Considering Japanese Industry in 2050

Structural transformation and industrial fusion to realize the ideal form

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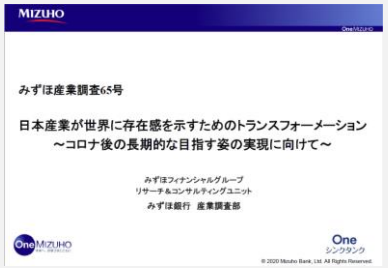
Link to survey

Summary: Problem Awareness and Structure of This Report

- When looking at the worldview surrounding Japanese industry and companies in 2050, the international situation continues to be unstable due to the competing economic scales of the US and China, and it is expected that the competition around trade, investment, technologies, resources, data, and rules will intensify even further. Currently, in addition to being a technological nation with strengths in manufacturing technology, Japan is also a net creditor country with a large amount of foreign assets, a country with major foreign investments, maintains a current account surplus, and has a strong presence in the world. However, if these strengths cannot be maintained in the future, then issues will emerge such as a sluggish potential growth rate, a declining population, a declining birthrate and aging population, becoming a resource-poor country, and low productivity, and Japan's presence in the world will decline.
- Based on this awareness of the problems, this report captures changing trends over the long-term time axis until 2050 and considers the initiatives that will be required of Japanese industry and companies. The structure of this report is briefly introduced below.
- Chapter I describes how changing trends such as population decline/aging population, realizing sustainability, ensuring economic security, and technological evolution will bring about changes in society, consumers, and industrial structure towards 2050.
- Chapter II considers a “future that is an extension of the current situation" in response to changing trends. Japan will fall into a labor shortage, a trade deficit will become normal, the domestic industrial base will contract, and will face a difficulty in maintaining infrastructure and social security systems. The burden of investment and costs for decarbonization will increase, profits and income will be sluggish, and industries, companies, and individuals will curb investment and consumption while being anxious about the future.
- Chapter III presents the "ideal form" for Japanese industry and companies. Amidst the competition in the world that was mentioned in the beginning, the areas that Japan should strengthen are the international competitiveness and productivity of its industries, and to connect its R&D, and the results of its R&D, to businesses. Strategic infrastructure investment for the next generation is necessary, and education and human resources development are important. These strengths will become national power, giving rise to products and services that are competitive in the world, creating markets, spreading to the world and earning foreign currency, and showing a presence in the world. Specifically, based on Japan's strengths and social needs, a form with the following is conceivable: (1) "Realizing the stable procurement and supply of energy and resources, and the decarbonization of society as a whole," (2) "Capturing domestic and overseas demand by providing value for decarbonization products while utilizing technological capabilities," and (3) "Utilizing technology to continue increasing productivity and providing services that are close to daily life."
- Chapter IV confirms the "required efforts" for industries and companies and the ideal shape of industrial policy and industrial finance. Companies will be required to smoothly proceed with creating growth areas and exiting legacy areas through initiatives that transcend industrial boundaries. Industrial policy and industrial finance will be required to work together with companies to contribute to the realization of Japan's independent growth.
- The above is the awareness of the problems and the structure of this presentation. For more details, in addition to this report, individual editions detailing each industry are also published, so we would appreciate it if you would look at the themes you are interested in and then provide us with your honest opinions and criticisms, etc.

Positioning of This Report

Publication Order

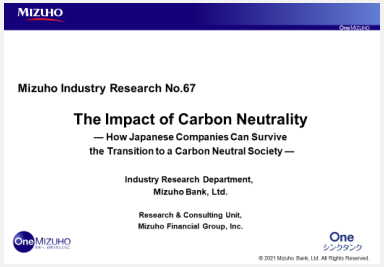


October 2020 <Mizuho Industry Research No.65> *Japanese only

Transformative steps needed for Japanese industry to show a strong global presence

- Strategies to realize long-term aims in post-coronavirus crisis era -

Considers the transformations required of Japanese industry and companies on the time axis of 2030 to 2040.

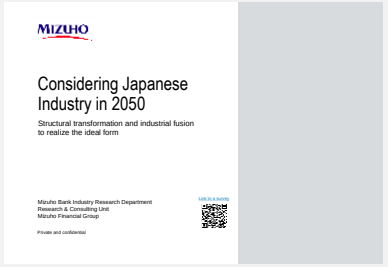


July 2021 <Mizuho Industry Research No.67>

The Impact of Carbon Neutrality

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

Considers changes in industrial structure that accompany the realization of a carbon-free society in 2050 and the direction of Japanese companies' business strategies.



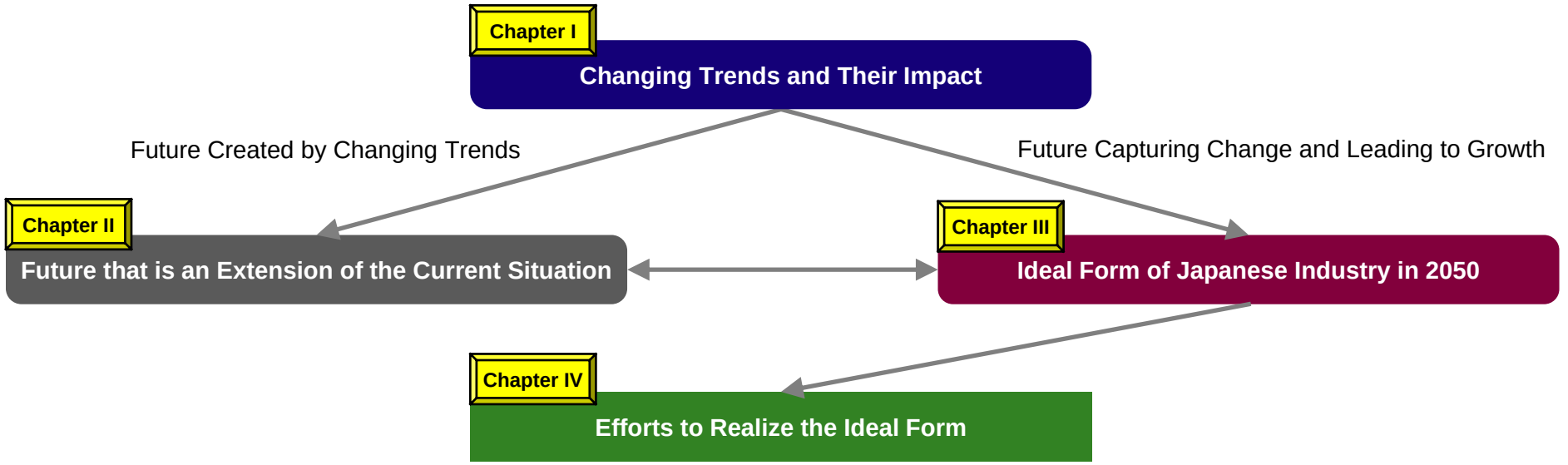
April 2022 <Mizuho Industry Research No.70> [This Report]

Considering Japanese Industry in 2050

- Structural Transformation and Industrial Fusion to Realize the Ideal Form -

Considering the ideal form for Japanese industry and companies in 2050, taking into account not only decarbonization based on trends such as decarbonization as well as economic security and population decline.

Table of Contents



Abbreviations

- ✓ AD: Autonomous Driving
- ✓ ADAS: Advanced Driver-Assistance Systems
- ✓ BaaS: Battery as a Service
- ✓ BECCS: Bio-energy with Carbon Capture and Storage
- ✓ BEV: Battery Electric Vehicle; also abbreviated EV
- ✓ CCS: Carbon dioxide Capture and storage
- ✓ CCUS: Carbon dioxide Capture, Utilization and storage
- ✓ CE: Circular Economy
- ✓ CN: Carbon Neutrality
- ✓ COP: Conference of the Parties
- ✓ CP: Carbon Pricing
- ✓ CVC: Corporate Venture Capital
- ✓ DACCS: Direct Air Carbon dioxide Capture and Storage
- ✓ DRI: Direct Reduced Iron
- ✓ D2C: Direct to Consumer
- ✓ EEA: Electric/Electronic Architecture
- ✓ ETS: Emission Trading Scheme
- ✓ FC: Fuel Cell
- ✓ FCV: Fuel Cell Vehicle; also abbreviated FCEV
- ✓ FIT: Feed in Tariff
- ✓ GHG: Greenhouse Gas
- ✓ GX: Green Transformation
- ✓ HEV: Hybrid Electric Vehicle; also abbreviated HV
- ✓ ICEV: Internal Combustion Engine Vehicle
- ✓ ICT: Information and Communication Technology
- ✓ IEA: International Energy Agency
- ✓ IoT: Internet of Things
- ✓ 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
- ✓ LCOE: Levelized Cost Of Electricity
- ✓ MaaS: Mobility as a Service
- ✓ 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
- ✓ OTA: Over the Air
- ✓ PHEV: Plug-in-Hybrid Electric Vehicle; also abbreviated PHV
- ✓ PF: Platform
- ✓ P2P: Peer to Peer
- ✓ QOL: Quality of Life
- ✓ SAF: Sustainable Aviation Fuel
- ✓ SC: Supply Chain
- ✓ Scope1: Direct emissions of greenhouse gases by the business
- ✓ Scope2: Indirect emissions due to use of electricity, heat, and vapor supplied by other companies
- ✓ Scope3: Indirect emissions other than those in Scope1 and Scope2 (emissions from other companies related to businesses activities)
- ✓ SDV: Software Defined Vehicle
- ✓ UAM: Urban Air Mobility
- ✓ VC: Venture Capital
- ✓ VPP: Virtual Power Plant
- ✓ 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
- ✓ ZEH: Net Zero Energy House; a house that can reduce annual primary energy consumption to zero or a negative amount

Source: Compiled by Mizuho Bank Industry Research Department

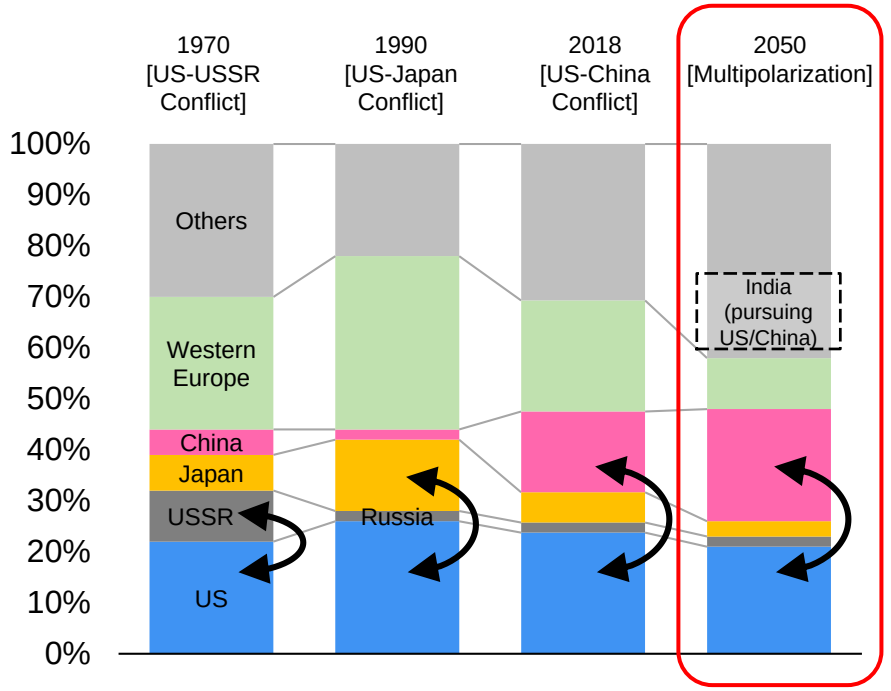
I. Changing Trends and Their Impact

- Japan's Current Industrial Structure
- Population Decline/Aging Population, Realizing Sustainability, Ensuring Economic Security, and Technological Evolution
- Changes in Society, Consumers, and Industrial Structure Toward 2050

