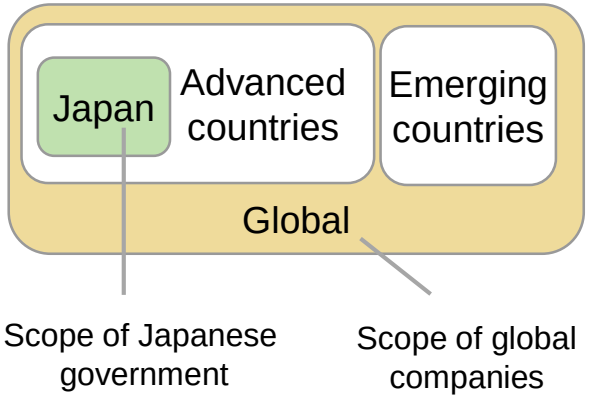
Issues in the Definition of Decarbonization

Due to the series of decarbonization declarations by the governments of major countries and regions, there is a risk that companies' achievement of decarbonization by 2050 will be taken for granted.

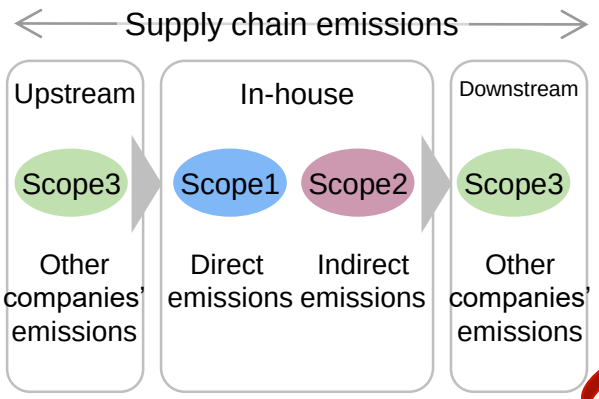
Achievement of decarbonization is not a simple thing, particularly for global companies.

To begin with, the definition of decarbonization is not clear.
—3 Main Issues—

1.Target Regions



2. Target Operations



Stakeholders may ask for measures based on the entire supply chain

3. Offset Certification

Some cases are similar but use different definitions.

Carbon neutral

Virtual offsetting is allowed by taking into account "reduction contributions" such as offset credits.

Net zero

Limited to physical offsetting via "absorption activities" such as forestation.

Useful in the short to medium term but an issue in the long term, as emissions do not actually go to zero.

Source: Compiled by Mizuho Bank Industry Research Department based on various materials

Mandatory Information Disclosure Accelerates the Trend Toward CN

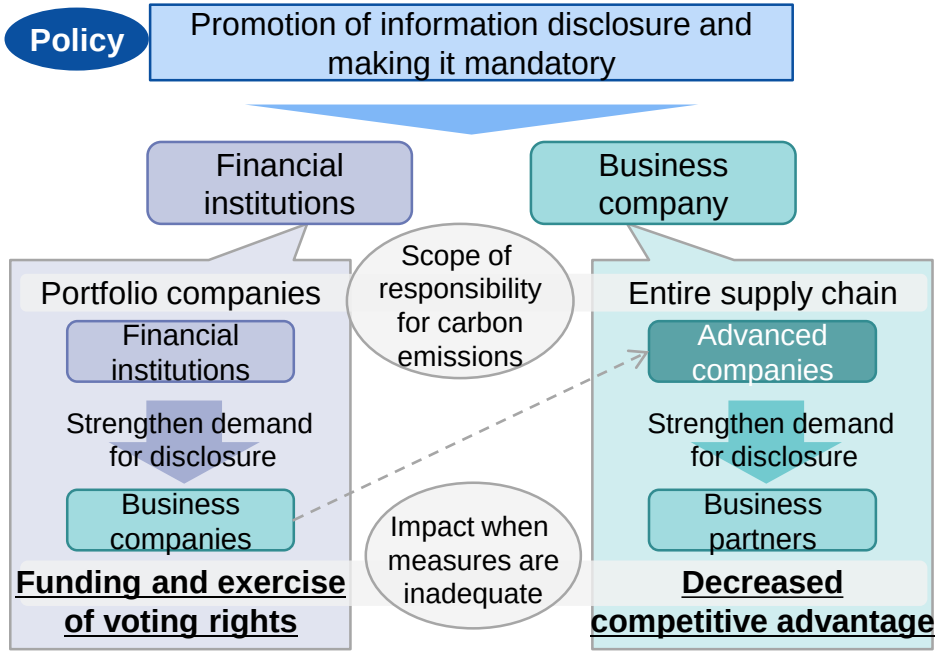
- In June 2021, the G7 Summit Joint Declaration expressed support for mandatory climate change-related disclosure under the TCFD framework.

Moves to Promote Information Disclosure and Make It Mandatory In Various Countries

EU	✓ The proposal for the NFRD Amendment (CSRD) which requires **disclosure under the EU taxonomy** was announced in April 2021. ✓ The direction of mandatory disclosure, expansion of targeted companies, and launch of application from 2024, etc., is being considered.
UK	✓ **Mandatory TCFD disclosure** for some listed companies starts from 2021. ✓ There is a roadmap for mandatory information disclosure, and it will be mandatory for listed companies by 2025.
US	✓ In March 2021, the US Securities and Exchange Commission solicited public comments related to **a review of ESG information disclosure standards**. ✓ Issues included the pros and cons of utilizing frameworks such as TCFD and the method for mandatory disclosure.
Singapore	✓ In January 2021, Singapore's and ASEAN's concept of taxonomy was announced. ✓ Specific usages are unknown, but it is a framework for **classifying not only green but also transitional activity.**
Japan	✓ The June 2021 CG Code revision urges companies listed on the prime market in particular **to enhance the quality and quantity of their disclosures on climate change impacts** under TCFD or equivalent frameworks.

Potential to Accelerate Game-Changing Through Decarbonization

Promotion of information disclosure is targeted not only at business companies but also at financial institutions.



Mandatory information disclosure improves the transparency of GHG emissions and management strategies, and it accelerates the expansion of impact of CN trends.
It has become a fundamental issue of corporate management and an indispensable element for improving corporate value.

Note: NFRD(Non-Financial Reporting Directive); CSRD: (Corporate Sustainability Reporting Directive)
Source: Compiled by Mizuho Bank Industry Research Department based on various materials

The Carbon-Neutral Trend Could Be Game-Changing for Businesses

- Given that the carbon-neutral trend is expected to bring about changes in the future, it may be game-changing, making the status of GHG emissions an important factor in management decisions and requiring a review of existing business models.

Changes Expected to Be Brought About by the Carbon Neutral Trend

As policies and rule-making for a carbon-free society progress, all companies are being asked what contribution they will make to the achievement of a carbon-free society.

Expected Future Changes

Policy

With the implementation of specific policies and regulations, **GHG emission costs** that are currently an external diseconomy **will become evident.**

Cost structure transformation

Finance

As financial markets are made more sustainable, **companies** with insufficient decarbonization measures **will face increasing demands and pressures.**

Shifting funding requirements

Companies (business partners)

As major companies work to decarbonize their entire supply chain, **the quality of their response may lead to competitive advantages.**

Shifting competitive conditions

Consensus

A consensus on definitions and rules for CN will be cultivated, and **measures based on uniform rules will be desirable**, instead of having different measures at each company.

Acceleration of requests for essential measures

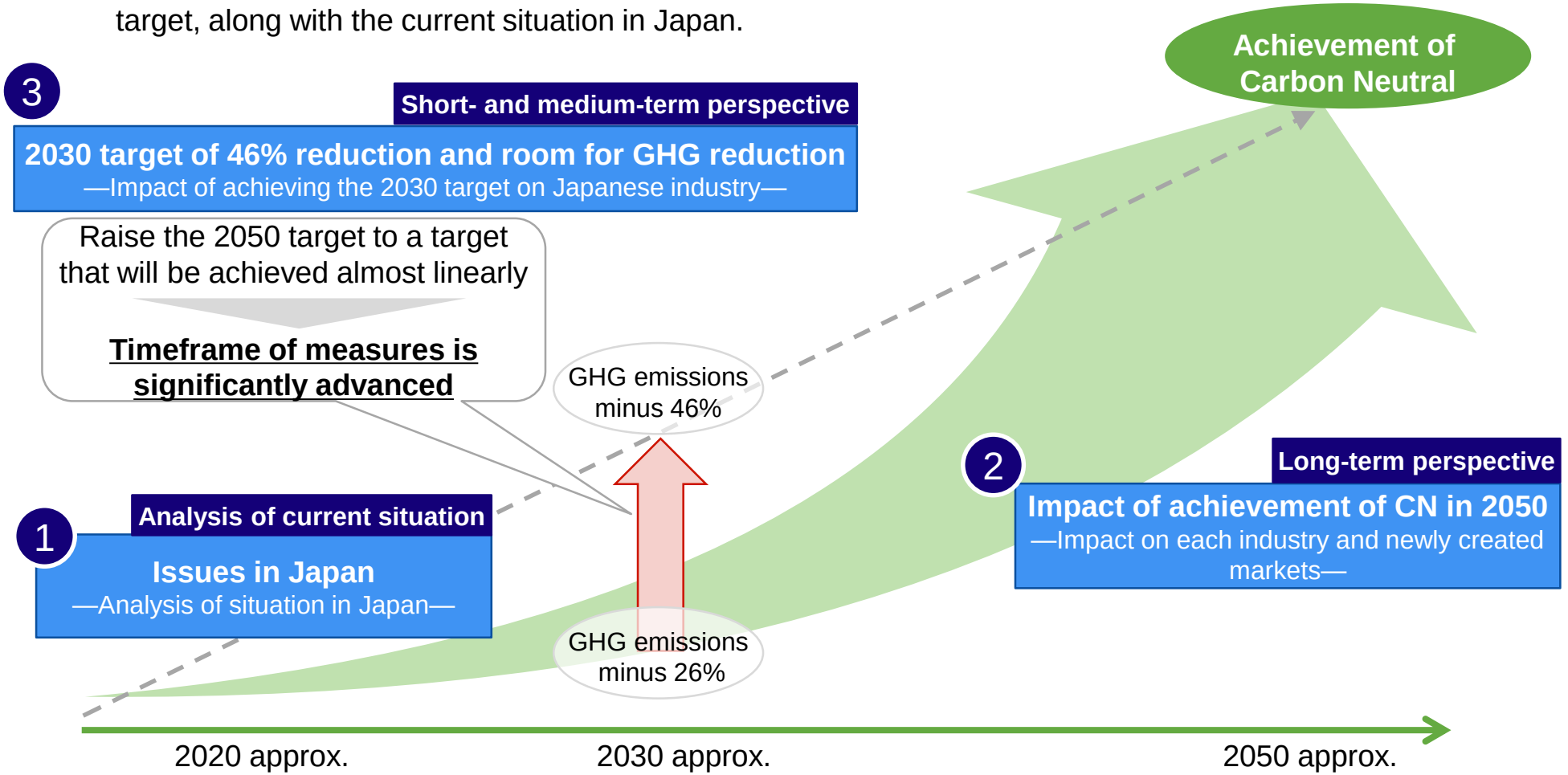
- ✓ **Although uncertainty does remain in the various trends, GHG emissions may bring about game changes that influence corporate management decisions.**
- ✓ **It is necessary to review the existing industrial structure and business models that are premised on GHG emissions.**

Source: Compiled by Mizuho Bank Industry Research Department

2. Impact of 2050 and 2030 Targets on Japan

Impact of 2050 and 2030 Targets on Japan

- In addition to CN in 2050, the 2030 GHG reduction target has been raised, and the process to achieve that will have a significant impact.
  - Analysis of the impact of the achievement of CN in 2050 and the impact of the achievement of the 2030 target, along with the current situation in Japan.

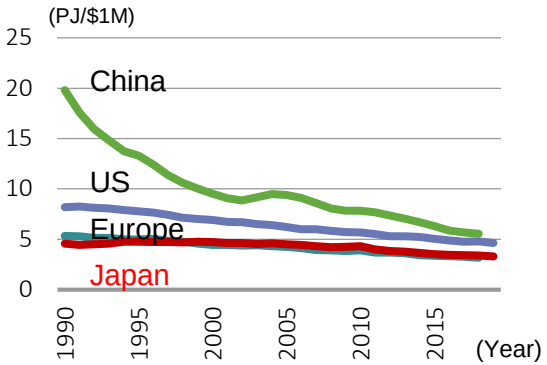


Source: Compiled by Mizuho Bank Industry Research Department

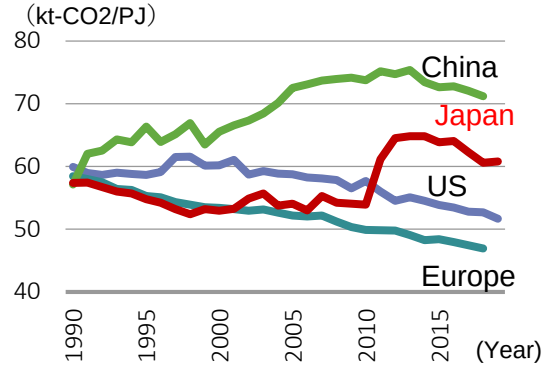
Issues in Japan in Reducing CO2 Emissions

1. How can Japan take advantage of its energy efficiency and find ways to create the added value of environmental value and develop innovative technologies?
2. How will Japan create CN power sources and reduce its CO2 emission intensity even though suitable land for renewable energy power generation is limited in Japan?
3. How can CN initiatives lead to a higher potential growth rate thanks to industrial restructuring?

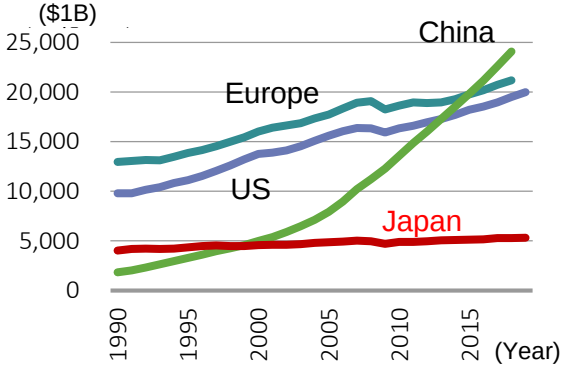
(1) Energy Intensity



(2) CO2 Emission Intensity



(3) GDP



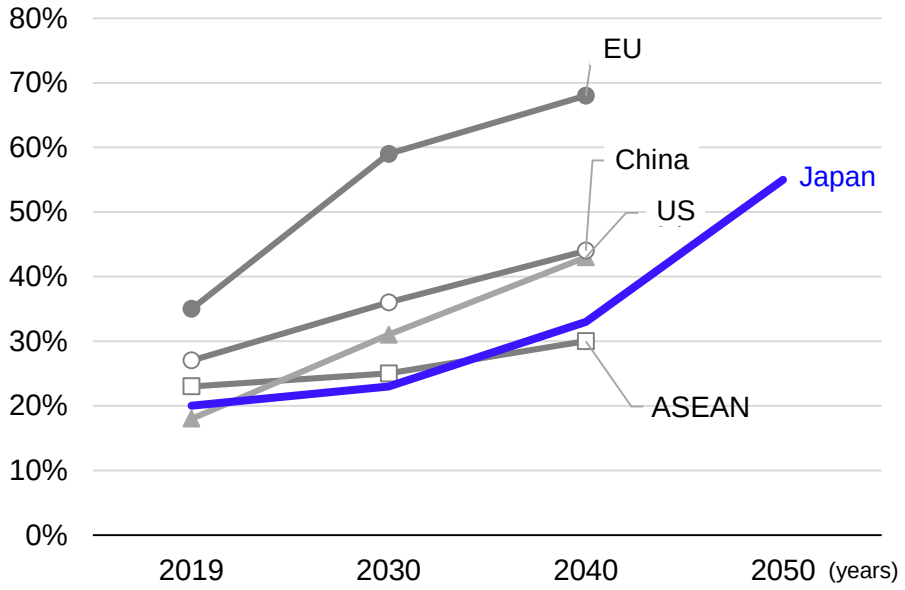
	(1) Energy Intensity	(2) CO2 Emission Intensity	(3) GDP
Japan's current situation	➢ Relative superiority in energy efficiency	➢ Deteriorating situation because the increased percentage of coal-fired power generation due to the shutdown of nuclear power plants due to earthquakes.	➢ Japan's economic growth rate is low compared not only to China but also compared to Europe and the US
Japan's issues with CN	➢ How to connect Japan's energy-saving value to monetization? ➢ How to develop and introduce innovative technology?	➢ How to achieve reasonable cost, stable supply, and safety along with CO2 emission reduction?	➢ How CN will lead to an increased potential growth rate thanks to industrial restructuring (investment expansion, productivity improvement)?

Source: Compiled by Mizuho Bank Industry Research Department based on the UNFCCC GHG Data Interface

Japan's renewable energy ratio is likely to remain low compared with other countries

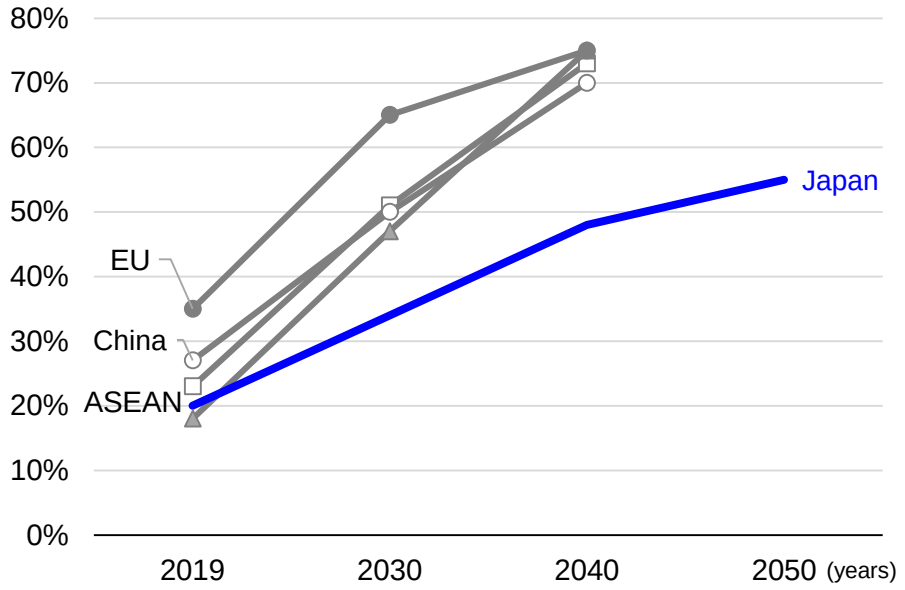
- There is limited room for expansion of renewable power generation in Japan due to its limited land area and limited grid capacity connecting power sources and demand areas.

Renewable Energy Ratio (IEA's Current Policy Scenario)



	2019	2030	2040	2050
Japan	Achievement	Strategic Energy Plan (22~24%)	IEA Forecast	Green Growth Strategy Note: Reference Value (50~60%)
Japan Other	Achievement	IEA Forecast	IEA Forecast	None

Renewable Energy Ratio (IEA Sustainable Development Scenario)



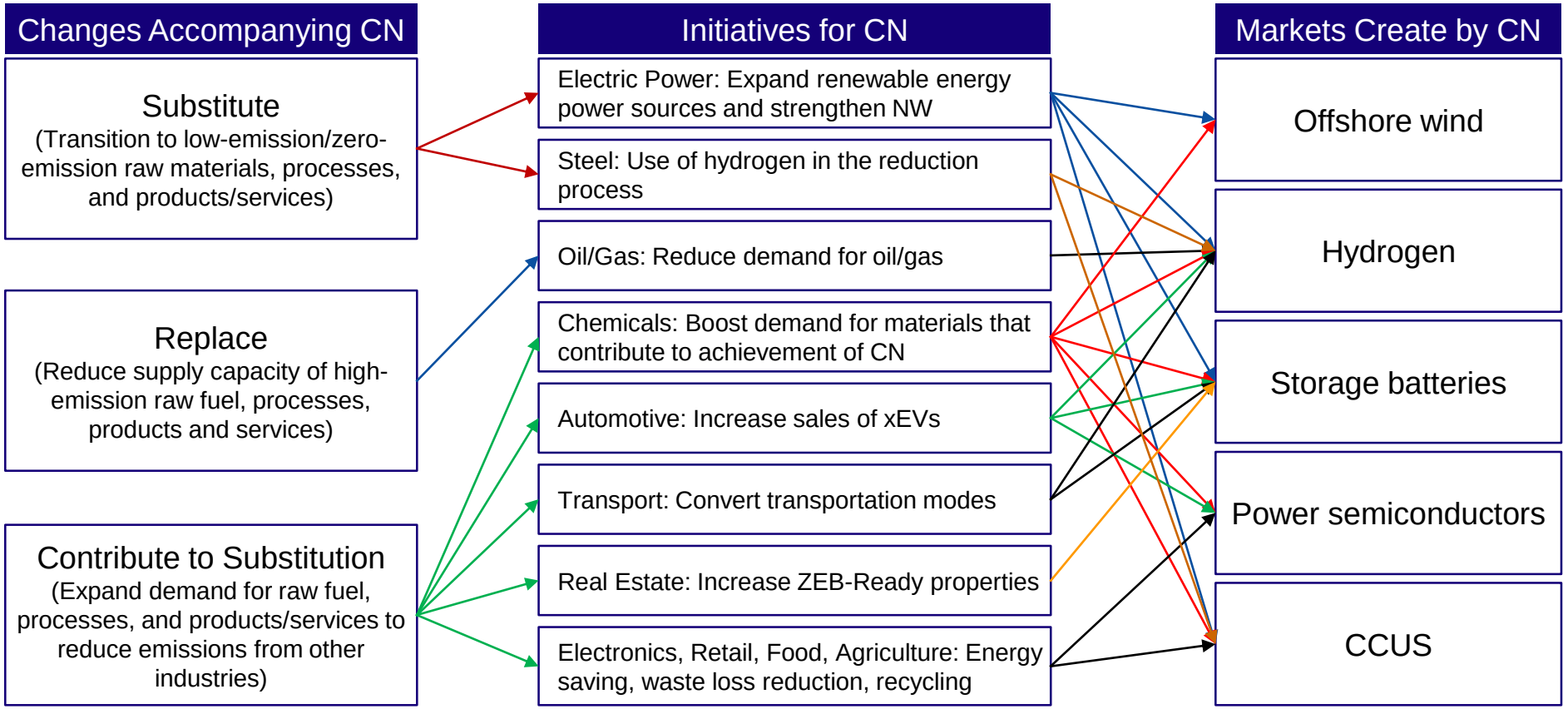
	2019	2030	2040	2050
Japan	Achievement	IEA Forecast	IEA Forecast	Green Growth Strategy Note: Reference Value (50~60%)
Japan Other	Achievement	IEA Forecast	IEA Forecast	None

Source: Compiled by Mizuho Bank Industry Research Department based on IEA

Impact of the Trend Toward the Achievement of Carbon Neutrality in 2050

- To achieve carbon neutrality, existing raw fuels, processes (manufacturing/operations), and products/services will be replaced with low-emission/zero-emission ones.
- Among these, offshore wind power, hydrogen, storage batteries, power semiconductors, and CCUS are expected to create and expand markets.

Impact of Achievement of Carbon Neutrality in 2050

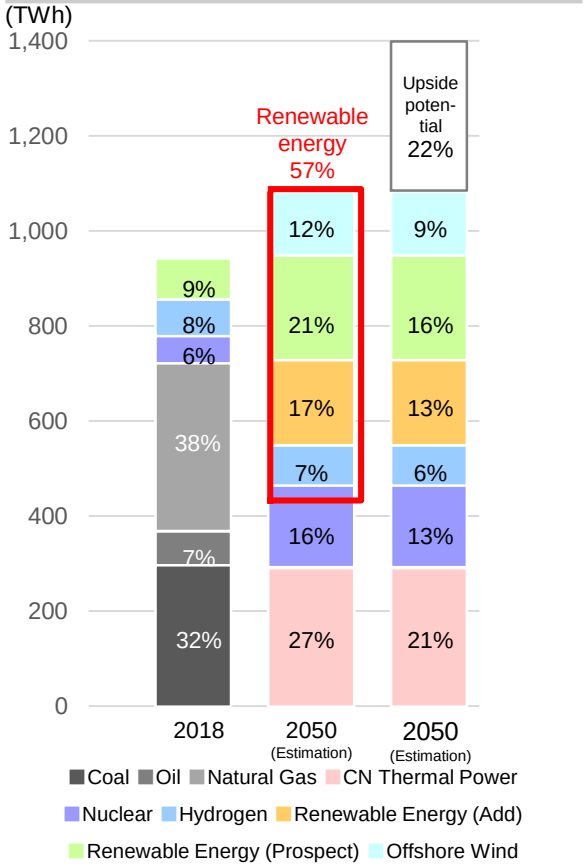


Source: Compiled by Mizuho Bank Industry Research Department

Electric power: Potential investment of 30~50 trillion yen in renewable energy toward 2050

- Assuming decarbonization of the power sector, simulated power supply mix to meet electric power demand in 2050.
  - Estimate the amount of each power source installed based on its position in the policy and the current situation.
  - Calculate the investment scale from current costs and cost targets.

Image of Energy Mix in 2050



Assumptions for each power source (calculated as electricity demand: 10,865 kWh)

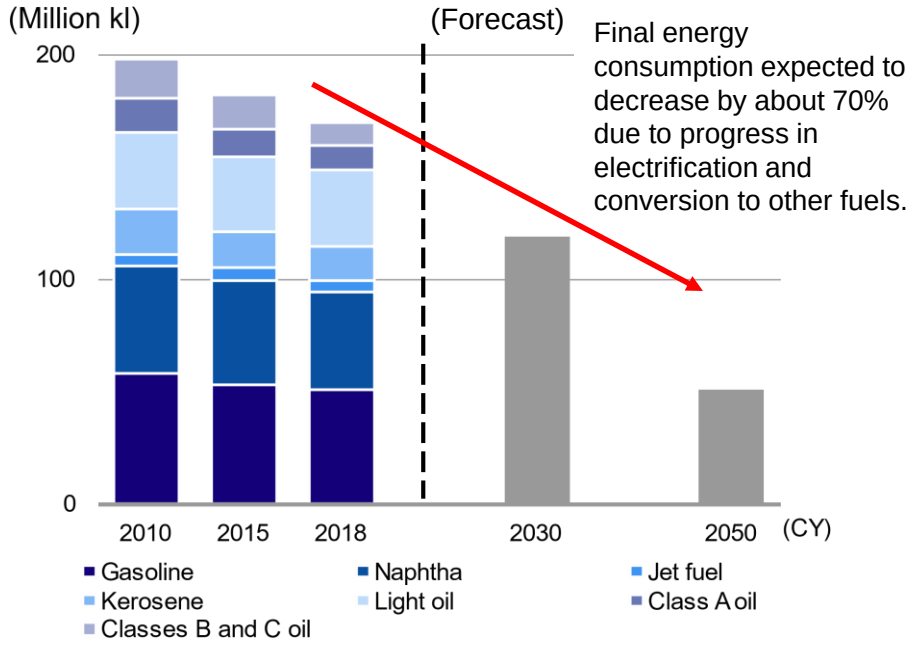
Sources	Ratio	Assumed scenario	Investment scale
Offshore wind	12%	Achieve the target (45GW) of introduction in the offshore wind industry vision	(Capital Expense) Approximately 11 ~ 23 trillion yen
Renewable energy (Prospect)	21%	Full introduction of FIT certification as of March 2020 Note: Offshore wind is scarce	(Capital Expense) Approximately 9 trillion yen
Renewable energy (Add)	17%	Introduction of 200 GW of solar power gemneration through initiatives for next-generation solar cells (120 GW of difference from (estimated) renewable energy was introduced)	(Capital Expense) Approximately 12 ~ 19 trillion yen
Hydro	7%	Power Generation in Fiscal 2018 Note: Remain flat due to limited availability of land	—
Renewable energy: 57%			
Nuclear	16%	Expected operation for 60 years of a total of 36 units, 33 existing units and 3 units under construction(23 units as of 2050) (Facility Utilization: 80%)	(Safety measures upgrades, etc.)
Hydrogen	13%	Achieve intermediate target of 7.5 million tons of hydrogen for power generation in the growth strategy	(Hydrogen generator) about 1.6 ~ 2.1 trillion yen
CCS thermal power plant	14%	Difference between assumed renewable energy, hydrogen, and nuclear power generation and electricity demand	(Annual separation and collection costs) Approximately 0.1 ~ 1.3 trillion yen/year
CN thermal power: 27%			

Note 1: Power source composition (power generation) and facility capacity are calculated assuming annual power supply and demand
Note 2: In this estimation, although solar power is assumed as additional renewable energy, there is a possibility of additional introduction of other renewable energy sources
Source: Compiled by Mizuho Bank Industry Research Department

Oil/Gas: Demand Expected to Decline Through 2050

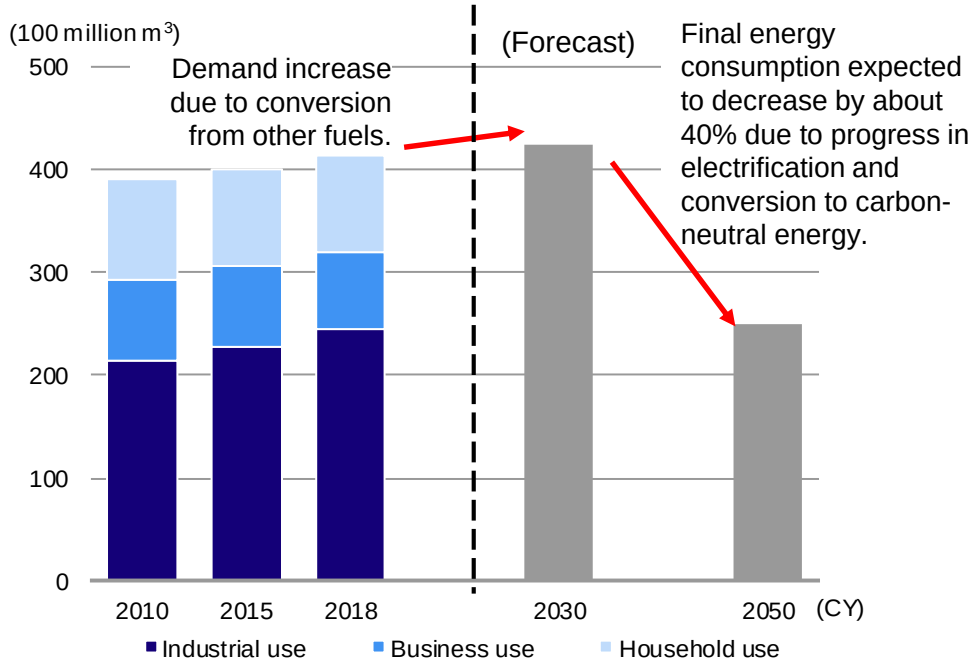
- Assuming a reduction in final energy consumption and progress in electrification, oil demand is expected to decrease by about 70% in 2050 compared to 2018, and utility gas demand is expected to decrease by about 40% in 2050 compared to 2018.
  - Oil demand is expected to continue to decline through 2050 due to the spread of EVs and the conversion of industrial fuels.
  - Demand for utility gas is expected to increase through 2030 because, with its relatively low CO2 emissions compared to other fossil fuels, it meets the need for a low-carbon fuel. However, demand is expected to decrease through 2050 due to the progress in conversion to carbon-neutral energy, such as via electrification and hydrogen.