While the US and China Compete, the Global Situation is Becoming Complicated/Destabilizing due to the Absence of a Hegemonic Power

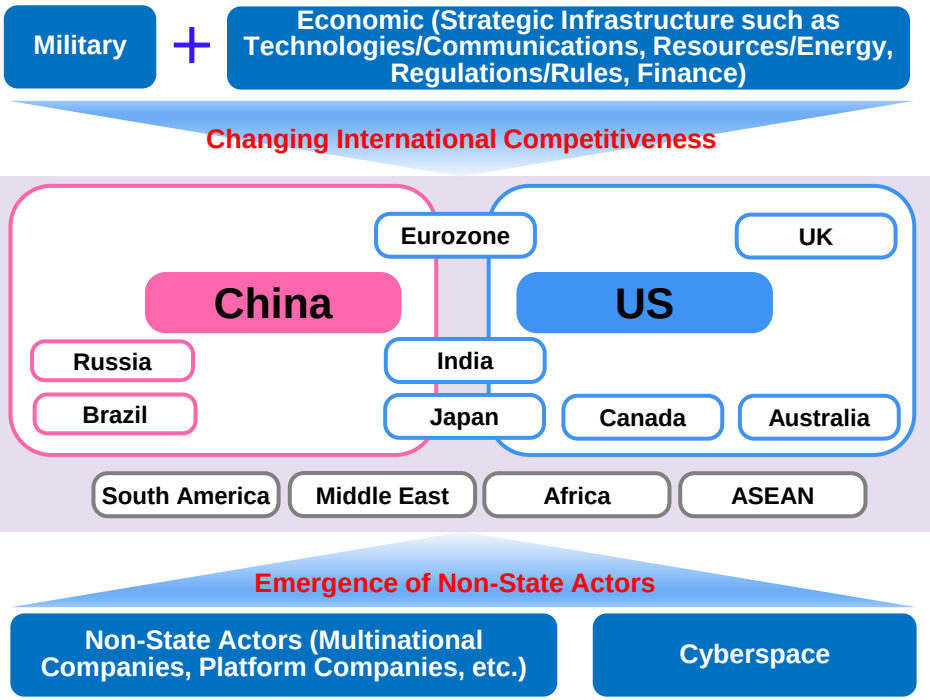
- China will briefly overtake the US on an economic scale around 2030, but it is expected to reverse again after that. This is a situation in which there is no hegemonic power.
- The two major powers, the US and China, are economically dependent on each other. In values and technologies, they are confronting each other and bloc economies are forming to an extent.
  - While the economically dependent relationship remains unchanged, conflicts will intensify in the form of pursuing or using economic superiority such as technologies, strategic infrastructure (communications and semiconductors, etc.), resources/energy, and finance, and this conflict will also impact industries and companies. With the emergence of companies which have powers comparable to nations, such as platform enterprises, and the emergence of cross-border cyberspace, how governments should be will become an issue.

Image of GDP Share and Economic Conflict for Major Countries/Regions



Note: 2050 is based on real GDP. Others are based on nominal GDP
Source: Compiled by Mizuho Bank Industry Research Department based on the IMF

World Power Diagram for 2050 and Long-Term/Structural Issues

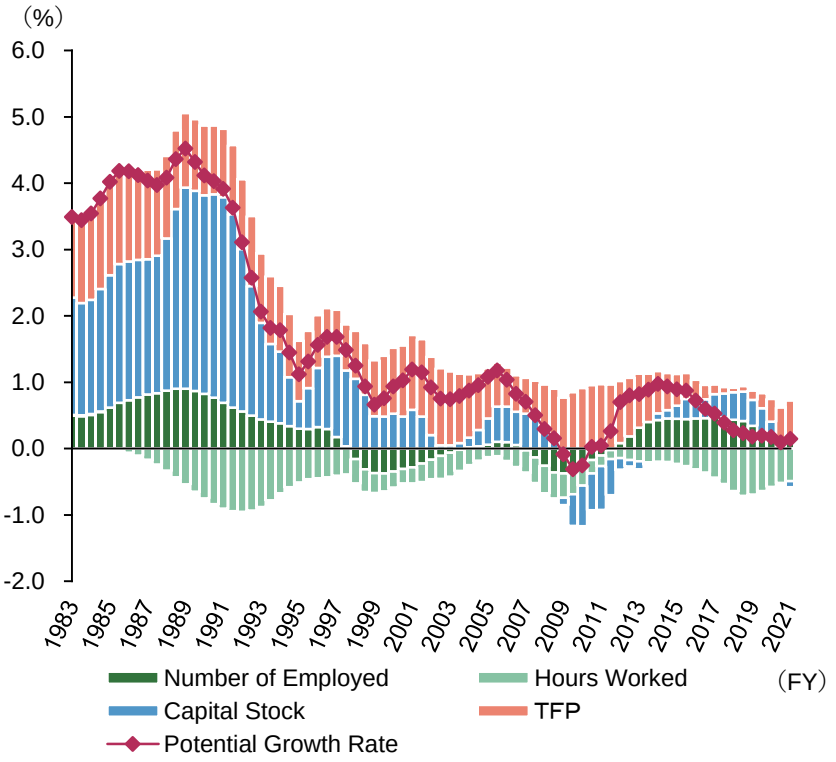


Source: Compiled by Mizuho Bank Industry Research Department

The Japanese Economy has Continued to Grow at a Low Rate since the1990s, and Its Presence in Terms of Scale has Declined

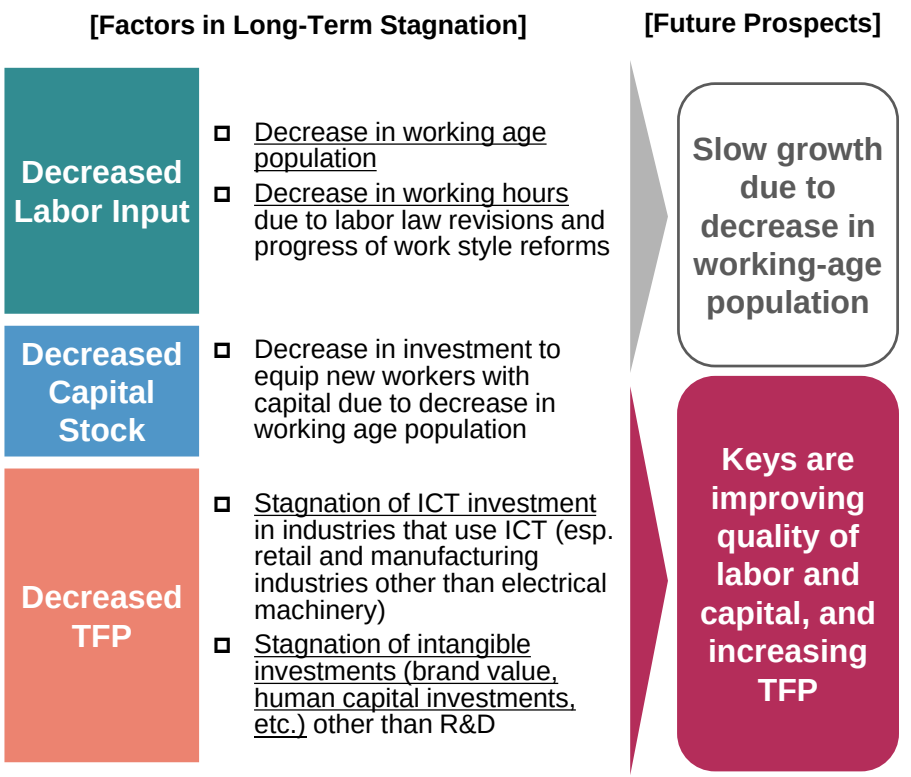
- Since the 1990s, Japan has continued to grow at a low rate due to the combination of a decline in labor input due to the declining birthrate and aging population, and decline in capital accumulation and productivity (TFP).
  - The potential growth rate, which was 4.5% in the late 1980s, sharply dropped in the early 1990s and now drops to 0.5%.
- From a supply perspective rising labor, capital quality, and productivity are key to improving growth potential, as labor input is not expected to increase significantly in the future.

Long-Term Trends in Japan's Potential Growth Rate



Note: TFP is Total Factor Productivity
Source: Compiled by Mizuho Bank Industry Research Department based on the Bank of Japan's "Output Gap and Potential Growth Rate"

Factors in Long-Term Stagnation of the Japanese Economy, and Future Prospects

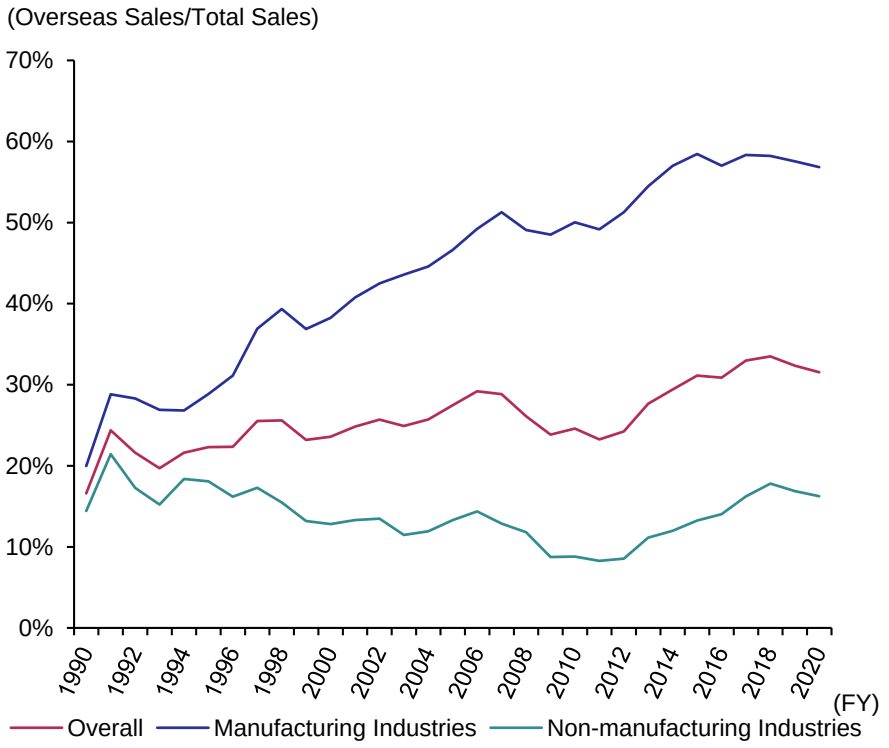


Source: Compiled by Mizuho Bank Industry Research Department based on various materials

Japanese Companies have Expanded their Overseas Sales, Mainly in the Manufacturing Industry

- Over the past 30 years, the ratio of overseas sales has risen, especially in the manufacturing industry, while there has only been a modest rise for non-manufacturing industries.
  - In the manufacturing industry, increases in the overseas sales ratios of materials/chemicals, automobiles, and electrical/precision divisions has been the driving force, but in recent years it has been leveling off.
  - In non-manufacturing industries, while the increases in overseas sales ratio from trading companies/wholesalers and telecommunications divisions has contributed, retail sales are still low.