Oil Demand Outlook for 2050



Source: Compiled by Mizuho Bank Industry Research Department based on materials from the Petroleum Association of Japan

Utility Gas Demand Outlook for 2050

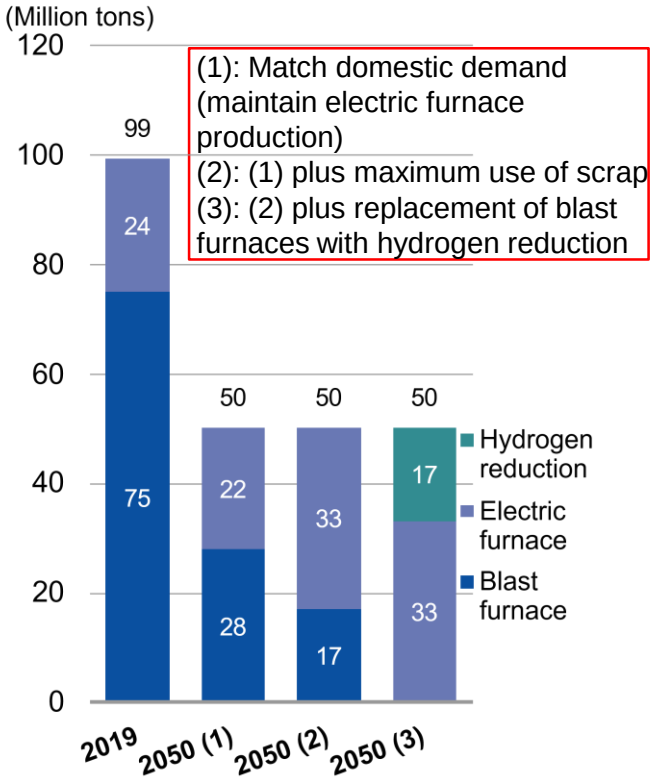


Source: Compiled by Mizuho Bank Industry Research Department based on *Comprehensive Energy Statistics* and *Monthly Report on Gas Business Statistics* by Japan's Agency for Natural Resources and Energy

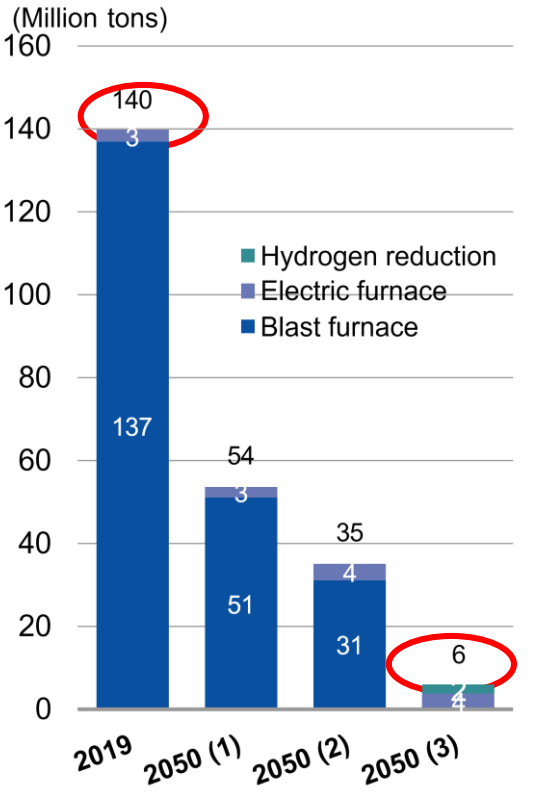
Steel: Possible to Reduce CO2 by 90% by Combining Scrap Utilization + Hydrogen Reduction

- This calculation assumes that, regarding crude steel production in 2050, domestic demand (assumed to be 50 million tons of crude steel) is secured.
- By utilizing all the scrap generated in Japan and replacing the blast furnace production of crude steel with hydrogen reduction, the amount of CO2 generated to meet the domestic demand in 2050 can be reduced to 6 million tons, which is 4% of the 2019 level. However, external power consumption will be 1.4 times the actual amount in 2019.

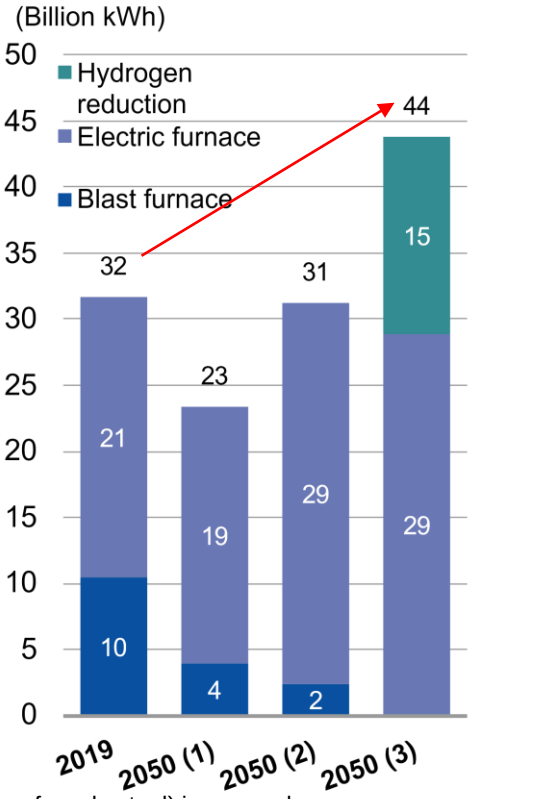
Crude Steel Production



CO2 Generated



External Power Consumption

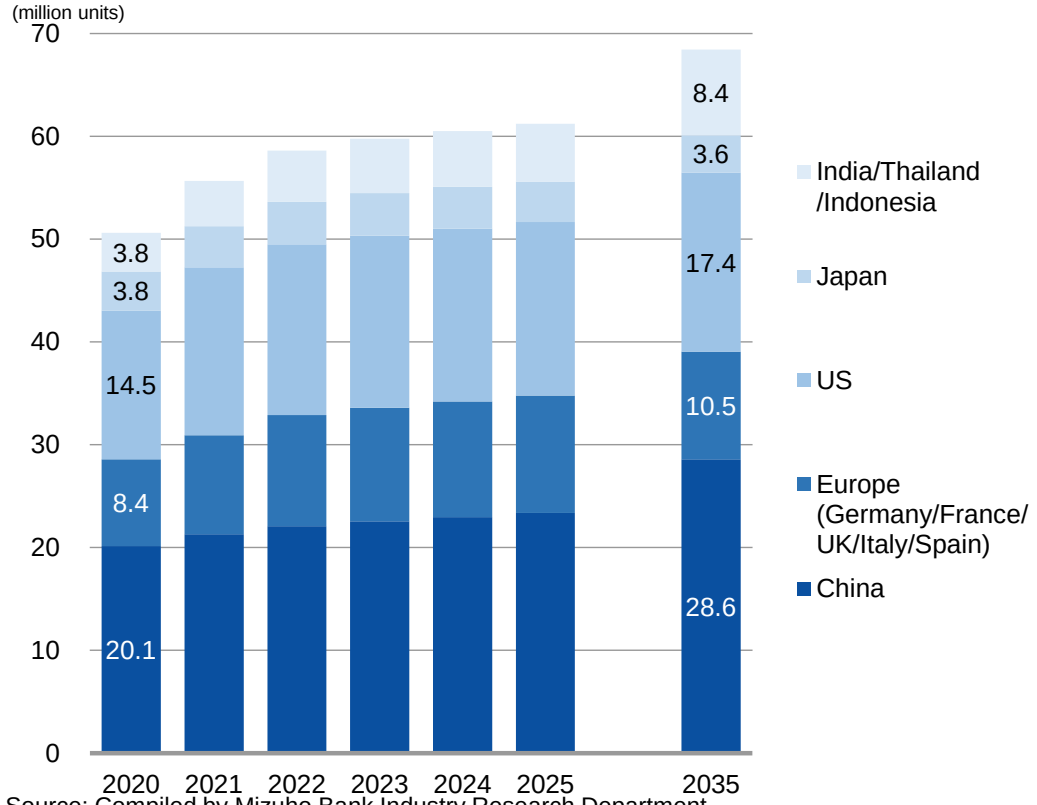


Note: This calculation assumes that, regarding crude steel production in 2050, domestic demand (assumed to be 50 million tons of crude steel) is secured
Source: Compiled by Mizuho Bank Industry Research Department based on *Greenhouse Gas Inventory* by the National Institute for Environmental Studies and materials from the Japan Iron and Steel Federation

Automotive: Top-down analysis of 2035 passenger car powertrain mix (1/2)

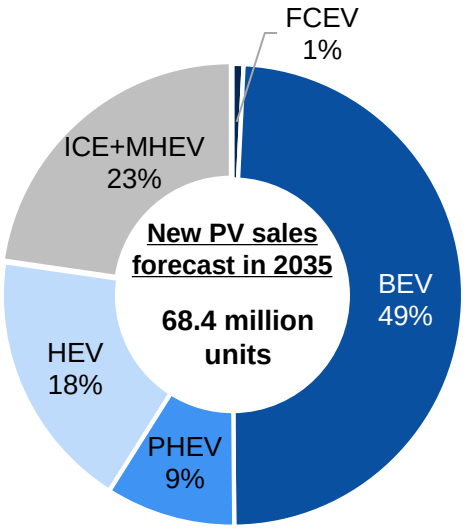
- The number of new passenger vehicle sales in the 5 target regions by 2035 might continue to grow mainly driven by China and India, however, the growth rate will become smaller (CAGR from 2025 to 2035 is expected to be 1.1%).
- In 2035, BEV ratio of new PV sales might reach about 50%, in the case OEMs would meet every regulation that has been introduced or is under consideration.

Forecast of New Car Sales in the 5 Regions in 2035



2035 passenger car powertrain configurations in the 5 regions

FCEV	0.5 million units
BEV	33.8 million units
PHEV	6.0 million units
HEV	12.5 million units
ICE + MHEV	15.5 million units

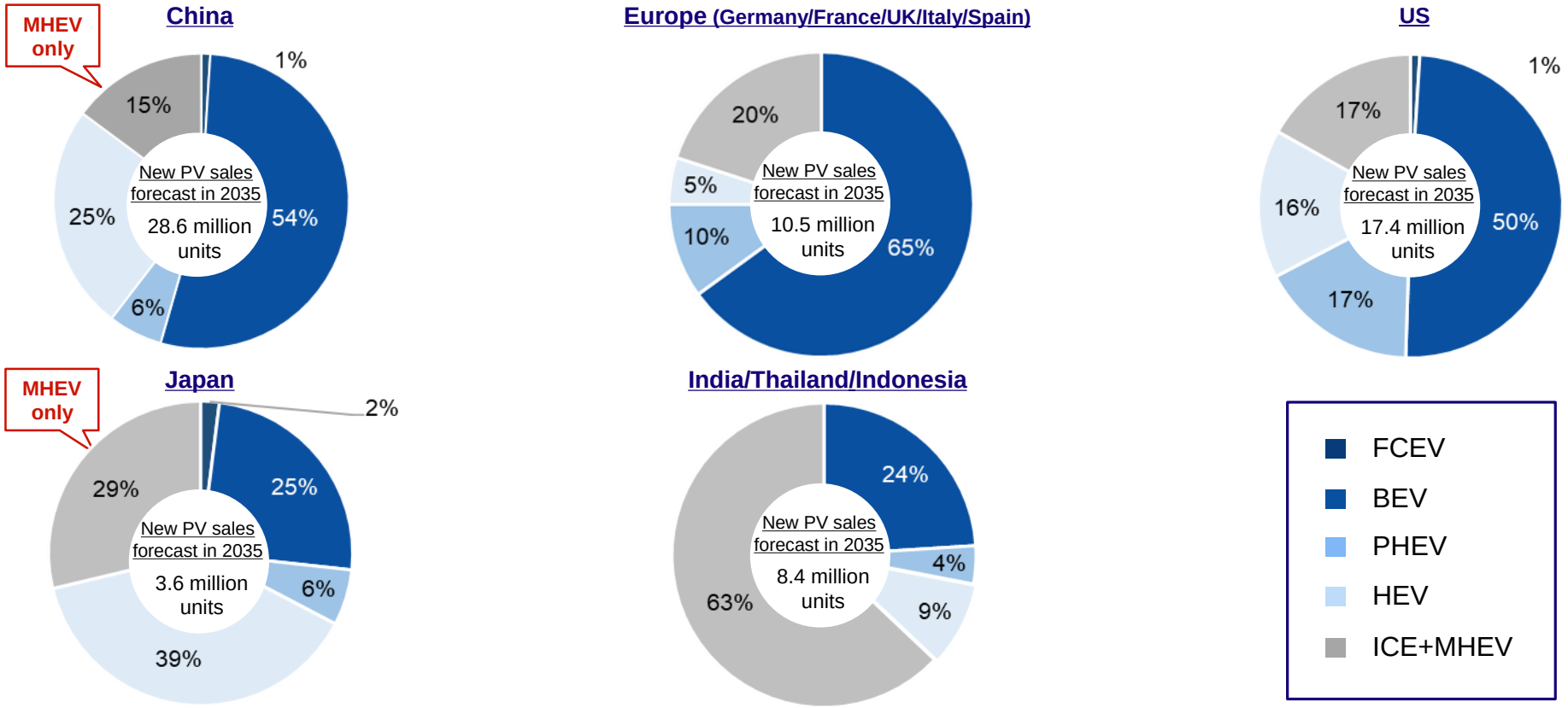


Source: Compiled by Mizuho Bank Industry Research Department

Automotive: Top-down analysis of 2035 passenger car powertrain mix (2/2)

- In addition to China and the five major Western European countries, where the BEV ratio is currently rising, there is a possibility that a scenario with a majority of BEVs can be assumed in the United States as well.
- In addition to Japan, it is estimated that a considerable number of HEVs are acceptable in China and the United States. Thus, it may be possible to maintain sales of HEVs for the time being.