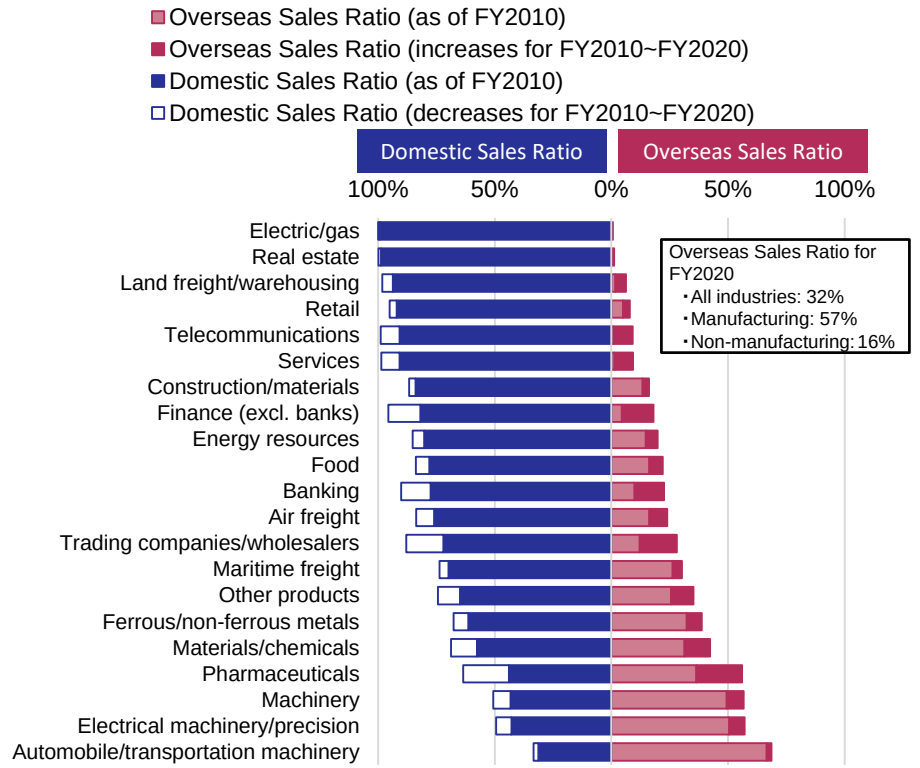
Changes in Overseas Sales Ratios of Listed Companies in Japan (FY1990-FY2020)



Note: Totals companies listed on TSE First Section, Second Section, Mothers, and JASDAQ(Standard Growth)

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

Domestic and Overseas Sales Ratios of Listed Companies in Japan



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

Japan's Economy is Mature, the Third Largest in the World. Population Exceeds 100 Million

- Japan's population has begun to decline, and its economy is growing at a low rate (1), but its population exceeds 100 million (2) and its economy is the world's third-largest in terms of GDP (3). It is a country at a mature development stage that continues to have a current account surplus (4), but a small trade surplus (5) and an income balance that occupies a large portion (6).

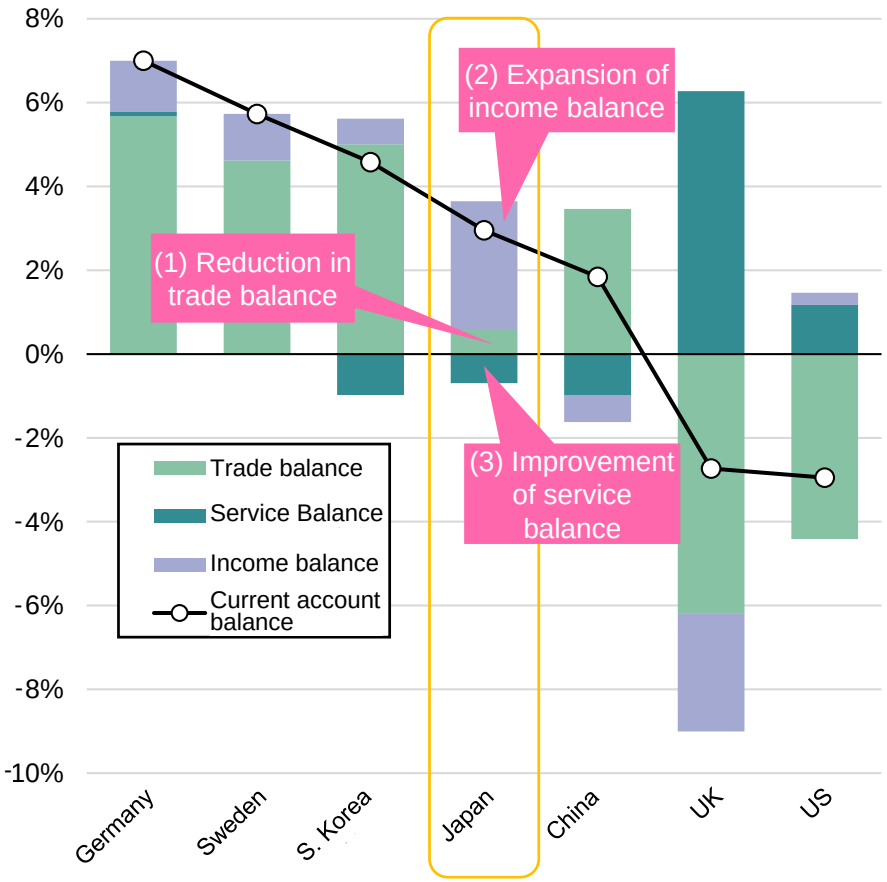
2020 Results		US	China	Japan	Germany	UK	S. Korea	Sweden
Population	Million People (Japan=100) <Past 10 years>	330 (261) <+0.6%>	1,414 (2) (1,120) <+0.5%>	126 (100) <-0.1%>	83 (66) <+0.4%>	67 (53) <+0.7%>	52 (41) <+0.4%>	10 (8) <+1.0%>
Nominal GDP	$1.0 billion (Japan=100) <Past 10 years>	1st 20,894 (414) <+3.3%>	2nd 14,867 (3) (295) <+9.4%>	3rd 5,045 (100) <-1.3%>	4th 3,843 (76) <+1.2%>	5th 2,710 (54) <+0.9%>	1,638 (32) <+3.7%>	541 (11) <+0.9%>
Current Account Balance	$1.0 billion	-616	274 (1)	149	269	-74	75	31
Trade Balance	$1.0 billion	-922	515 (4)	29	218	-168	82	25
Exports	Main Products	1. Automobiles/ parts 2. Industrial raw materials 3. Aircraft 4. Medical equipment	1. Machinery 2. Light industrial products 3. Chemical industry products	1. Automobiles/parts 2. Electronic components such as semiconductors 3. General machinery such as semiconductor manufacturing equipment 4. Steel	1. Machinery 2. Automobiles 3. Electrical machinery 4. Optical machinery 5. Pharmaceuticals 6. Plastics	1. Automobiles 2. Pharmaceuticals, etc. 3. Motors 4. Crude oil 5. Aircraft	1. Electrical machinery 2. Machinery 3. Automobiles 4. Plastics 5. Mineral fuels	1. Machinery 2. Transportation equipment 3. Electrical equipment 4. Mineral fuels 5. Paper/pulp
Imports	Main Products	1. Automobiles/ parts 2. Communication equipment 3. Medical equipment	1. Machinery 2. Non-food ingredients 3. Mineral fuel products	1. Mineral fuels 2. Food and animals 3. Raw materials	1. Machinery/ transportation equipment 2. Mineral fuels 3. Chemical products	1. Automobiles 2. Medical supplies/medicines 3. Refined oils 4. Motors 5. Clothing, etc.	1. Crude oil 2. Integrated circuits 3. Oil/gas 4. Telephone equipment/parts	1. Machinery 2. Transportation equipment 3. Mineral fuels 4. Plastics
Service Balance	$1.0 billion	245	-145	-35	4	170	-16	-0
Income Balance	$1.0 billion	61	-96 (6)	155	47	-76	10	6
Financial Balance	$1.0 billion	-662	78	118	268	-81	60	23
Capital, etc. Transfer Balance	$1.0 billion	-5	-0	-2	-6	-3	-0	0
Foreign Currency Reserves	$1.0 billion	9	28	9	-0	-4	17	0

Source: Compiled by Mizuho Bank Industry Research Department based on IMF and World Bank

Japan Secures Its Current Account Surplus by Expanding Income Balance and Improving Service Balance

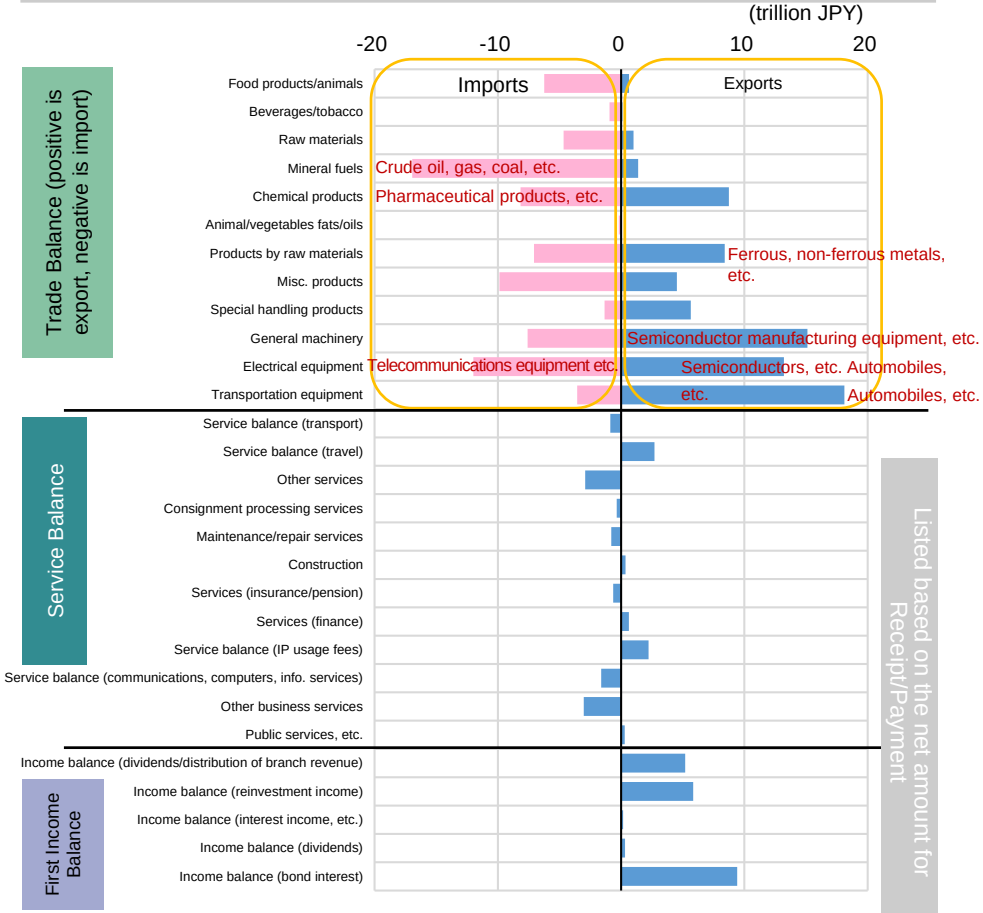
- Japan has a high income balance ratio amongst countries with a current account surplus and is a net creditor country, and overseas investment is progressing.
- The trade balance has remained near zero. The balance of automobiles, semiconductors, and manufacturing equipment for semiconductors/automobiles, etc. is positive, while resources and food negative.

Current Account Balance to GDP Ratio (2020 Results)



Source: Compiled by Mizuho Bank Industry Research Department based on the IMF

Breakdown of Japan's Current Account Balance (2020 Results)

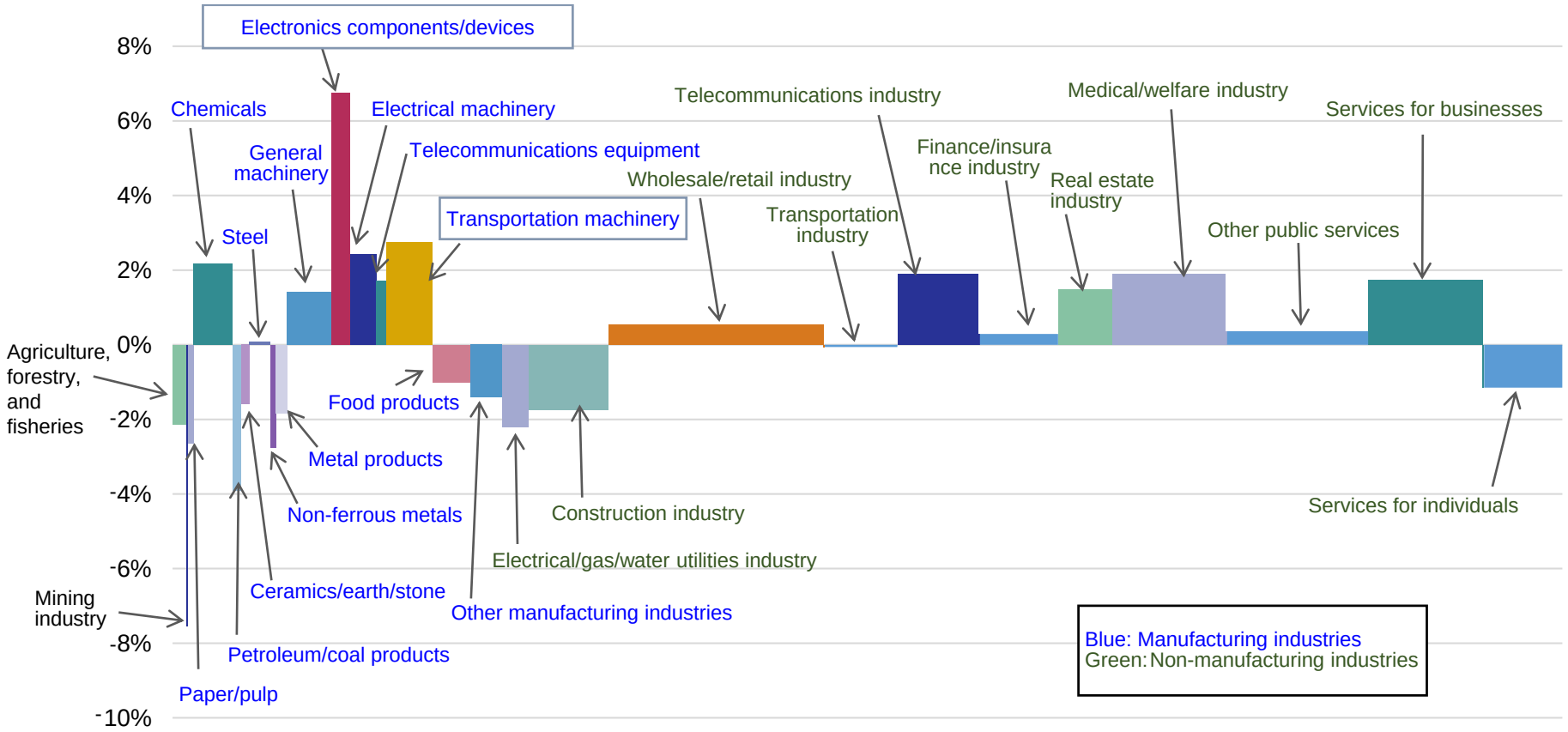


Source: Compiled by Mizuho Bank Industry Research Department based on "Trade Statistics" and "Balance of Payments" by the Ministry of Finance

High Value-Added Growth Rate in the 2000s was for Electronics Components/Devices and Transportation Machinery

- Looking at Japan's GDP by industry, the highest growth rates in the 2000s were in the manufacturing industry for electronics components/devices, transportation machinery, electrical machinery, and chemicals. In the non-manufacturing industry, the highest growth rates were in the telecommunications industry, the medical and welfare industry, and in the services for businesses industry.

Changes in GDP by Industry (2000→2018)

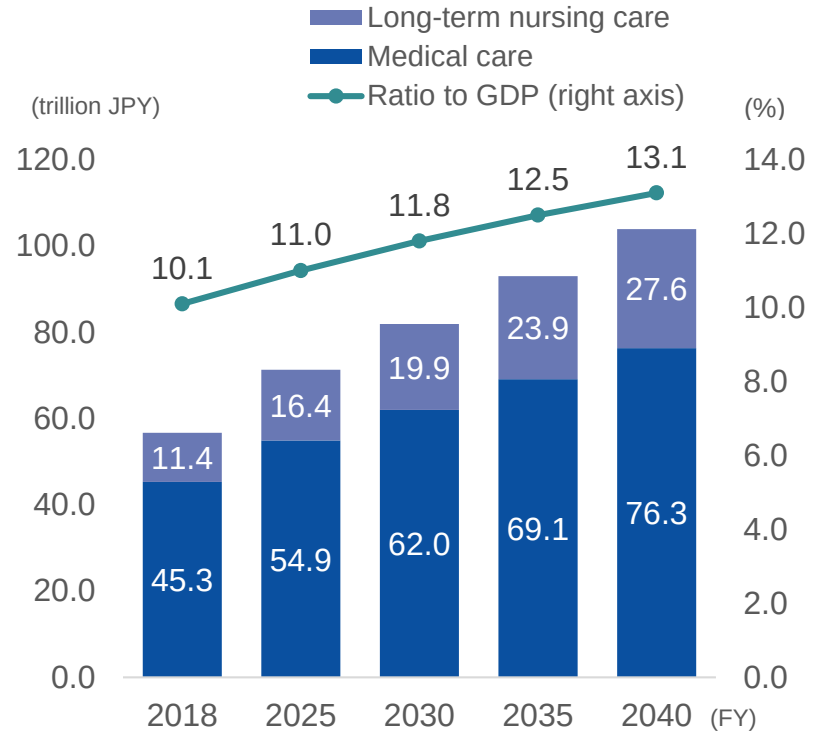


Note: The vertical axis is the average growth rate from 2000 to 2018. The horizontal axis is each industry's share of overall GDP (2018).
Source: Compiled by Mizuho Bank Industry Research Department based on "JIP Database" by the Research Institute of Economy, Trade and Industry

Financial burden in terms of GDP ratio as of 2040 is estimated to be 30% higher than current levels

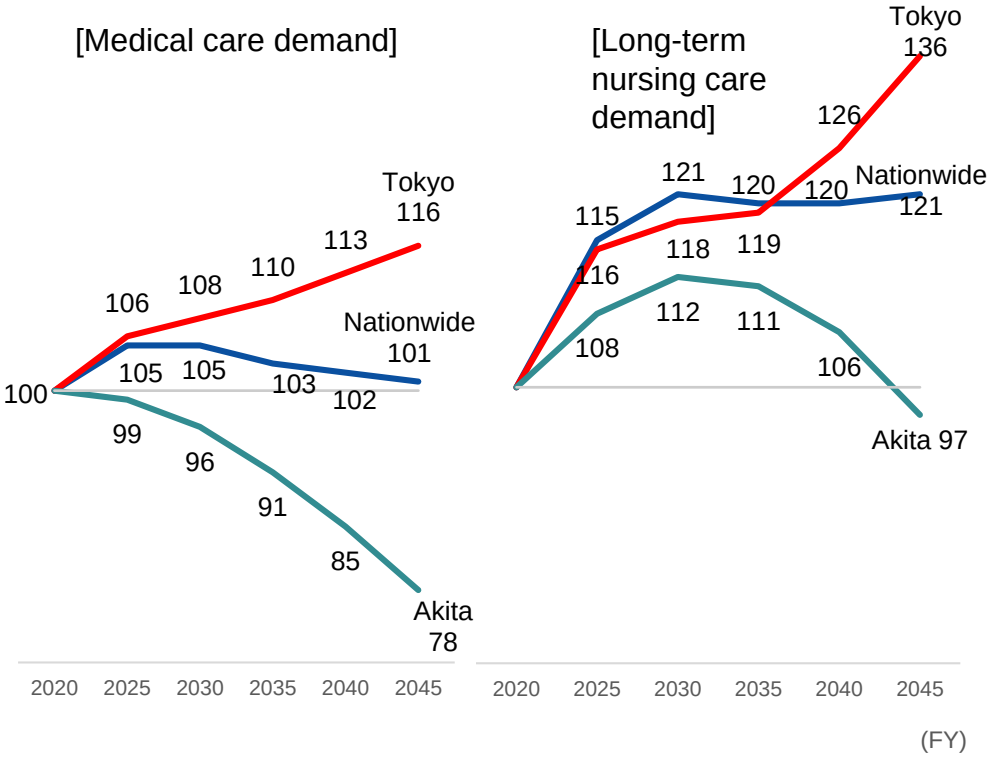
- The government has estimated future healthcare expenses until 2040, when the elderly population will peak.
  - The ratio of healthcare expenses to GDP is expected to increase from approx. 10% at present to approx. 13% by 2040.
- Healthcare demand will expand until around 2030 and remain high afterwards. However, there are large regional differences between urban and rural areas.
  - Demand will continue to grow in Tokyo towards 2045. In particular, long-term nursing care demand is expected to sharply increase.