Estimation of PV powertrain mix in the 5 target regions in 2035



Source: Compiled by Mizuho Bank Industry Research Department

Electronics: Finished Product Manufacturers Are Also Looking to Transform Their Business Models to Reduce CO2

- While there is limited room for reducing CO2 emissions in finished products through further technological advances, manufacturers need to consider reducing CO2 emissions in their entire supply chain, including intermediate goods, transportation, and manufacturing processes.
- It is necessary to consider not only the reduction of CO2 emissions in the supply chain but also the transformation of the business model.





	Intermediate goods	Transportation	Manufacturing processes	Finished products	Activities outside product manufacturing
Current problems	■Emissions of CO2, etc., from components such as circuit boards and electric parts and from materials such as chemical liquid and gas	■CO2, etc. released when transporting goods from the production bases of suppliers spread all over the world to EMS, etc.	■CO2 emissions from electricity usage in manufacturing processes	■Business model premised on mass production and mass consumption	■Each company has focused on controlling emissions of CO2, etc.
Direction of measures	■Utilization of recycling and low-carbon materials in components/materials ■Reduction of usage of components/materials	■Transformation of supply chain structure ■Transition to production/sales system of local production for local consumption, and restructuring of production system as part of that transition	■Curbing of power consumption ■Utilization of renewable energy	■Shift to a business model that premises long-term use and reuse of finished products	■Implementation of activities that contribute to the reduction of CO2 in the atmosphere ■Purchase of offset credits ■Utilization of CCUS
Considerations	■It is necessary to achieve total CO2 reduction through the supply chain				
	■It is possible that finished product manufacturers will select intermediate goods manufacturers based on their decarbonization efforts			■Energy saving in the finished product itself has progressed considerably	

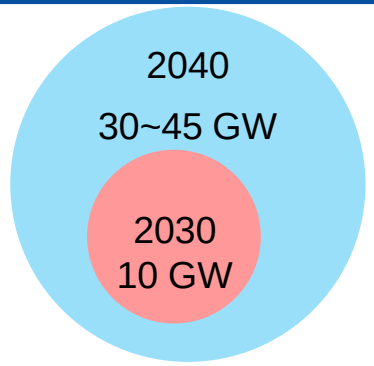
Source: Compiled by Mizuho Bank Industry Research Department

Offshore Wind Power: Goal to Promote Introduction Mainly in Hokkaido, Kyushu, and Tohoku Which Have Many Suitable Sites

- It is expected that the development of power sources will proceed in Hokkaido, Kyushu, and Tohoku, which have many suitable sites for offshore wind power.
- The development of a large power transmission grid (DC power transmission) that connects suitable sites (power generation areas) and power demand areas is also being considered.

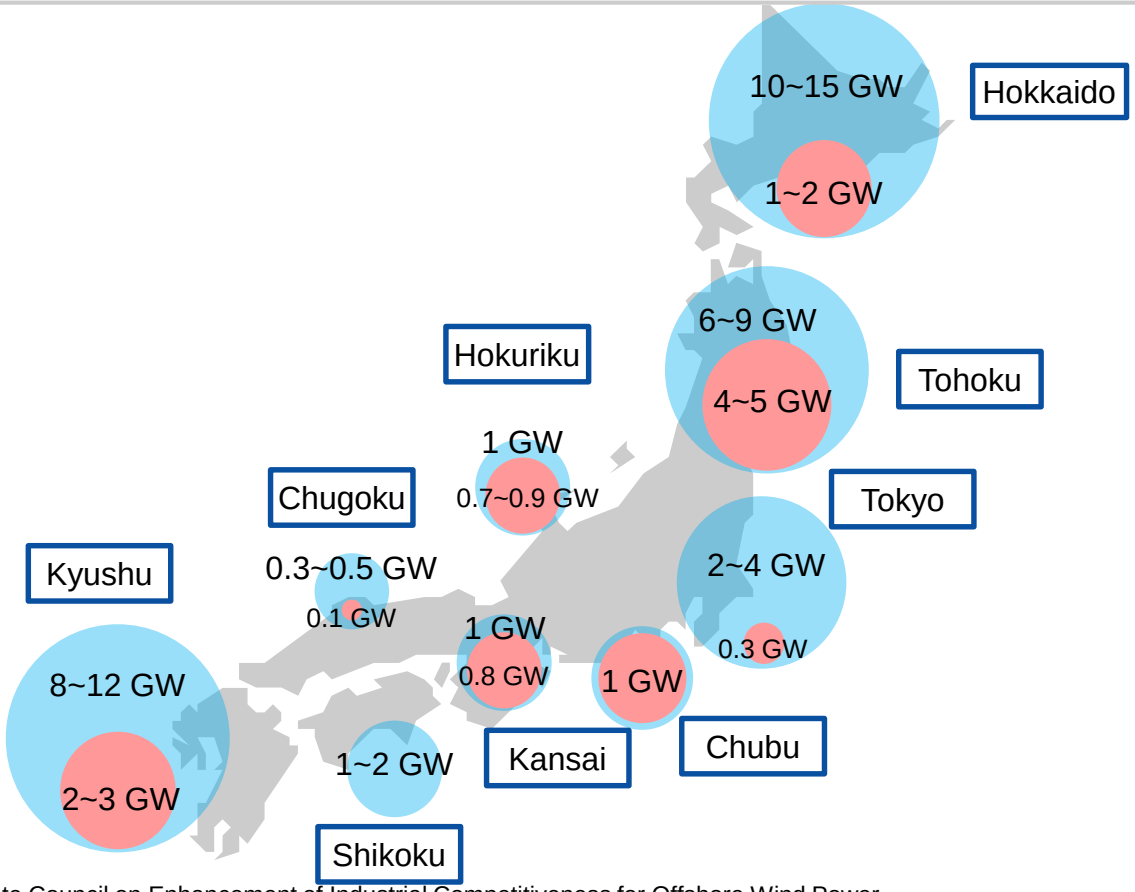
Introduction of Offshore Wind Power Generation Under the Jurisdiction of an Electric Power Company

Introduction Goal



Reference:
2020 result: 20,000 kW approx.
(0.02 GW approx.)

In creating a master plan for grid strengthening, study will also begin concerning power lines(DC transmission) that connects offshore wind power generation areas and power demand areas.

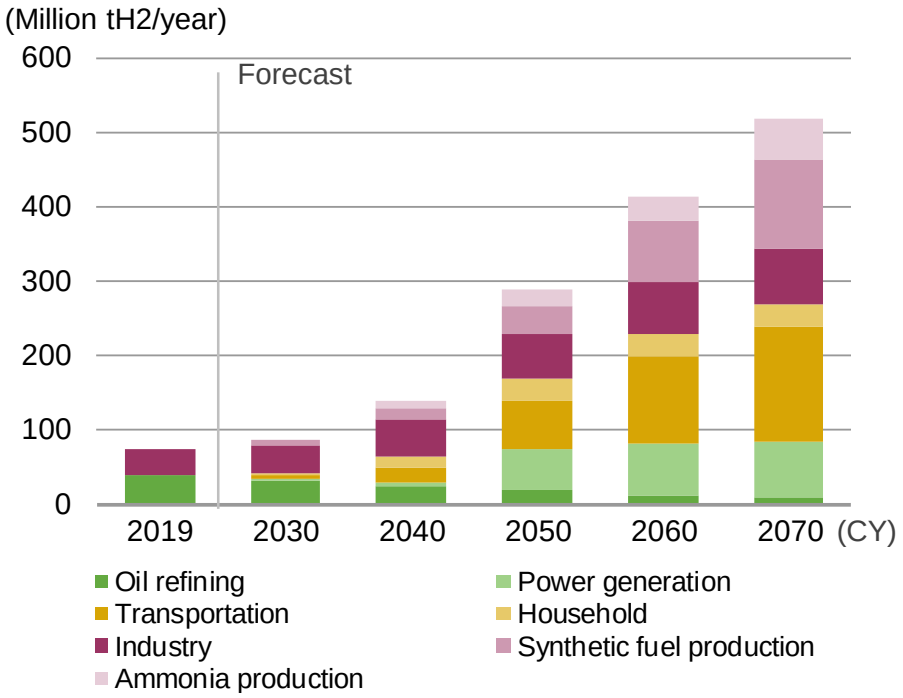


Note: Trial calculations by the Public-Private Council on Enhancement of Industrial Competitiveness for Offshore Wind Power
Source: Compiled by Mizuho Bank Industry Research Department based on the Public-Private Council on Enhancement of Industrial Competitiveness for Offshore Wind Power

Hydrogen: Remarkable Expansion of Demand in Japan and Overseas Expected

- According to IEA, the world's demand for hydrogen is expected to remarkably increase from 2030 (Assuming Sustainable Development Scenario)
- In Japan, FC trucks and hydrogen fueled ships are introduced sequentially. By 2030, to coincide with the timing of large-scale commercialization of international hydrogen supply chain, hydrogen usage is expected to be regionally implemented by the power generation sector

Outlook for Global Hydrogen Demand by Application (IEA)



Note: Outlook for a "Sustainable Development Scenario" on the premise that the 2˚C target will be achieved

Source: Compiled by Mizuho Bank Industry Research Department based on Energy Technology Perspectives 2020 by IEA

Path to Expanding Hydrogen Demand in Japan

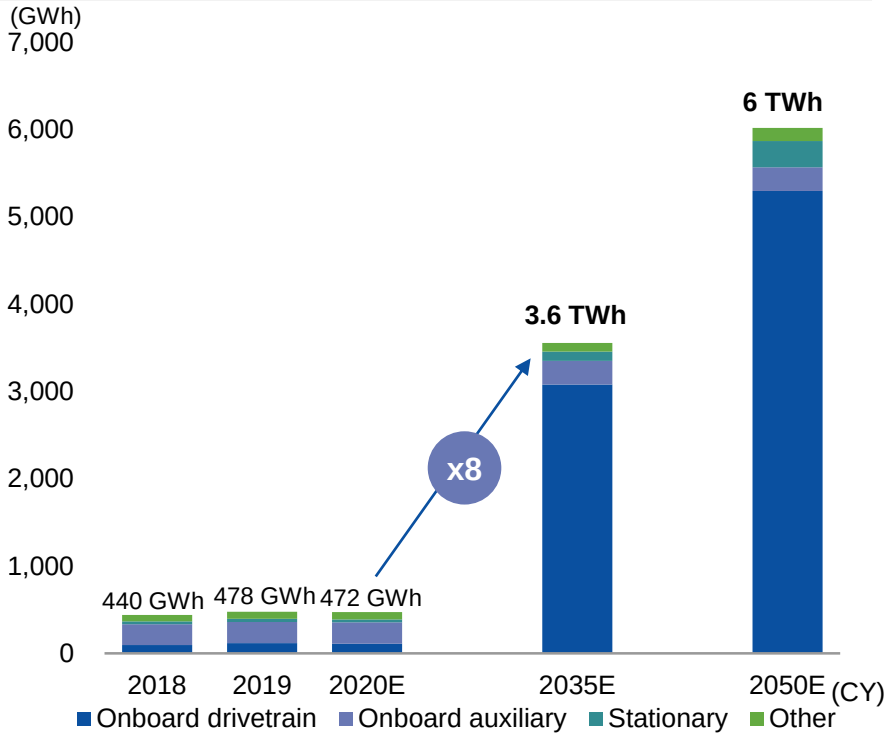
	Short term (up to 2025)	Medium term (up to 2030)	Long term (up to 2050)
Target amount	2 million tons approx.	3 million tons maximum	20 million tons approx.
Transport sector	Expansion of FCVs, FC buses, and FC trucks	Introduction of hydrogen-fueled ships to the market	Use of hydrogen (and synthetic fuels, etc.) for aircraft, etc.
Power generation sector	Regional development centered on stationary fuel cells and small turbines	Commercialization of large-scale hydrogen power generation turbines	Function as a coordinator that supports decarbonization of electric power
Industrial sector (industrial raw materials)	Implementation of cleaner hydrogen, which is used in the desulfurization of crude oil, and demonstration of manufacturing processes in the steelmaking and chemical fields, etc.		Hydrogen reduction steelmaking, green chemicals, etc.
Heat demand of industrial, business, and household sectors	Introduce water electrolyzers and pure hydrogen fuel cells, and supply via existing gas pipes, etc. Substitute hydrogen for fossil fuels for decarbonization of infrastructure, etc.		Expand supply through infrastructure development and reduction of hydrogen costs

Source: Compiled by Mizuho Bank Industry Research Department based on Agency for Natural Resources and Energy

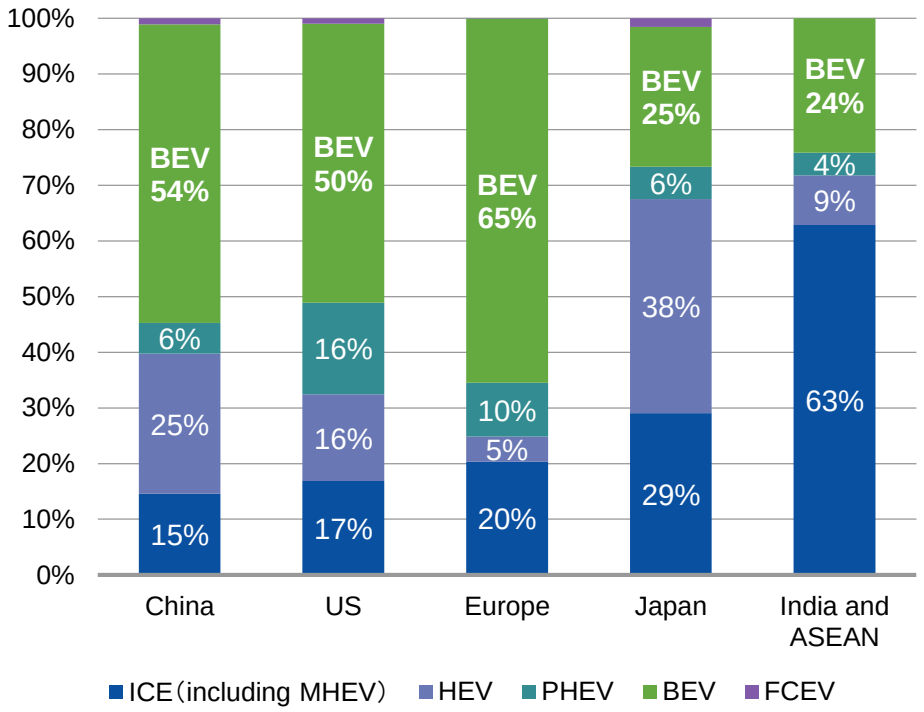
Storage Batteries: Required Investment for Production Estimated at up to 30 Trillion Yen Through 2035

- Assuming that 80% of new car sales will be BEV in 2050, investment of 20 trillion yen to 50 trillion yen will be required.
  - The required investment for battery manufacturing in 2035, estimated from the latest investment announcement, is estimated to be about 30 trillion yen (3 TWh).
  - If the investment utilizes the new technology announced by Tesla, it can be restrained to about 10 trillion yen (minus 66% compared to conventional batteries).
- In Japan, the required production volume of storage batteries in 2035 is estimated to be 120 GWh, and the required investment is estimated to be 1.1 trillion yen.