Forecast for changes in healthcare expenses



Note: For medical expenses, the figures are based on plan (1)
Source: Compiled by Mizuho Bank Industry Research Department based on "Future Outlook for Social Security with an Eye Towards 2040 (Materials for Discussion)" by the Ministry of Health, Labour and Welfare

Future demand for healthcare (2020 = 100)

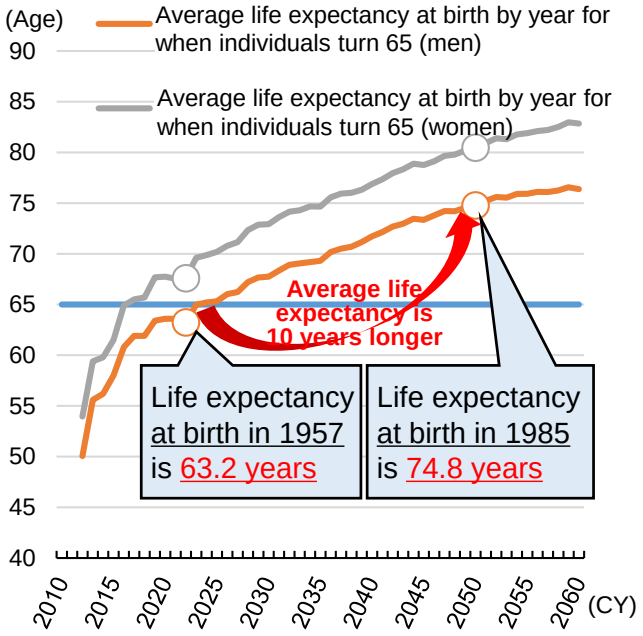


Source: Compiled by Mizuho Bank Industry Research Department based on "Japan Medical Analysis Platform" by the Japan Medical Association

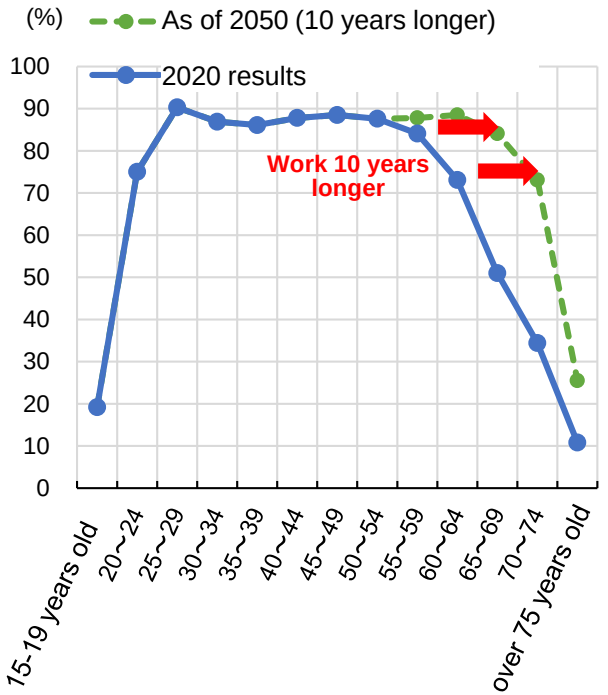
Labor Force will Decline as the Population Declines, and Retirement Age may also be Extended from the Viewpoint of Maintaining Social Security System

- In Japan in 2050, the labor force will decline and the sustainability of the social security system will become a problem. In the future, there is a possibility that the working period will be extended from the viewpoint of increasing tax revenues and maintaining health.
- 65-year old individuals in 2050 have a life expectancy that is 10 years longer than the life expectancy at this time (2022), so in 2050 if the elderly work for 10 years longer than they do now, then the workforce will be approx. 55 million people, a decrease of 12 million people when compared to 2020.

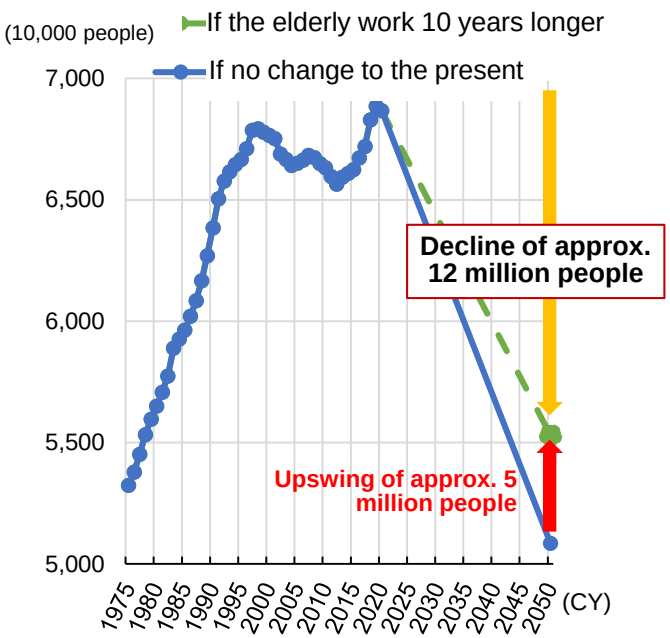
Average Life Expectancy for Individuals who Turn 65 in 2050



Labor Force Participation Rate Outlook as of 2050



Labor Force Outlook as of 2050

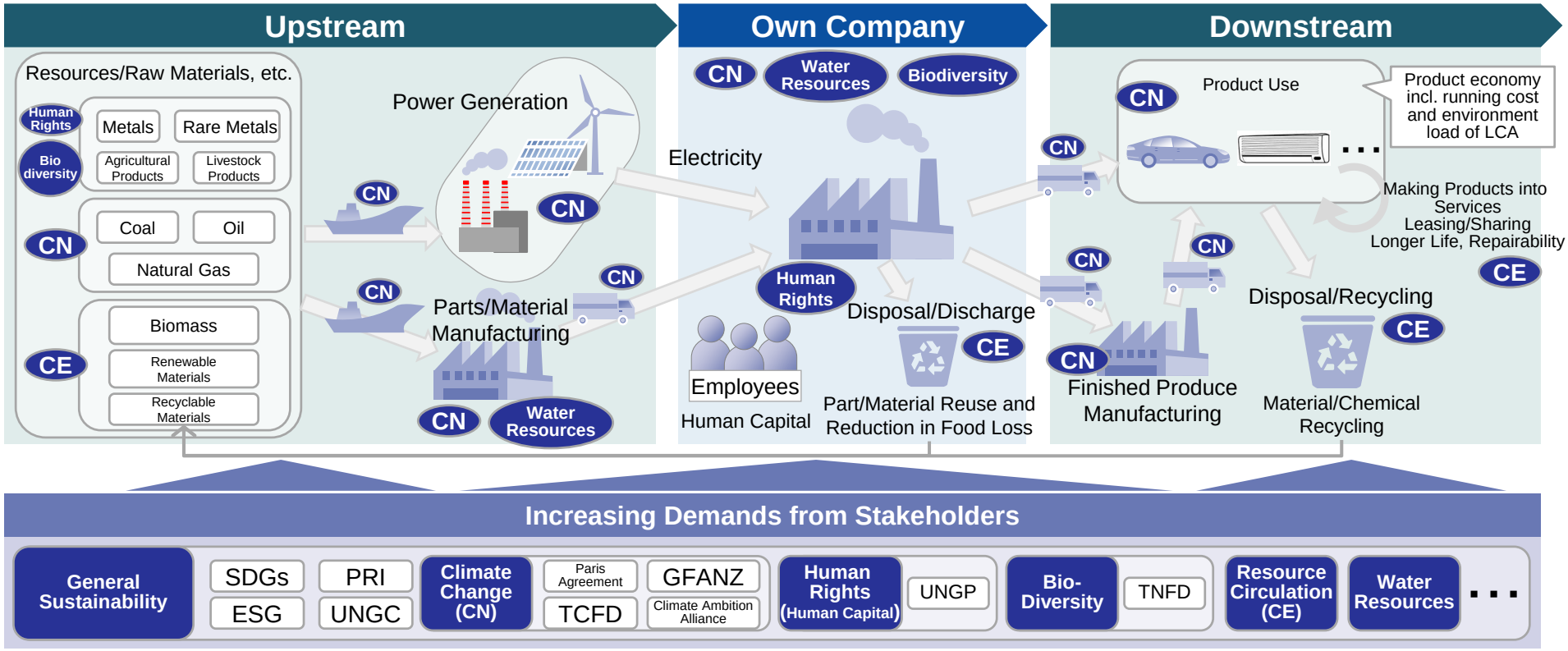


Source: Compiled by Mizuho Bank Industry Research Department based on “Annual Changes in Life Expectancy” by the Ministry of Health, Labour and Welfare, “Labor Force Survey” by the Ministry of Internal Affairs and Communications, and ”Population Projection for Japan" by the National Institute of Population and Social Security Research

Contributions to CN, Human Rights, Biodiversity, and CE, etc. will be Required Throughout entire Supply Chain

- Amidst the global demand for contributions to a sustainable society through the spread of SDGs and the Paris Agreement, companies will be required to contribute to sustainability not only through their own company, but also throughout their entire supply chain.
  - A variety of agendas, such as climate change (CN), human rights, biodiversity, resource circulation (CE), and water resources, will need to be evaluated and dealt with throughout entire supply chain. These currently occur as negative externalities, but internalization is progressing, led by climate change.

Sustainability Contributions Required in Supply Chains (Example)



Note: PRI is Principles for Responsible Investment; UNGC is United Nations Global Compact; TCFD is Task Force on Climate-related Financial Information Disclosure; GFANZ is Glasgow Financial Alliance for Net Zero; UNGP is United Nations Guiding Principles on Business and Human Rights; TNFD is Taskforce on Nature-related Financial Disclosures

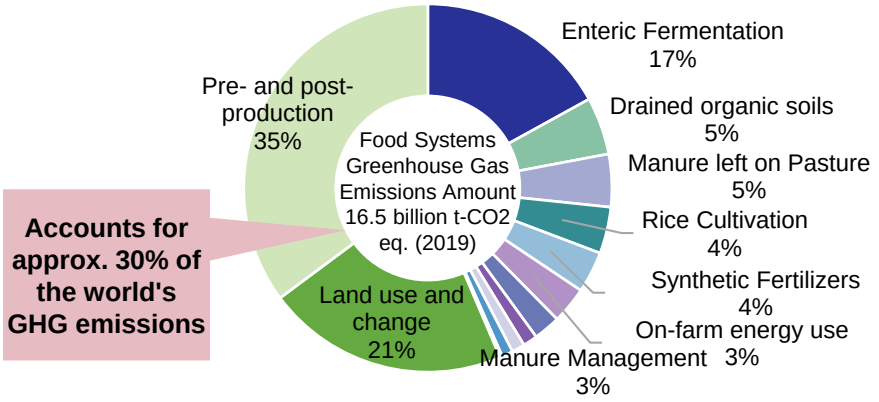
Source: Compiled by Mizuho Bank Industry Research Department

Sustainability Issues coming to the surface - Environmental Load Related to Food Supply

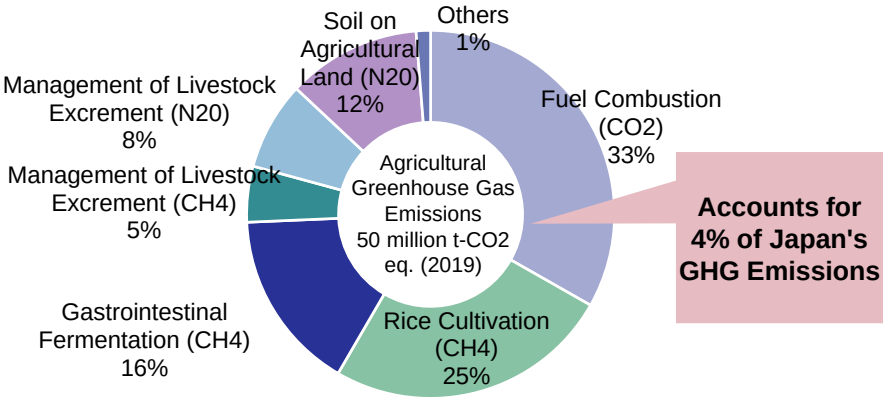
- Food supply faces a variety of environmental and social issues such as greenhouse gas emissions, land use, and water use.
- It will be necessary to pay attention to the environmental load of the raw materials to be procured and of the products to be handled, and to make this value attractive to consumers who seek products that are environmentally and socially friendly.

Environmental Load Related to Food Supply

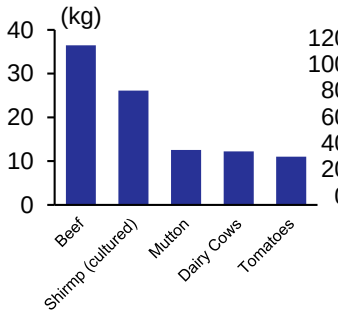
Breakdown of GHG Emissions from the Global Food System



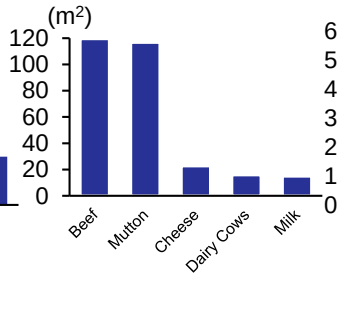
Breakdown of GHG Emissions from Japanese Agriculture



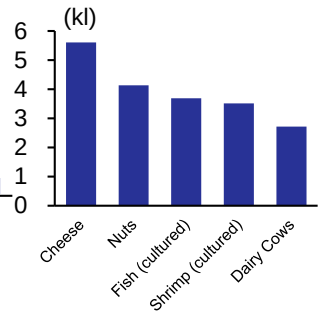
GHG Emissions from Production of 1,000 kcal



Land Area Required to Produce 1,000 kcal



Water Usage Required to Produce 1kg



Challenges in Other Food Systems

- Human rights violations against production workers such as for cacao and palm oil
- Occurrence of food losses
- Disposal of plastic
- Ecosystem loss due to land use and deforestation

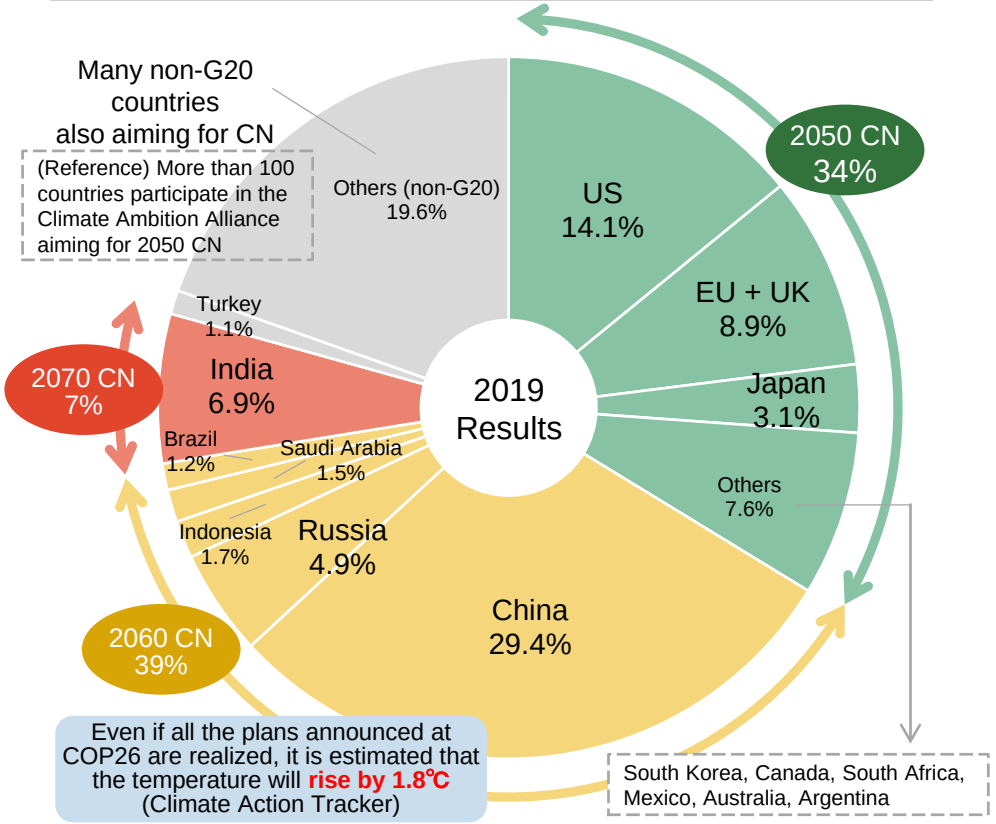
Source: Compiled by Mizuho Bank Industry Research Department based on "Reducing food's environmental impacts through producers and consumers" by Our World in Data

Source: Compiled by Mizuho Bank Industry Research Department based on greenhouse gas inventory and public information

In Order to Achieve the 1.5℃ target, it is Important to Further Strengthen Measures, in addition to CN, in the Next 10 Years

- Most major countries have implemented the CN Declaration in just two years since the EU declared in December 2019 that it would achieve CN by 2050.
- Even if all of the plans are realized, it is estimated that temperatures will rise by 1.8℃, so it is essential to strengthen measures to achieve the 1.5℃ target shared by COP26.
  - If the current pace of emissions continues, then temperatures will rise by 1.5℃ in about 10 years, so further measures are required for 2030.

Energy-Derived CO2 Emission Share and G20 CN Achievement Target Times



1.5℃ target in the Carbon Budget Concept

Nov. 2021 **Each country agrees on a "1.5℃ target" at COP26**

However, there is little time left to limit temperature rises to within 1.5℃

Carbon Budget	Cumulative upper limits for GHG emissions expected to limit temperature rise to a certain level

<Carbon budget on a global basis (67% achievability case)>

Cumulative until 2019 (1.1℃ rise)	Within 1.5℃	Within 2℃
23,900 (Already emitted)	4,000	7,500
100 mil. tCO2	100 mil. tCO2	100 mil. tCO2

If the current emissions pace continues, we will reach a 1.5℃ rise in approx. 10 years

<Probability of Climate Impact Occurrence According to Temperature Rise>

Climate Impact	Standard	1℃ (Current)	1.5℃	2℃
Extreme heat	1850-1900 Once every 10 years	2.8x	4.1x	5.6x
Torrential rain		1.3x	1.5x	1.7x
Drought		1.7x	2.0x	2.4x
Sea level rise (as of 2150)	Vs. 1995-2014 average	0.37-0.86m	0.46-0.99m	0.98-1.88m

Source: Compiled by Mizuho Bank Industry Research Department based on IEA, Greenhouse Gas Emissions from Energy 2021, "Working Group I contribution to the 6th Assessment Report" by the IPCC, and Climate Action Tracker, etc.

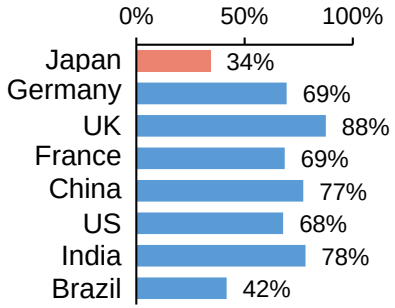
Japan is in a Disadvantageous Situation for Realizing CN - Inferior Conditions for Renewable Energy, and Dependent on Imports for Resources

- Japan must consider a strategy based on its disadvantageous preconditions (esp. for energy supply) to realize CN
  - Japan has inferior conditions for renewable energy power sources (which provide local production for local consumption of energy) when compared to other countries, so further efforts are required to reduce costs.
  - Active investment in the resources and materials required to achieve CN is expected, but Japan is expected to continue to be dependent on imports.

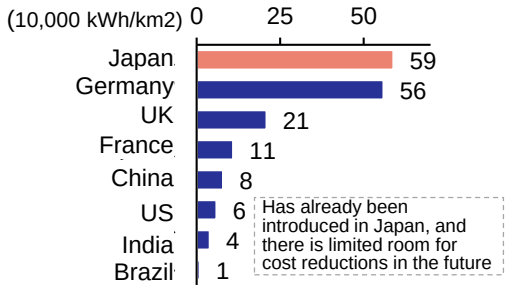
Comparison of Potential for Renewable Energy Sources

Percentage of Flat Land Area in Country

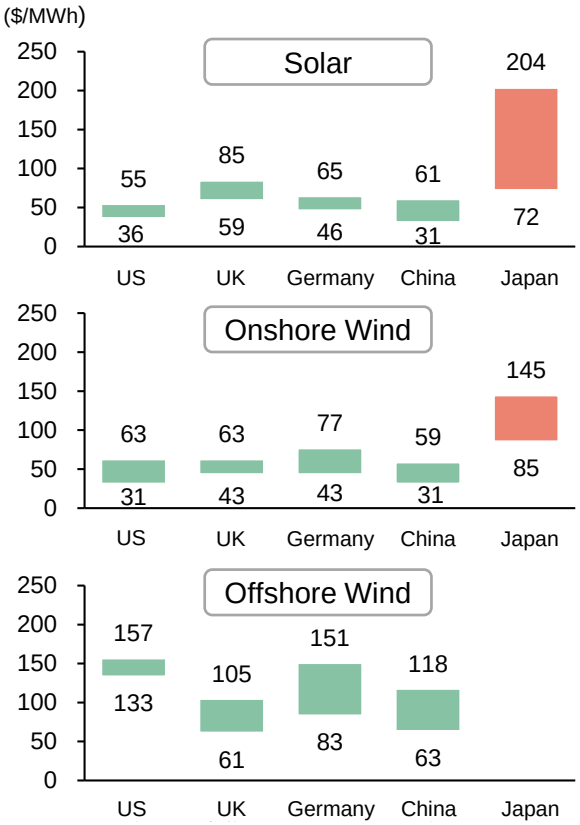
It is possible to introduce renewable energy on flat land at a relatively low cost, but flat land is limited in Japan



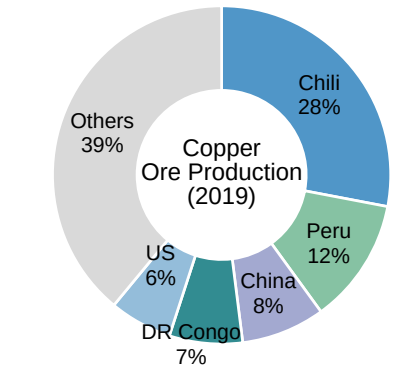
Results of Solar and Onshore Wind Power Generation per Flat Land Area