Outlook for Storage Battery Market



Reference: Assumed EV Mix in 2035

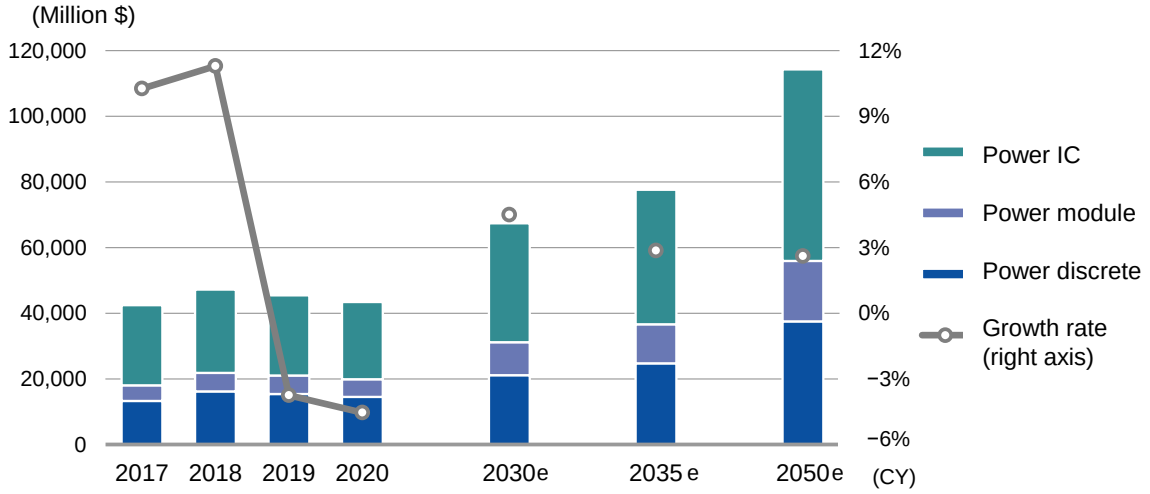


Note: Figures for 2020 and thereafter are forecasts of Mizuho Bank Industry Research Department.
Source: Compiled by Mizuho Bank Industry Research Department

Power Semiconductors: Market Size Will Increase 1.6 Times in the Next 10 Years and 2.6 Times in 30 Years

- The global market size, which was $43.4 billion in 2020, is expected to grow to $67.4 billion in 2030 and $114.3 billion in 2050.
  - The average annual growth rate from 2020 to 2030 is expected to be 4.5%, and the average annual growth rate from 2030 to 2050 is expected to be 2.7%.
- Due to the decarbonization, the shift to xEVs and the sophistication of cars' functions are accelerating, and infrastructure investment in renewable energy is also increasing.
- In the industrial and consumer goods sector as well, the number of power semiconductors installed is expected to increase due to the progress of electrification and sophistication of equipment.
  - Semiconductors, electronic components, and circuits are intricately complex inside products that use electricity, and the types of currents (AC/DC) and voltages that flow through each are different. Therefore, as equipment becomes more sophisticated, more power semiconductors will be installed.
- With the growing need for energy saving and the increase in battery-powered products, the importance of power ICs will further increase.
  - In smartphones, the power management IC manages the flow of electricity, while the battery management IC manages the charge, discharge, and remaining capacity of the battery.
  - It is very important to manage the charge, discharge, and remaining capacity of the battery to effectively utilize the limited battery capacity and prolong the life of the battery.

Forecast of Long-Term Global Market for Power Semiconductors

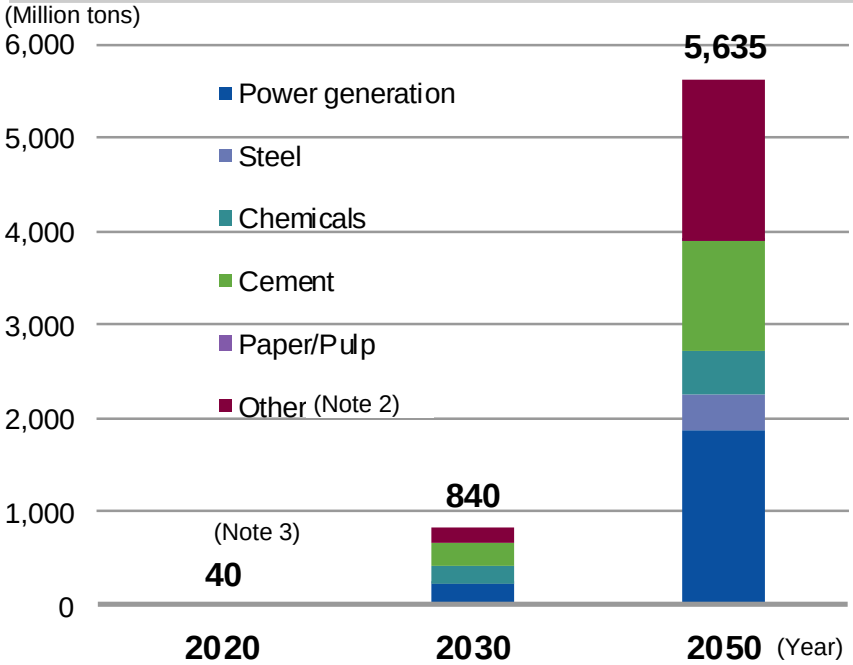


Note 1: The growth rates from 2030 onward indicate the compound annual growth rates between the previous forecast year and the forecast year (example: 2030 figures refer to the 2020−2030 period)
Note 2: Figures for 2030 and thereafter are forecasts of Mizuho Bank Industry Research Department
Source: Compiled by Mizuho Bank Industry Research Department based on OMDIA

CCUS: Usage Expected to Expand to a Medium- to Long-Term Perspective in Preparation for 2050

- The IEA incorporates medium- to long-term expansion of CCUS utilization in its Sustainable Development Scenario.(Note 1)
  - It is predicted that 5.6 billion tons/year of CO2 will be stored or used globally by 2050 by utilizing CCUS technology.
  - In the industrial sector, active use of CCUS in the cement industry is expected.
- In CCS-related sectors, there is a large amount of capital investment, and the main players are large companies such as major energy companies. In some cases, overseas startups take the lead in R&D and demonstration of advanced technologies such as CCU and DAC.

Outlook for CO2 Separation/Capture (global)



Note 1: A scenario to achieve net zero in the energy industry in 2070
Note 2: The CO2 separation/capture amount mainly from fuel manufacturing processes such as hydrogen and ammonia
Note 3: Actual CO2 capture by CCS in 2020
Source: Compiled by Mizuho Bank Industry Research Department based on IEA materials

Players in Each Category and Process of CCUS

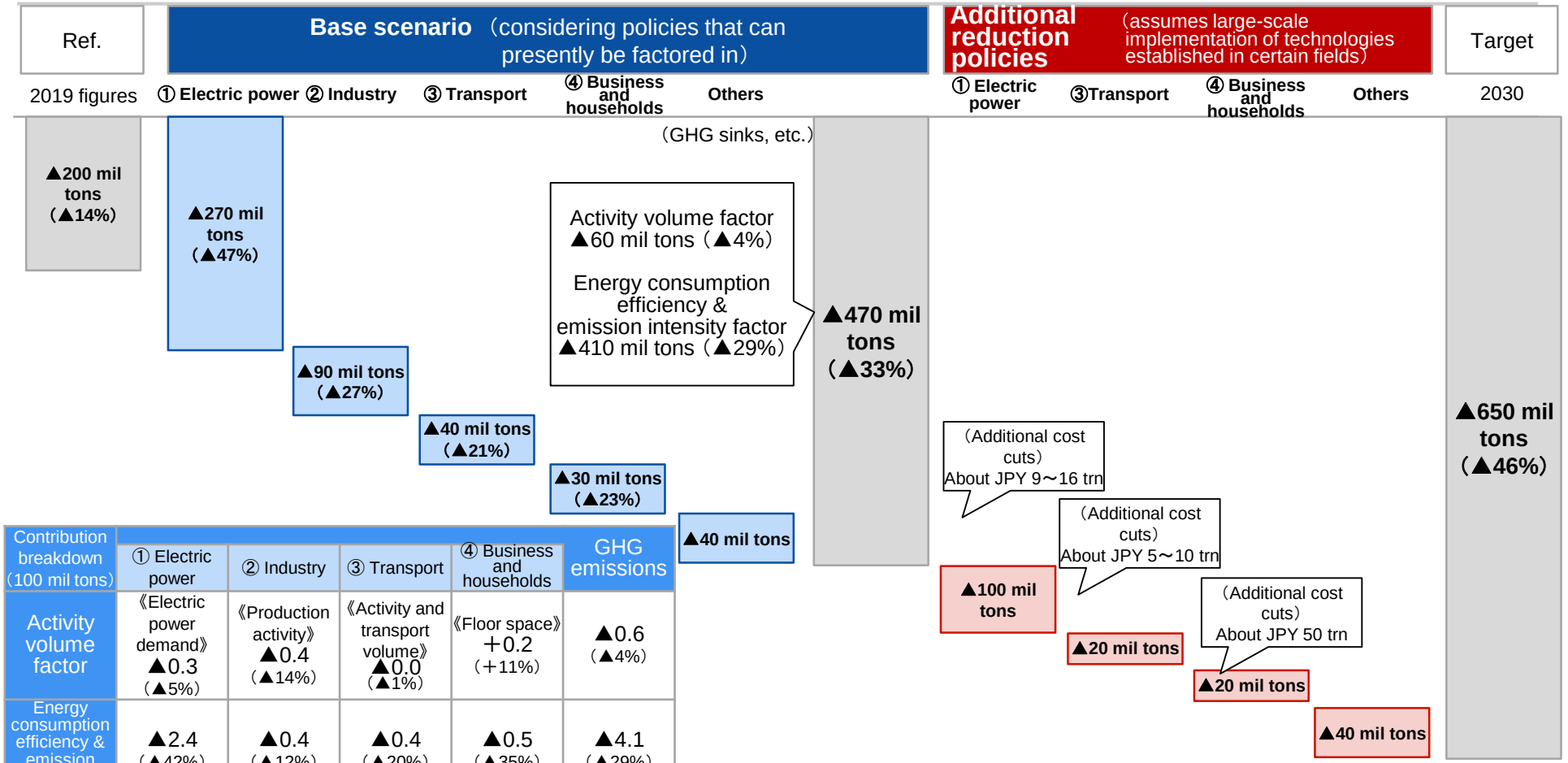
Category	Process	Player
Joint	Separation and capture	• R&D is underway via collaboration by industry, academia and government. Technology is possessed by plant engineering companies, chemical manufacturers, and major energy companies, etc. • In DAC, startups lead the R&D.
CCS	Shipping	• Companies in high CO2 emissions industries and major energy companies lead CCS projects. • Since oil and gas fields are suitable for storage including EOR, upstream oil and natural gas developers are also actively working on storage.
	Storage	
CCU	Mineralization	• There are many startups. There are also cases of practical application through collaboration with existing companies.
	Fuel conversion	• Mainly in the technology development/demonstration stage. Players are startups, research institutes (including universities), etc.
	Chemical conversion	• In Japan, chemical manufacturers and research institutes such as universities are developing and demonstrating this technology. A limited number of startups are working in this area.

Source: Compiled by Mizuho Bank Industry Research Department based on materials from Japan's Ministry of Economy, Trade and Industry and JOGMEC

Results outline of estimated potential GHG reduction in 2030

- Our base scenario, considering policies that can presently be factored in, is for just a 33% GHG cut by 2030.
  - Meeting the targets is not impossible if a collection of aggressive steps is implemented. However, consideration should be paid to possible negative aspects like cost increases and the impact on competitiveness.

GHG reduction relative to 2013



Contribution breakdown (100 mil tons)	① Electric power	② Industry	③ Transport	④ Business and households	GHG emissions
Activity volume factor	《Electric power demand》 ▲0.3 (▲5%)	《Production activity》 ▲0.4 (▲14%)	《Activity and transport volume》 ▲0.0 (▲1%)	《Floor space》 +0.2 (+11%)	▲0.6 (▲4%)
Energy consumption efficiency & emission intensity factor	▲2.4 (▲42%)	▲0.4 (▲12%)	▲0.4 (▲20%)	▲0.5 (▲35%)	▲4.1 (▲29%)

Source: Compiled by Mizuho Bank Industry Research Department

Base scenario assumptions and details of additional reduction steps

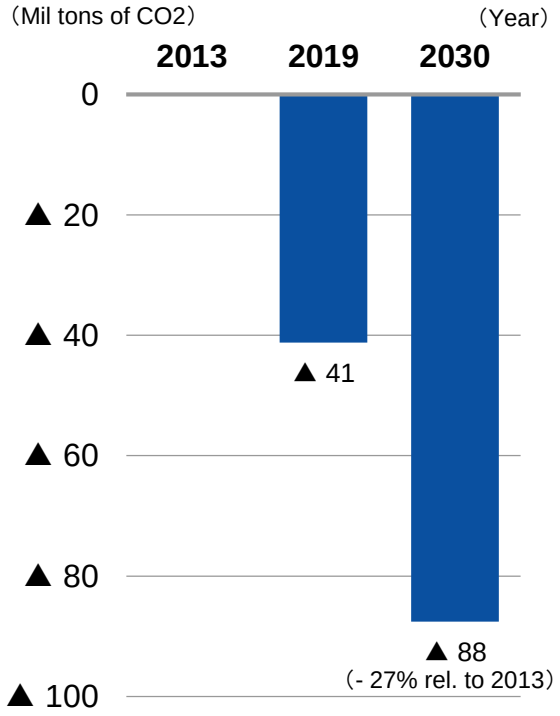
	Base scenario assumptions	Additional reduction steps	Issues arising from additional reduction measures
① Electric power	✓ Power demand decrease（energy-saving measures more than offset rising demand from electrification） ✓ Oil and gas maintain their proportion with declining volume. Coal volume declines with fade-out of inefficient types. Nuclear power weighting in line with previous target energy mix	Raise renewables to 35~45% of power sources	✓ Increasing renewables introduction requires sophisticated grid operation and grid strength as well as location constraints and cost increases to ensure stable supply
② Industry	✓ Steel, chemicals, cement related production volume and emission intensity forecast based on industry body predictions • Steel: Lower production volume. Introduce COURSE50 for three blast furnaces, lowering GHG emissions by 10% • Chemicals: Production volume virtually flat. Lower emission intensity • Cement: Slightly lower production volume. Emission intensity flat ✓ Other industries assumed to progress in energy saving and electrification	(Limited scope for reduction through energy saving. For further cuts, technical innovations like CCUS will be essential, but such technology is unlikely to become widespread in 2030)	
③ Transport（traveler）	✓ Overall transport volume flat (passenger cars: flat; air and rail: slight rise, buses: fall) ✓ Emission intensity decline with boosts to fuel efficiency and partial introduction of electric vehicles and synthetic fuel • Based on policies and individual company trends, stock-based passenger car ZEV ratio estimated to be around 3%	Stock-based passenger car ZEV ratio: 5~15%	✓ Regardless of considerable hurdles concerning timeline and effectiveness of measures, BEV has certain technical prospects. However, rapid progress in a BEV shift may impact global competitiveness
③ Transport（freight）	✓ Assumption of overall decline in transport volume and no change in individual transport mode allocation ratios ✓ Emission intensity decline with boosts to fuel efficiency and partial introduction of synthetic fuel	(Progress in modal shift from trucks to rail and coastal shipping will require large-scale infrastructure investment for capacity expansion, which is unlikely to be realized in 2030)	
④ Business & households	✓ Introduction of ZEB and ZEH principles for new buildings from 2021 (energy usage assumed at 50% less, in line with ZEB Ready level)	Introduce ZEB and ZEH into 35~45% of existing buildings too (ZEB Ready level energy use)	✓ In addition to increased regulation of new buildings, policies promoting existing building renovation are likely, but these will require large-scale investment incentives

Source: Compiled by Mizuho Bank Industry Research Department

Industry-derived emissions: Base scenario

- Industry sector GHG emissions are estimated to be reduced by 27% in 2030 relative to 2013.
  - In addition to decreased production volume stemming from falling domestic demand and a production shift to high added value goods, steady progress in improving energy efficiency and intensity and a switch to low-emission technology will contribute to the reduction.