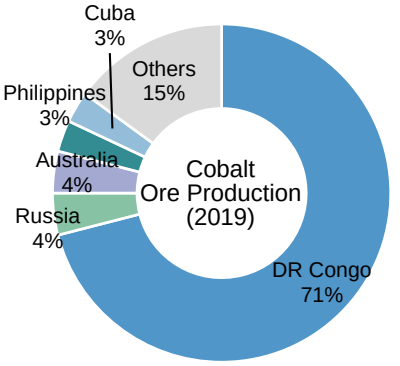


Comparison of LCOE by Renewable Energy Source

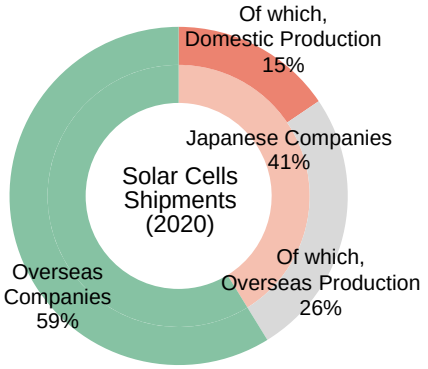


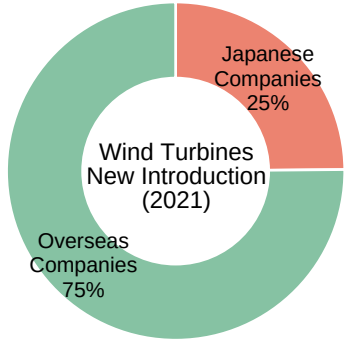
Global Share of Resources





Japan's Share of Renewable Energy Parts and Materials

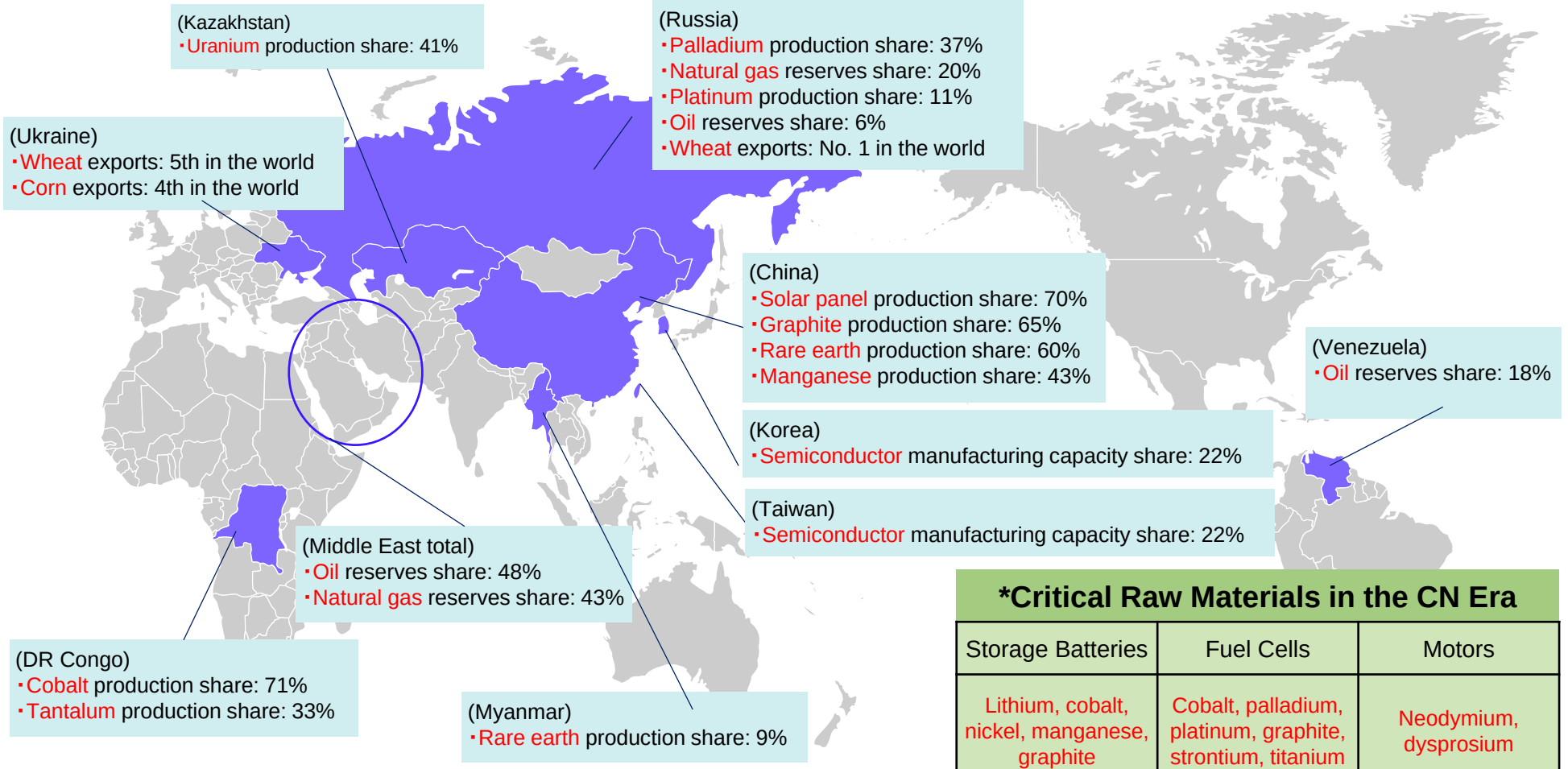




Note: Japan's offshore wind power in the LCOE comparison by renewable energy sources has no record for the second half of 2021.
Source: Compiled by Mizuho Bank Industry Research Department based on Agency for Natural Resources and Energy materials, Bloomberg NEF, JOGMEC materials, Japan Photovoltaic Energy Association materials, and Japan Wind Power Association materials, etc.

Conflict Areas and Resources/Food - Continuing Risks for Japan, a Resource-Poor Country

- Amidst the carbon-neutral trend, even if the amount of fossil fuel resources usage decreases in the future, the amount of rare metals and rare earths usage for storage batteries and fuel cells will increase. High degree of dependence on the resources of foreign countries can continue to be a major risk.



***Critical Raw Materials in the CN Era**

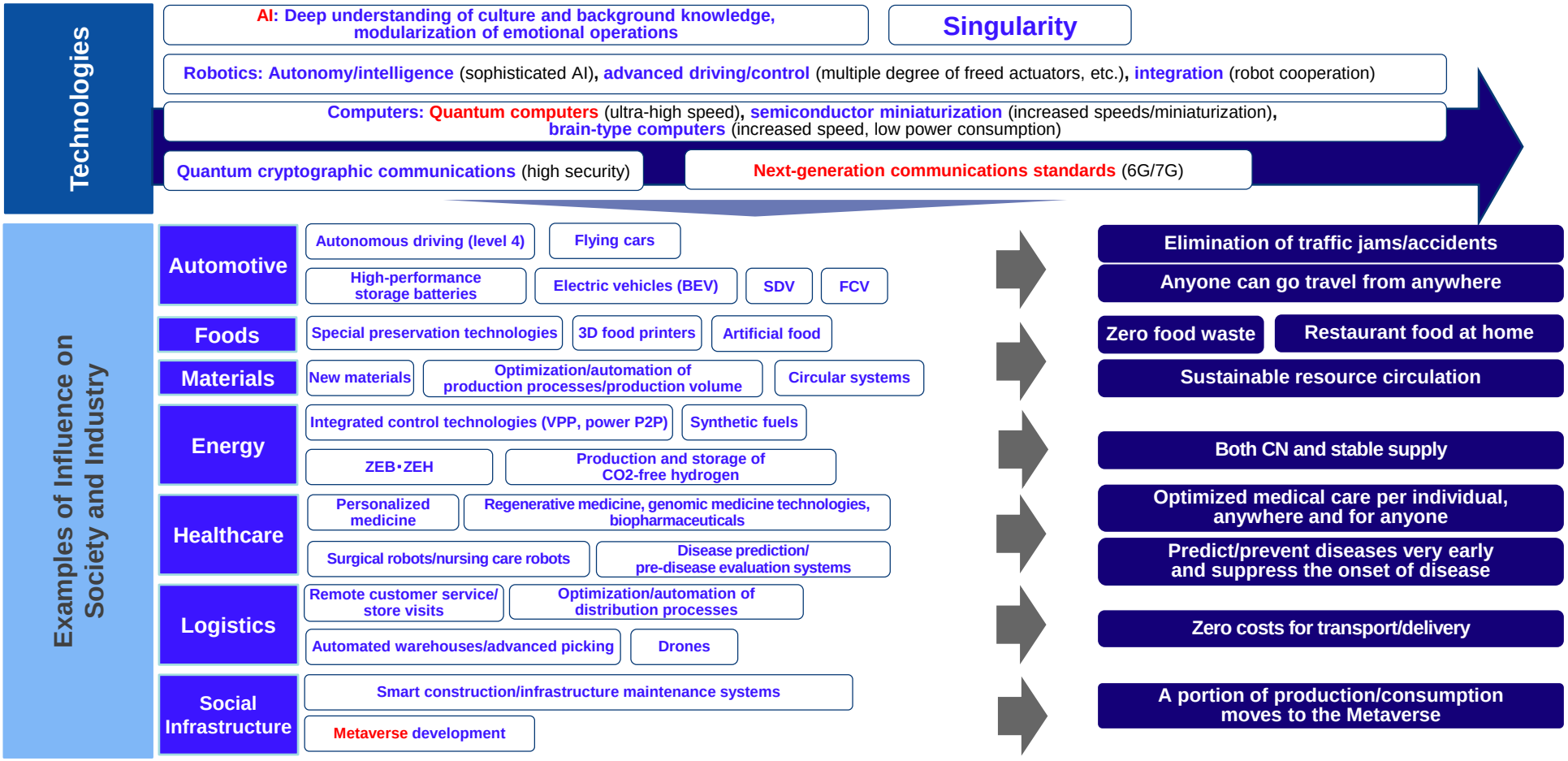
Storage Batteries	Fuel Cells	Motors
Lithium, cobalt, nickel, manganese, graphite	Cobalt, palladium, platinum, graphite, strontium, titanium	Neodymium, dysprosium

Source: Compiled by Mizuho Bank Industry Research Department based on WNA, USGS, and BP

Society and Industry Will Change as Technological Implementation Progresses in the Medium to Long-Term

- Technology is being developed ever more rapidly, connecting with other areas and changing all industries. Amidst the intensifying competition between countries and companies to secure human resources and technological development, a long-term strategy that lets Japan prevail is required.