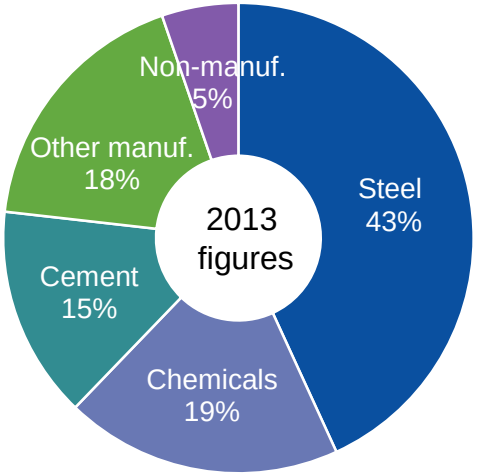
Industry sector GHG emissions reduction estimates



Assumptions that reduction estimates are based on

	Assumptions
Steel	✓ Lower production volume ✓ Introduce COURSE50 for three blast furnaces, lowering GHG emissions by 10%.
Chemicals	✓ Production volume virtually flat. ✓ Lower emission intensity, based on Japan Chemical Industry Association's BAU reduction target
Cement	✓ Slightly lower production volume. ✓ Emission intensity flat relative to 2019, based on Japan Cement Association's energy intensity target
Others	✓ Progress in energy saving and electrification makes emission intensity improve 1% annually

(Ref.) Industry sector CO2 emissions



- Figures include energy-derived CO2 (industry sector) including self-generated power, and non-energy derived CO2 (industrial processes and product use)
- Non-CO2 GHG emissions are not included

Note: 2030 figure is forecast by Mizuho IRD
Source: Compiled by Mizuho Bank Industry Research Department based on National Institute for Environmental Studies greenhouse gas report

Industry-derived emissions：Possible further steps and issues for realization

- Steps to lower GHG emissions in the industry sector have become more aggressive than previously, and our base scenario already factors in predictable steps. There is therefore limited room for projection of further policy steps.
  - Further cuts will require technical innovation, and large-scale outlays will be needed for R&D and testing to realize emission cuts in the post-2030 period.

Further reduction steps and issues for realization

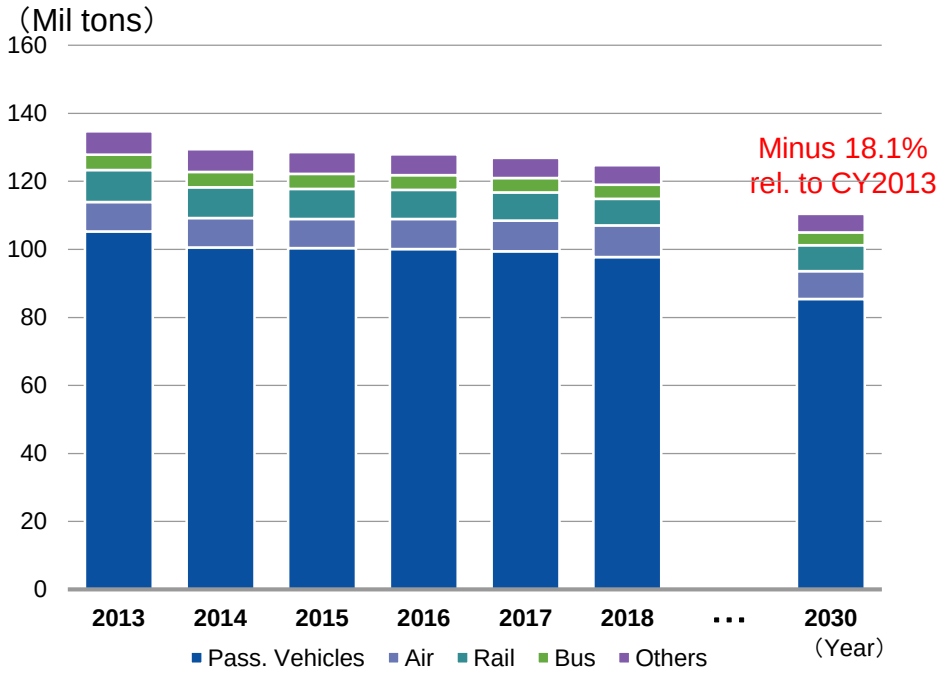
Possible further reduction steps		Concerns and issues regarding further measures
CO2 separation and capture（CCUS）	✓ CCUS technology for GHG emission capture	✓ Time needed till technology established ✓ Lower competitiveness with excessive cost burden
Manufacturing process reform（new technology）	✓ Reform of manufacturing processes using hydrogen reduction steelmaking, artificial photosynthesis, CCU etc.	✓ Time needed till technology established ✓ Lower competitiveness with excessive cost burden
Activity volume factor（production volume）	✓ —	✓ Greater efficiency stemming from supply reduction accompanying domestic demand decline already factored in. Any further production decline could impact future ability to secure stable supply
Energy efficiency improvement（energy saving）	✓ —	✓ In additional to previous steps, further steps already factored in, so limited scope for further cuts
Policy support	✓ With carbon pricing, additional support measures will lower the cost structure to an economically-rational level	✓ Limited room for further cuts, and excessive burden may be concentrated in certain fields ✓ Decline in due to cost increase may lower international competitiveness and make present assets stranded ones

Source: Compiled by Mizuho Bank Industry Research Department

Transport (traveler)-derived emissions: Base scenario

- Traveler-related CO2 emissions are expected to decline over the very long term, with decreased activity (transport volume) due to the effects of demographics (population decline, declining birthrate and aging population, etc.). However, a contribution from such decreased activity is unlikely by 2030.
- Therefore, prior to 2030 individual transport modes need to target reduced CO2 emission intensity through their own efforts.

CO2 emission forecast by transport mode



Note: 2030 figure is forecast by Mizuho Bank Industry Research Department
Source: Compiled by Mizuho Bank Industry Research Department based on National Institute for Environmental Studies and MLIT materials

Assumptions for base scenario

	Activity	CO2 emission intensity
Pass. vehicles	• Flat (unit ownership and travel distance both virtually flat)	• Fall (increased fuel efficiency and ratio of lightweight cars and HEV)
Air	• Slight growth (despite falling population, with contribution from inbound visitor growth)	• Fall (introduction of fuel-efficient planes and use of SAF)
Rail	• Slight overall growth (slight intra-urban fall; inter-urban rise)	• Fall (introduction of fuel-efficient rolling stock, use of renewables)
Bus	• Fall (impact of demographics such as population decline and aging society)	• Flat (difficult to factor in introduction of EV and FCV buses)

Source: Compiled by Mizuho Bank Industry Research Department

Transport (traveler)-derived emissions: Possible further steps and issues for realization

- Further reduction in emissions will center on how to reduce auto-related emission intensity and transport activity volume, which account for around 80% of emissions.
- Policies that greatly contribute to carbon neutrality could also be studied. However, recognized issues exist including the 2030 timeline and outlays required for target realization. As such, policy promotion towards achieving the final 2050 goal of a carbon-neutral society is needed.
  - Comprehensive decision-making required, accounting for factors including key industry competitiveness and economic ripple effects.

Further reduction steps and issues for realization

	Further reduction steps	Contrib.	Issues for realization		
Emission intensity reduction	• Raising fuel efficiency (incl. HEV-rel. steps)	Small	Outlay / Timeline	• Limited scope for further fuel efficiency gains in engine-equipped cars including HEV	• Need replacement incentives as well as new vehicle sales ones
	• Rapid progress in BEV shift	Large	Outlay / Timeline	• Difficult to raise BEV sales target for 2030 timeline from OEM perspective • LCA-based emissions reduction	
	• e-fuel use	Large	Outlay / Timeline	• Depends on technical development trends and realization unlikely over a short period. Further, manufacturing costs may remain high in future	
Activity volume reduction	• Shift to public transport for local mobility needs	Small	Outlay / Timeline	• Investment burden required to help raise public transport convenience and capacity • Need incentive (disincentive for car use) like subsidy to promote public transport use	
	• Forming of compact cities	Large	Outlay / Timeline	• Large investment and extended time period needed to consolidate urban functions within compact area and improve public transport system	

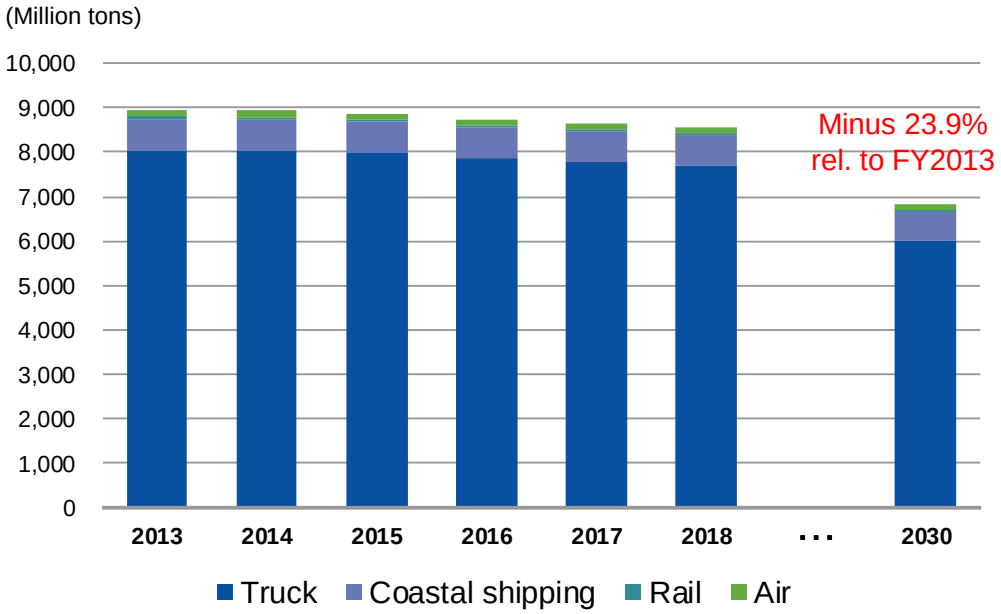
Source: Compiled by Mizuho Bank Industry Research Department

Transport (freight)-Derived Emissions: Base Scenario

- Freight-area CO2 emissions, due to decreased activity and a switch to transport modes and fuels with fewer emissions, should contribute to reduced emissions to a certain extent even by 2030.
- Furthermore, due to the modal shift, CO2 emission reductions may further accelerate.

  Note: Modal shift refers to a switch from vehicle use (including trucks) to rail and ships, which produce a lower environmental burden.

Projected CO2 Emissions by Transport Mode



Note: FY2030 and FY2050 figures are forecasts by Mizuho Bank Industry Research Department

Source: Compiled by Mizuho Bank Industry Research Department based on various public materials

Assumptions for Base Scenario

	Activity (freight vol.)	CO2 emission intensity
Trucks	• Decrease (GDP, etc., considered. In the past, the percentage share of the transportation modes has not changed.)	• Lower (higher fuel efficiency and load factor)
Coastal shipping		• Lower (intro. of LNG ships whose fuel carries lower environmental burden)
Rail		• Lower (introduction of fuel-efficient rolling stock)
Air		• Lower (introduction of fuel-efficient planes and use of SAF)

Source: Mizuho Bank Industry Research Department

Transport (freight)-Derived Emissions: Possible Further Steps and Issues for Achievement

- Policies to further reduce emissions will center on a modal shift from truck-based transport, which accounts for the majority of emissions, to coastal shipping and rail.
  - In our base scenario, accounting for past freight volumes in different transport modes and assuming modal shifts progress to the extent possible, FY2030 emissions should be cut by around 28.7% relative to FY2013.
- On one hand, in advancing the modal shift, there are measures such as expansion and maintenance of infrastructure and conversion from old ships to advanced ships. However, issues remain, such as the 2030 timeline and the investment burden required for realization.

Effect of Modal Shift on Emission Reductions

Share ratio in base scenario	FY2030			
	Truck	Costal shipping	Rail	Air
	50.1%	44.9%	4.8%	0.2%

Using the highest value of the past handling volume, the share ratio is 48.2% for coastal shipping and 5.6% for railways.

Study allocation rate

Share ratio of coastal shipping	Share ratio of rail freight				
	4.8%	5.2%	5.6%	6.0%	6.4%
44.9%	−23.9%	−24.4%	−24.9%	−25.4%	−25.9%
46.5%	−25.8%	−26.3%	−26.8%	−27.3%	−27.8%
48.1%	−27.7%	−28.2%	−28.7%	−29.2%	−29.7%
49.7%	−29.6%	−30.1%	−30.6%	−31.1%	−31.6%
51.3%	−31.4%	−31.9%	−32.4%	−32.9%	−33.4%
52.9%	−33.3%	−33.8%	−34.3%	−34.8%	−35.3%

Note: In the sensitivity analysis at the bottom, the white-shaded area is the possible share ratio in consideration of the past handling volume of each mode. As shown in the figure on the right, issues in the blue-shaded area needs to be addressed.

Source: Compiled by Mizuho Bank Industry Research Department based on various public materials

Issues in Realizing Further Modal Shifts

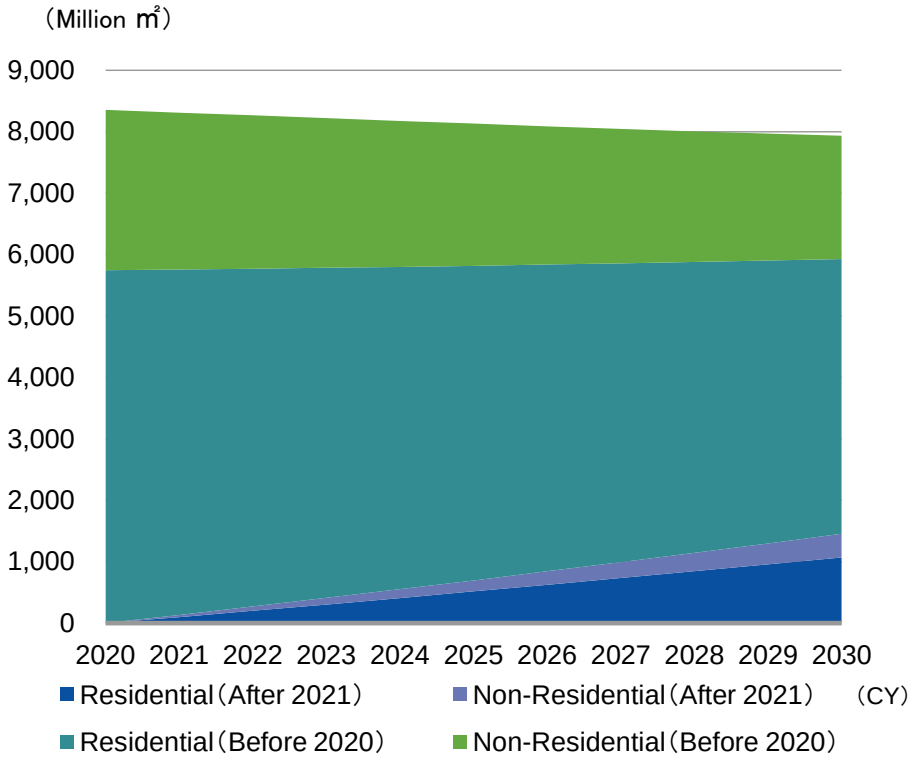
	Measures	Issues facing achievement	
Increase the share ratio of coastal shipping	Expansion/ maintenance of port infrastructure	Investment amount, Timeline	→ Infrastructure development (berth water depth, cargo handling equipment, warehouses, roads, etc.) is required to shorten lead times and build a flexible logistics system for ports and land transportation.
	Conversion from old ships to advanced ships	Investment amount, Timeline	→ Currently, the percentage of old ships is about 70%; it is necessary to invest in advanced ships (LNG ships, automated ships, etc.) that ensure efficiency and safety and reduce the environmental burden.
	Securing of ship crew	Investment amount, Timeline	→ It is necessary to deal with the aging of ship crews and the retention rate of young crew members; there is a need for workstyle reform and creation of attractive workplaces.
Increase the share ratio of rail	Expansion/ maintenance of rail infrastructure	Investment amount, Timeline	→ Rail freight transport is operating at full capacity, and it is necessary to increase the transport capacity → This will be difficult to realize by 2030 due to cost and time.

Source: Compiled by Mizuho Bank Industry Research Department based on various public materials

Business- and household-derived emissions: Base scenario

- Out of the predicted 2030 building stock, an estimated 18% will be new buildings constructed from 2021. If the new constructions' energy usage is assumed to be 50% less, in line with the ZEB Ready level, buildings' overall energy use should decline by 14.3% from the 2019 level.

Estimated building stock and related energy use



Source: Compiled by Mizuho Bank Industry Research Department based on MLIT and IPSS public materials

	2019	2030	Energy Use
Existing Residential	5,773million ㎡	4,472million ㎡	▲130,053
Existing Non-Residential	2,632million ㎡	2,004million ㎡	▲62,829
New Residential	0million ㎡	1,065million ㎡	+53,289
New Non-Residential	0million ㎡	388million ㎡	+19,436
合計	8,405million ㎡	7,931million ㎡	▲120,157
		Reduction Rate	▲14.3%

Note: Estimated based on 1 energy consumption per 10,000 ㎡ as of 2019

Assumptions for estimates

項目	Assumptions
Housing stock	Housing stock taken to be housing demand (based on household numbers) + a certain vacant housing rate. New floor area supply estimated as each year's housing stock – (previous year's stock - disposed stock)
Non-housing stock	Non-housing stock estimated based on working-age population and their assumed per-capita floor space use. New floor area supply taken to be each year's non-housing stock – (previous year's stock - disposed stock)
Energy use	Assumed that all new constructions use 50% less energy

Business- and household-derived emissions: Possible further steps and issues for realization

- Cutting energy use in new constructions alone will only reduce overall energy use to 86%, and even factoring in expected decreased emissions intensity, CO2 emissions are unlikely to fall by 46%. It is therefore essential, in addition to further boosting energy savings at new properties, to take steps to reduce energy use at existing constructions.
- However, there is viewed to be a lack of incentives promoting renewal of existing properties. Therefore, introduction of incentives and related rules are required.

Possible further steps and current hurdles

Items	Further reduction steps	Predicted issues and hurdles
Boosting energy savings at new properties, and increasing ZEB/ZEH buildings	• Increase areas covered by energy-saving conformity obligations and raise related standards • Reduce initial costs through subsidies and other incentives to promote buildings with high energy savings	Rapid introduction of new rules may chill the market for new constructions
Boosting energy savings at existing buildings	• Rules mandating fulfillment of certain level of environmental performance when conducting second-hand property transactions • Reduce initial costs through subsidies and other incentives to promote buildings with high energy savings	Rules introduction may chill second-hand property market
Broadening areas for energy management systems	• Introduce energy management systems spanning different areas to increase efficiency of energy use	Single-area undertakings seen. However, energy management systems with larger coverage spanning different areas will give rise to many stakeholders, possibly making coordination difficult. Necessary to appeal the benefits to parties leading related efforts

Source: Compiled by Mizuho Bank Industry Research Department

Combinations of Possible Additional Reduction Measures If the 2030 Target Is Achieved

- There are various issues involved in boosting the GHG reduction beyond the minus 33% figure in the base scenario. Regarding additional reduction measures to achieve the target of minus 46%, below is an approximation of the effects of policy implementation in sectors with certain established technologies and the required additional investment.
  - It is necessary to consider how to combine and accumulate reductions, while considering the cost-effectiveness and the impact on competitiveness.

Possible Additional Measures by Sector

To achieve a 2030 target of minus 46%, it is necessary to reduce 180 million tons more than in the base scenario.

—Assuming broad introduction of renewable energy (electric power), BEV (transportation), and ZEB/ZEH (business/households), for which there are currently certain established technologies—

Given the large industrial impact and low economic rationality, it is necessary to seek measures to maintain a fair competitive environment while resolving various concerns, based on the premise of implementation of large-scale policy support.
—In particular, consideration for the international competitiveness of the export industry is essential—

	(1) Electric Power	(2) Industry	(3) Transportation		(4) Business/Household
			Passenger	Freight	
Additional reduction policies approaching 2030	Renewable energy ratio of power supply (35%~45%)	Technological innovations in hydrogen, CCUS, etc., is required for further reduction	Stock-based vehicle ZEV ratio (5%~15%)	Modal shift capacity and truck ZEV conversion are limited	Introduce ZEB and ZEH to existing buildings as well (35%~45%)
GHG reduction effects	Minus 100 million tons approx.	–	Minus 20 million tons approx.	–	Minus 20 million tons approx.
Required additional investment to implement additional policies	9~16 trillion yen approx. Capital costs (premised on full solar power)	–	5~10 trillion yen approx. Battery production facilities, Purchase subsidies	–	50 trillion yen approx. Cost of introducing ZEB and ZEH through renovation
Shortfalls	It is necessary to add a reduction of about 10 million tons in each sector due to further progress in energy saving and electrification.				

It is necessary to be aware that the drastic changes in the competitive environment due to the introduction of strong policies may hinder the growth of companies that take appropriate measures.

Source: Compiled by Mizuho Bank Industry Research Department

Important to have framework to evaluate firms that respond appropriately to strengthened policies to meet targets

- Strengthening measures to achieve 2030 targets requires a broad combination of various well-thought-out policies.
  - Cost spikes stemming from over-radical measures may lower Japan's competitiveness and impede economic and corporate growth.
  - The phenomenon of being locked in to use of particular products or technologies also poses risks for the attainment of 2050 targets, so it is important to have a framework to evaluate firms that have an appropriate policy response.

Perspective needed when strengthening policies in response to climate change

Extreme policies may cause cost spikes that impede growth of firms implementing a real policy response

～This may hinder industrial competitiveness and the realization of a decarbonized society～

＜Issues for policy strengthening to realize 2030 targets＞

Impact on international competitiveness	Securing stable supply	Fair cost shouldering	Incentives to promote behavioral change	Consistency with policy purpose
• Extreme policies may lower Japanese industry competitiveness • Need to make equivalent rules globally	• Concerns about energy security due to increased overseas dependence • Reduced flexibility and coordination by focusing on specific options	• Avoid concentrating excessive cost burden on specific sectors and industries • Equal burden shouldering to limit asset stranding	• Framework to ensure environmentally-friendly policies increase competitiveness • Subsidy support to economically rational level	• Consistency with realizing decarbonized society and promoting worldwide measures • Evaluation system incorporating not only overall emissions but related intensity and energy-saving measures

Broad combination of various policies which takes into account regional characteristics essential

Carbon pricing | Promote disclosure of non-financial data | Transition finance | Policies supporting innovation | Various subsidies

Important to compose framework to suitably evaluate firms that rationally respond to the need to meet targets within the 2030 timeframe

Source: Compiled by Mizuho Bank Industry Research Department

3. Corporate Strategies Required for the Carbon Neutral Era

Corporate strategies to translate the achievement of 2050 carbon neutral targets into growth

- Given the game-changing environment brought on by the carbon neutral trend, firms need to show they are taking steps to respond with the prescribed timeframe by clearly illustrating to stakeholders their measures taken and future plans and strategies.
- Firms need to hammer out a long-term transition strategy towards achieving carbon neutrality, and, to translate strategy into growth, actively create new markets and added value.

Management strategy
～Realizing carbon neutrality as well as boosting corporate value～

Transition strategy hammer-out
- Propose LT plan to contribute to carbon neutrality and raise corporate value
- Appeal to stakeholders with clear strategy
- GHG reduction steps based on timeframe and regional characteristics

Quantification of emissions, organizational structure, and target setting
- Setting KPI targets with SBT Initiative Verification
- Conducting refined scenario analysis and SC-wide strengthened emissions control accompanying policy realization

Management resource allocation review
- Segment-based investment strategy formulation
- Increase consistency with financial strategy. Use sustainable finance to procure funds for necessary action

Business strategy
～Apply carbon neutrality realization to strategy～

Existing business reform and new business creation
- Conforming to regulations, meeting investor needs
- Secure profit and prepare for risk of existing asset stranding
- Capture share of domestic and foreign decarbonization-rel. markets

Innovative technology development and application
- R&D investment using also policy support
- Cost reduction stemming from technology standardization and economies of scale
- Acquisitions of or alliances with firms possessing required capabilities

Location and supply chain strategy review
- LCA (Life Cycle Assessment)-based optimization
- Adapt to procurement conditions that consider environmental burden

Business tactics
～Make external tie-ups create growth～

Tie-ups with firms in different fields
- Tie-ups with firms in different fields to create new markets and build supply chains

Appeal environmental value
- Build system to appeal environmental value (enabling its visualization and adding environmental costs to sales prices)

Strengthen links with government policies
- Obtain support via catering to pivotal policy areas（appeal significance of domestic production and Asian exports）

Source: Compiled by Mizuho Bank Industry Research Department

Transition Story: Achieving decarbonization and improving corporate value

■ Transition story needs to have a series of consistent and simple measures (long-term strategy) for realizing CN.

Elements Required for Transition Stories

Responses required of companies

It's important to be able to convince the people of "transition story"- how to achieve growth while contributing to the realization of a decarbonized society

Prerequisite and necessary perspective

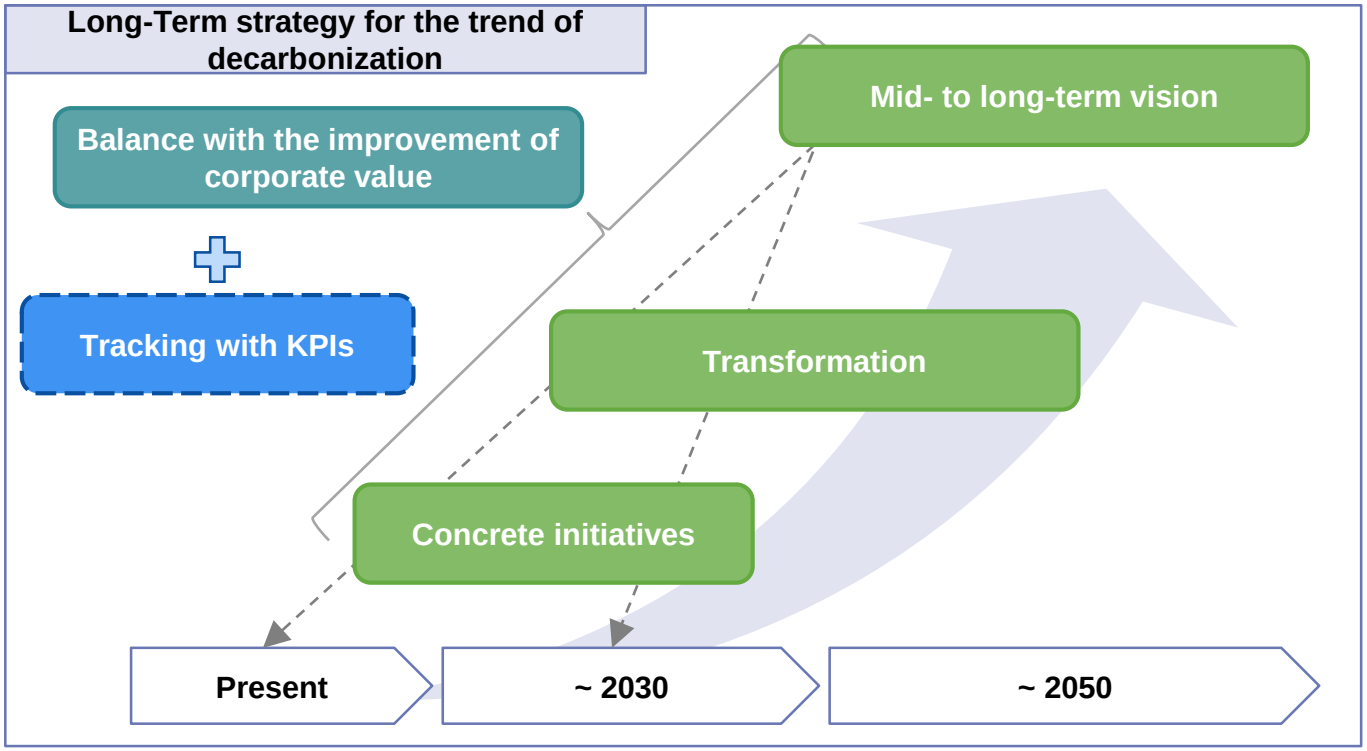
Decarbonization

How can you contribute to the realization of decarbonized society?

Corporate value improvement

How will you achieve corporate growth?

Components of a "transition story" to promote a long-term strategy



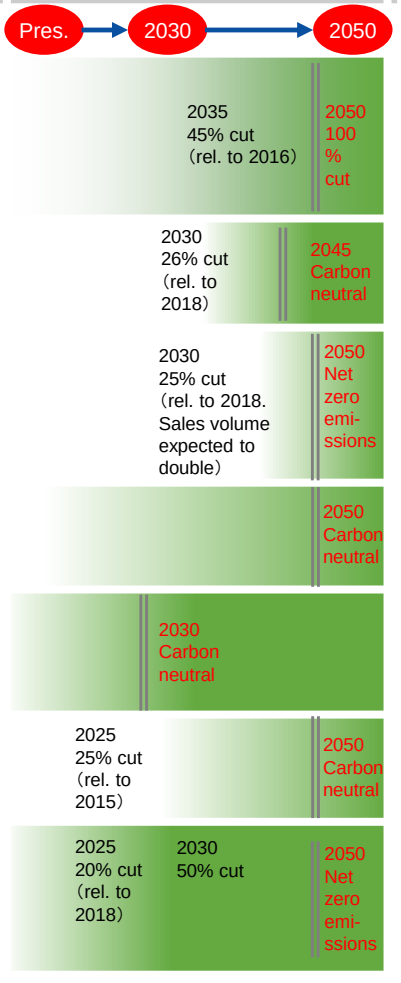
Source: Compiled by Mizuho Bank Industry Research Department

Using leading European and US firms as a benchmark

- Seven firms selected from perspective of resources, intermediate products and final products.
  - Final product firms chosen for their aim to realize carbon neutrality early in their overall product supply chains and life cycles.
  - Intermediate product firms selected for providing products and services, that are aimed at realizing clients' carbon neutrality, with clear environmental value.

Benchmark firms' carbon neutral realization efforts and related timelines

		Details of measures	Reduction targets
Resources	Shell (Oil/Gas)	➢ Renewables sales expansion, EV charging station expansion, low carbon fuel production, CCS implementation ➢ Recompose business segments (in relation to upstream development, transition, growth), and formulate strategies based on risk-return characteristics and the expected timeframe for establishment of net zero energy businesses	Scope 1,2,3
Intermediate products	SSAB (Steel)	➢ Aim to tie up with companies in different fields like mining and energy firms and automakers, and supply the world's first green steel. A pilot plant is up and running, and in June 2021 hydrogen reduction steelmaking was successfully carried out	Scope 1,2
	BASF (Chemicals)	➢ Carbon neutral strategy (renewables investment, shift from steam production to electrified processes, use of bio-based materials) ➢ CE strategy (mechanical recycling, battery recycling etc.) ➢ Support customers' carbon neutral and CE strategy implementation through generation and visualization of environmental value	Scope 1,2
	DHL (Logistics)	➢ Provides environmentally-friendly logistics solutions, and supports environmental value visualization and CO2 reduction for customers. Aims to invest EUR 7bil. up to 2030 (on EV truck fleet expansion and raising the proportion of alternate aircraft fuels)	Scope 1,2,3
Final products	Apple (Electronics)	➢ Targets carbon neutrality realization throughout supply chains and life cycles ➢ Material procurement and development (recycled material, in-house IC chip development, process and transport method review), renewables expansion (generation facility ownership, external financing, long-term procurement), CO2 removal	Scope 1,2,3
	VW (Automotive)	➢ Aims for lifecycle-based (production, use, recycling) carbon neutrality in overall value chain. Electric vehicle shift (plan to invest EUR 35bil. over 5 years from 2021. Aim for 50% electric vehicles sales weighting in 2030) and renewables use are key	Scope 1,2,3
	Nestlé (Food)	➢ Commitment to achieving carbon neutrality relating to feedstock and agriculture and livestock materials, and plan to invest a few hundred billion yen ➢ Business portfolio changes (switch to low-carbon materials and use of plant-derived food) and carbon neutral-related branding to order to raise value of offerings and stimulate consumer purchases and selection	Scope 1,2,3



Source: Compiled by Mizuho Bank Industry Research Department

【Ref.】Position of benchmark firms and their related strategies

		Resources	Intermediate products			Final products		
Benchmark firm		Shell (UK, Neth.)	SSAB (Sweden)	BASF (Germany)	DHL (Germany)	Apple (US)	VW (Germany)	Nestlé (Neth.)
Industry		Oil	Steel	Chemicals	Distribution	Electronics (Smartphone)	Automotive	Food
CO2 emissions relative to sales ※Up to Scope3		210,000 tons /JPY bil	190,000 tons /JPY bil	190,000 tons /JPY bil	40,000 tons /JPY bil	10,000 tons /JPY bil	150,000 tons /JPY bil	110,000 tons /JPY bil
Emission volume	Scope1	9%	59%	13%	n.a.	0.2%	1%	3%
	Scope2	1%	7%	3%	n.a.	3%	1%	2%
	Scope3	90%	34%	84%	n.a.	97%	98%	95%
Management strategy	Transition story hammer-out	✓	✓	✓	✓	✓	✓	✓
	Emissions quantif., org. target setting	✓	✓	✓	✓	✓	✓	✓
	Management resource allocation review	✓		✓			✓	✓
Business strategy	Existing business reform and new business creation	✓	✓	✓	✓	✓	✓	✓
	Innovative technology development and application	✓	✓	✓	✓	✓	✓	✓
	Location and supply chain strategy review		✓	✓	✓	✓	✓	✓
Business tactics	Tie-ups with firms in different fields	✓	✓	✓		✓	✓	✓
	Appeal environmental value	✓	✓	✓	✓	✓	✓	
	Strengthen links with government policies		✓	✓			✓	

Source: Compiled by Mizuho Bank Industry Research Department based on companies' IR materials

Characteristics of European and US players

① Presenting course to CN realization as a growth story, and incorporating concrete measures into business strategy

Shell（Oil/Gas; UK, Holland）	➢ Businesses classified into 3 groups. While generating earnings from the upstream business for the time being, it will shift activities in stages to transition and growth businesses ➢ It has laid out numerical targets for carbon emissions intensity reduction along a set timeline and business activities through 2030
Nestlé（Food; Switz）	➢ Switching to low-carbon materials, changes to the business portfolio to include products like plant-derived food and progress in CN brand creation ➢ Enabling environmental value visualization may raise brand value and lead to consumers purchasing and selecting the firm's products

② Leading in efforts to construct business models aimed at winning the new CN game

BASF（Chemicals, Germany）	➢ Supporting customers' CN / CE strategy execution through technologies and strategies that enable the creation and visualization of environmental value that can avoid product price competition, centered on Verbund (integrated production base)
Apple（Electronics; US）	➢ To make overall supply chain carbon neutral, study and promote wide-ranging solutions including technological development from a long-term perspective ➢ While requesting suppliers to procure renewable energy, Apple also carries out various types of support and publicizes the response status to promote environmental value.
VW（Automotive; Germany）	➢ Targeting LCA-based emissions reduction, the firm is taking action to lower overall supply chain and value chain emissions ➢ The firm plans to cut emissions through use of renewables, with an emphasis on emissions released during 1) vehicle use, 2) the production of complete vehicles and 3) the production of battery cells
DHL（Logistics; Germany）	➢ Firm enables visualization of customers' environmental impact, then provides environmentally-friendly logistics solutions and offset solutions to support CO2 reduction

③ Making full use of government support measures, and on the path to CN realization

SSAB（Steel; Sweden）	➢ Firm established a hydrogen reduction steel JV with state-run mining company LKAB and energy firm Vattenfall, and in August 2020 the world's first hydrogen reduction steel pilot plant began operation. In June 2021, the plant successfully produced hydrogen-reduction steel.
BASF（Chemicals, Germany）	➢ Plan to utilize subsidies to develop next-generation technology in the areas of switching to renewables, converting heat sources to electricity and green hydrogen manufacturing and utilization

Source: Compiled by Mizuho Bank Industry Research Department

4. Conclusion

A Corporate Strategy to Survive Is Required in the Transition to a Carbon-Free Society

- Assuming carbon neutrality in 2050 and the intermediate goal of 2030, Japanese companies need to seriously consider strategies for how to achieve a transition to a carbon-free society and how to survive that transition.

Global trend toward carbon neutrality	■ The trend toward CN will **create a game-changing situation for all companies** through fostering "consensus," in addition to bringing changes in policy, finance, and companies (business partners). ⇒ **GHG emission status is becoming an important factor in management decisions.**
Impact of 2050 and 2030 targets on Japan	■ The achievement of the 2050 CN target will have a significant impact on industries, and **changes in the industrial structure and business models are expected.** ■ The amount of GHG reduction as of 2030 is **only minus 33% in the base scenario**, and there are concerns about adverse effects, such as a decline in competitiveness, when additional measures to achieve minus 46% are implemented. ⇒ **It is necessary to have a framework to evaluate companies that take appropriate measures based on the time axis.**
Corporate strategies required for the carbon-neutral era	■ In order for companies to show that they are taking appropriate measures based on the time axis for CN, **it is necessary for them to explain the status of their measures and their future policies and strategies in an easy-to-understand manner.** ⇒ **It is important to create a transition story that shows what the company is aiming to be and its process to get there.** ■ It is necessary to integrate the achievement of CN into the corporate strategy and to proceed consistently from management strategy to business strategy and tactics. ■ **Efforts are required to connect story-building and strategy-integration to growth,** taking into account the examples of companies farther ahead in dealing with CN.

Source: Compiled by Mizuho Bank Industry Research Department

Reference: Strategy for Achieving Carbon Neutrality in Each Industry (1/2)

Industry		Strategy for Achievement of Carbon Neutrality
1	Electric power	• Rebuild the existing power generation structure centered on thermal energy to one centered on renewable energy (secure investment resources), utilize nuclear power generation, and decarbonize thermal power generation. • Cooperation with businesses inside and outside the industry is an important strategy for producing and supplying hydrogen using surplus renewable energy, as well as for developing power sources. • In the thermal power field, it is important to establish technology and reduce costs for decarbonization using ammonia/hydrogen, etc. • Cooperation within the electric power industry is also an option for procuring inexpensive fuel derived from renewable energy overseas and for repairing and replacing existing equipment.
2	Oil/Gas	• The oil industry has options, including expansion into the electric power business or diversifying by engaging in non-energy businesses in the short to medium term. • In the long term, it is necessary to decarbonize fuel by supplying hydrogen, biofuels, and synthetic fuels. • In the short to medium term, the utility gas industry has options including responding to fuel conversion needs to the maximum extent, diversifying its business by expanding life services, or becoming low-carbon by supplying carbon-neutral utility gas. • In the long term, it is necessary to utilize methanation and to decarbonize fuel by supplying hydrogen.
3	Steel	• Approaching 2050, the favored technologies are hydrogen reduction ironmaking processes that do not use blast furnace processes and high-grade steel production using large electric furnaces. However, for the time being, companies will promote low carbonization by developing innovative technologies that utilize hydrogen while using existing blast furnace equipment and operational know-how. • Contribute to the decarbonization of the entire supply chain by responding to the green steel procurement needs of demand industries such as automobiles. • Expand engineering business overseas by developing low-carbon steelmaking technology as soon as possible.
4	Chemicals	• The chemical industry can work to reduce its own GHG emissions, and it can achieve growth by developing technologies and products that contribute to the decarbonization of other companies. • Approaching 2030, companies can promote the development and demonstration of new technologies such as raw fuel conversion, recycling, and CCUS, and make maximum efforts to reduce GHG. Furthermore, in order to achieve CN in 2050 and to maximize the efficiency of the material provision system, it is important for companies to arrange for full-scale societal implementation of innovative technologies such as artificial photosynthesis and to build an ultra-efficient recycling chain through collaboration with local chemical complexes. • In addition, companies can realize growth and provide customers with a variety of materials and technologies that contribute to decarbonization, such as those for reducing the weight of transportation equipment, increasing the capacity of storage batteries, and reducing food loss.
5	Electronics	• Finished product manufacturers: Reduce CO2 emissions of the entire supply chain, including intermediate goods, transportation, and manufacturing processes, and transform business models (extension of the lifecycle of existing hardware equipment and transformation in non-hardware areas). • Semiconductor manufacturers: The horizontal division of labor may reach a turning point. Centralize the location of semiconductor-related plants and promote industrial agglomeration to reduce CO2 emissions associated with movement and incidental work. Coupled with the trend toward differentiation in packages, this can develop into partial vertical integration. It also requires a discontinuous effort to radically change the manufacturing process.
6	Automotive	• It is essential for Japanese OEMs to focus on BEVs looking ahead to 2035 and beyond. In addition to developing business strategies that improve the profitability of BEVs, it is necessary, in terms of environmental measures, to work on reducing emissions from an LCA perspective. For this purpose, it is important to complement the BEV strategy by working on improving the efficiency of ICE vehicles, whose market will be shrinking, while generating cash from HEV, where a certain amount of market growth is expected and in which Japanese OEMs have technological

Source: Compiled by Mizuho Bank Industry Research Department

Reference: Strategy for Achieving Carbon Neutrality in Each Industry (2/2)

Industry		Strategy for Achievement of Carbon Neutrality
7	Transportation (travel)	• Business operators engaged in passenger transportation have been working on MaaS for a long time, and their strategic direction remains unchanged. • However, in order to switch to a more energy-efficient transportation mode, it is necessary to overcome the hurdles involved in changing people's behavior. Thus, it is necessary to study transportation policies including MaaS at the policy level (the case of Helsinki is used as a reference) as part of efforts toward carbon neutrality, in addition to businesses' promotion of MaaS and improvement of convenience. • Aviation, where it is considered difficult to achieve zero emissions as a single transportation mode, requires (1) supply of alternative fuels such as biofuels and (2) involvement in businesses that contribute to credit creation.
8	Transportation (freight)	• The fact that logistics companies need to lower carbon consumption through operators' improved productivity remains unchanged from the past. • While the logistics business itself is becoming more commoditized over the long term, there was always a possibility that the winning or losing would depend on how far the logistics company could get involved in the logistics "strategy" of the shipper company, not just the contract of "business." Currently, getting involved in logistics strategies, including CO2 reduction, is becoming even more important.
9	Real Estate	• The fact that the real estate industry needs to lower carbon consumption through energy saving, etc., remains unchanged from the past. Moreover, it is necessary to continue investing in renewable energy while boosting energy saving performance to the maximum and balancing investment amounts with profitability. • The composition of real estate owners and users is broad and varies from individuals to large companies. The issue is how to spread initiatives in the real estate industry to the surrounding areas, so designing incentives and regulations may be a key point.
10	Retail	• It is essential to prepare for decarbonization while overcoming industry issues such as oversupply of stores and low productivity. • For the time being, in addition to promoting energy conservation and introducing green electric power, the industry needs to remodel stores to be highly energy-efficient. In the long run, the challenge is how to cover the cost of Scope 3 credit purchases throughout the supply chain. • In the medium to long term, it is possible that the efforts of stores and major retailers will be expanded, and furthermore, that decarbonization will be taken as an opportunity to explore the best form of the retail industry.
11	Food/Agriculture	• For the food industry, the response to carbon neutrality is only one of many food-related ways of providing social value. Other aspects are that its impact is limited compared to other industries, and the response to carbon neutrality depends on the progress of the government's efforts in agriculture, forestry and fisheries. • However, as consumer needs are diversifying, environmental measures and review of business portfolios may offer business opportunities. It is necessary to take measures for decarbonization with an understanding of the opportunities and threats.

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