Major Technologies Expected to be Implemented by 2050 and their Influence on Industry and Society



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

It is Necessary to See How IOWN Concept Will be Implemented by 2050

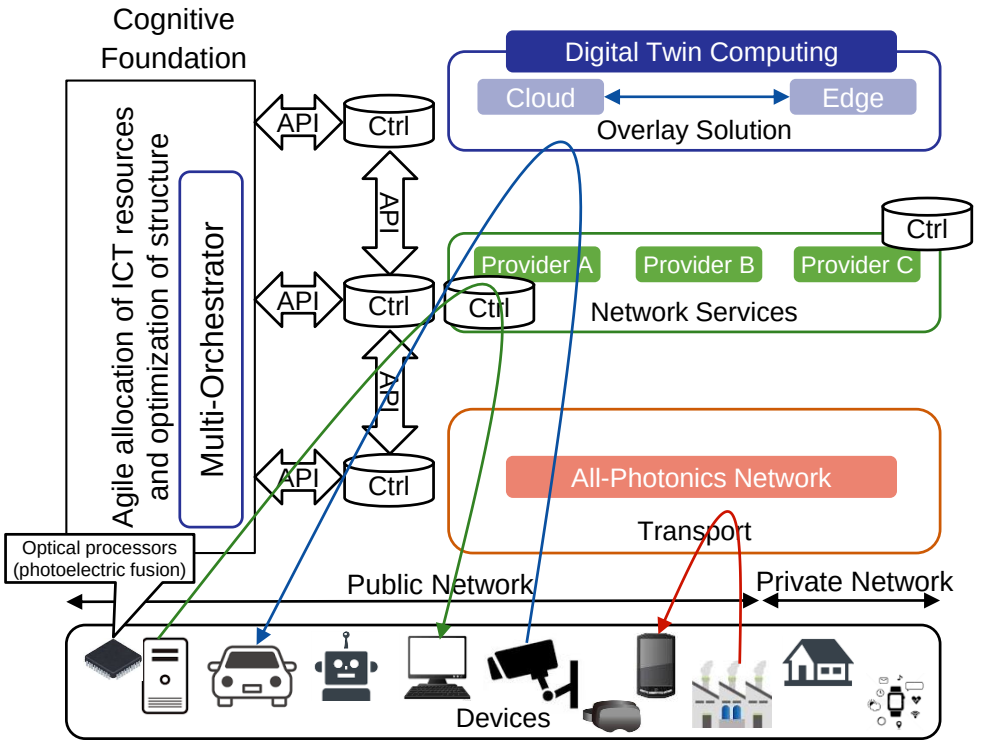
- The IOWN concept is a general term for networks and information processing infrastructure, including terminals, that can provide high-speed/large-capacity communications and enormous computational capabilities that utilize innovative light related technologies.
- The IOWN has the potential to create solutions to social demands such as addressing diversity, transcending the limits of the internet, and overcoming increased power consumption.

What is the IOWN Concept?

Social Demand and Necessary Responses

Addressing Diversity	■ It is necessary to deepen understanding of others by gaining information and feelings from others' perspectives. — Information acquisition collection via high-definition/high-sensitivity sensors, and information processing that goes into the senses and subjectivity of others
Transcending the Limits of the Internet	■ Issues such as multiplied communication volumes, complex network, and increased delays due to congestion (see note), etc. — Telecommunications systems breakthrough
Overcoming Increased Power Consumption	■ Increased energy consumption due to the explosive growth in networked devices and traffic — Significant improvements in power efficiency through the fusion of electronics and photonics

Overview Diagram of the IOWN Concept



Note: Congestion is a state in which access is concentrated on a specific line
Source: Compiled by Mizuho Bank Industry Research Department based on NTT website

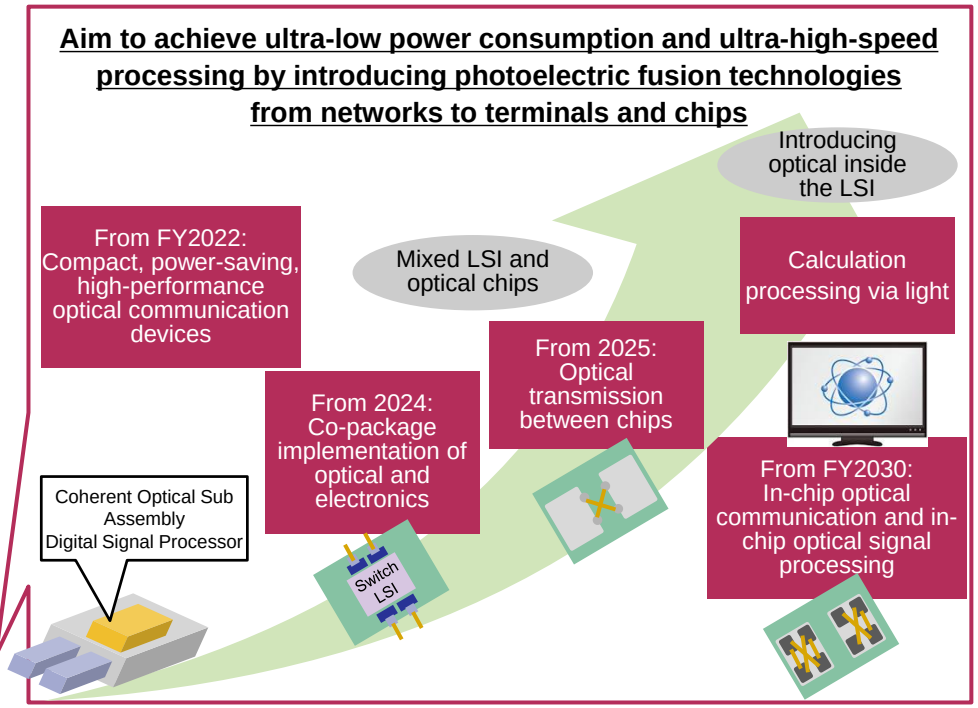
It is Necessary to Develop and Manufacture Equipment with the Adoption of Photoelectric Fusion Devices in Mind

- Under the IOWN concept led by Japan, it is assumed that the networks and information processing infrastructure will be constructed by 2030.
- If photoelectric fusion technologies are introduced in the network and terminals/chips through the IOWN concept, then the Metaverse will be supported by the realization of ultra-low power consumption and ultra-high-speed processing.
  - It is necessary to develop and manufacture equipment with the introduction Adoption of photoelectric fusion devices in mind.

Each Country's National/Private Projects Related to Optical Wiring Technologies (Examples)

Institutions/ Businesses, etc.	Content
DOE, ARPA-e ENLITENED	■ Improve data center energy efficiency by changing information transmission from electricity to light via optical integration technologies
HP Enterprise The Machine	■ Memory-driven computing + optical connections
Microsoft Optics for the Cloud	■ Application of optical technologies to cloud computing and development of new technologies
NEDO Photoelectrical Mounting Project	■ Development of basic technologies for optical wiring technologies for data communication between chips and their mounting technologies
NTT IOWN	■ Network/information processing platform utilizing innovative technologies centered around light ■ Aim to realize it by 2030

Evolution of Photoelectric Fusion Devices via the IOWN Concept



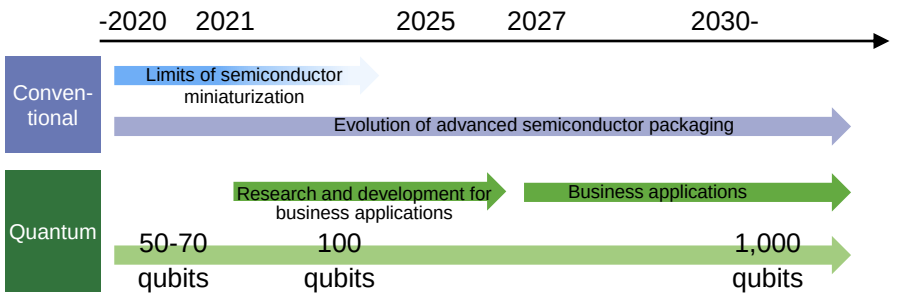
Note: DOE is the US Department of Energy
ARPA-e is the Advanced Research Projects Agency–Energy
ENLITENED is Energy-efficient Light-wave Integrated Technology Enabling Networks that Enhance Dataprocessing
Source: Compiled by Mizuho Bank Industry Research Department based on Ministry of Economy, Trade and Industry materials

Room for Contributing to the Realization of Quantum Computers, which Supports the Metaverse

- With the limits of semiconductor miniaturization approaching, the realization of quantum computers, in addition to the evolution of advanced packaging technologies, may become a supporting factor for the Metaverse.
  - Research and development is also important, such as on how to apply quantum computers to actual business.
- There is room for electronics companies to contribute to the realization of the Metaverse by addressing technical issues that needed to be resolved for the realization of quantum computers.

Quantum Computers Could Help Realize the Metaverse

Limitations of Conventional Computers and the Possibilities of Quantum Computers



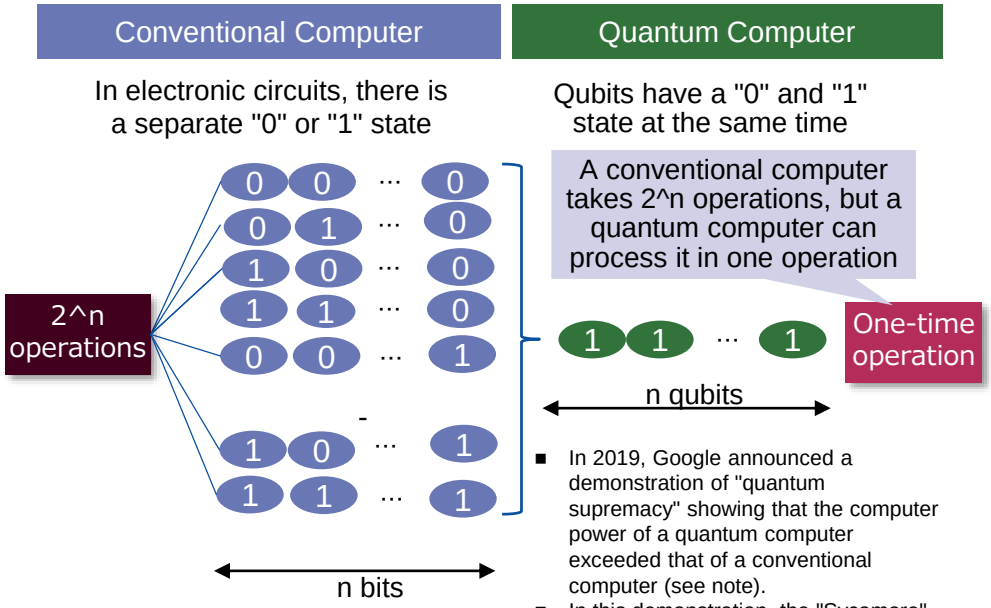
Technical Challenges and Opportunities for Realizing Quantum Computers

Controlling Electromagnetic Waves	■ One cable required per qubit for electromagnetic wave control — Evolution of cable wiring
Cooling Technologies	■ Realization of temperatures that stabilize qubit movement — Cooling technologies within the computers — Development of processors that operate in extremely low temperature ranges
Operating Environment	■ Realization of an ideal operating environment, incl. vibration/humidity — Possibility of using semiconductor technology/know-how such as thin-film deposition equipment and lithography equipment

Source: Compiled by Mizuho Bank Industry Research Department based on various published materials, etc.

<Reference>Calculation Speed-ups by Quantum Computers

- Quantum computers allow for far more computation than conventional computers



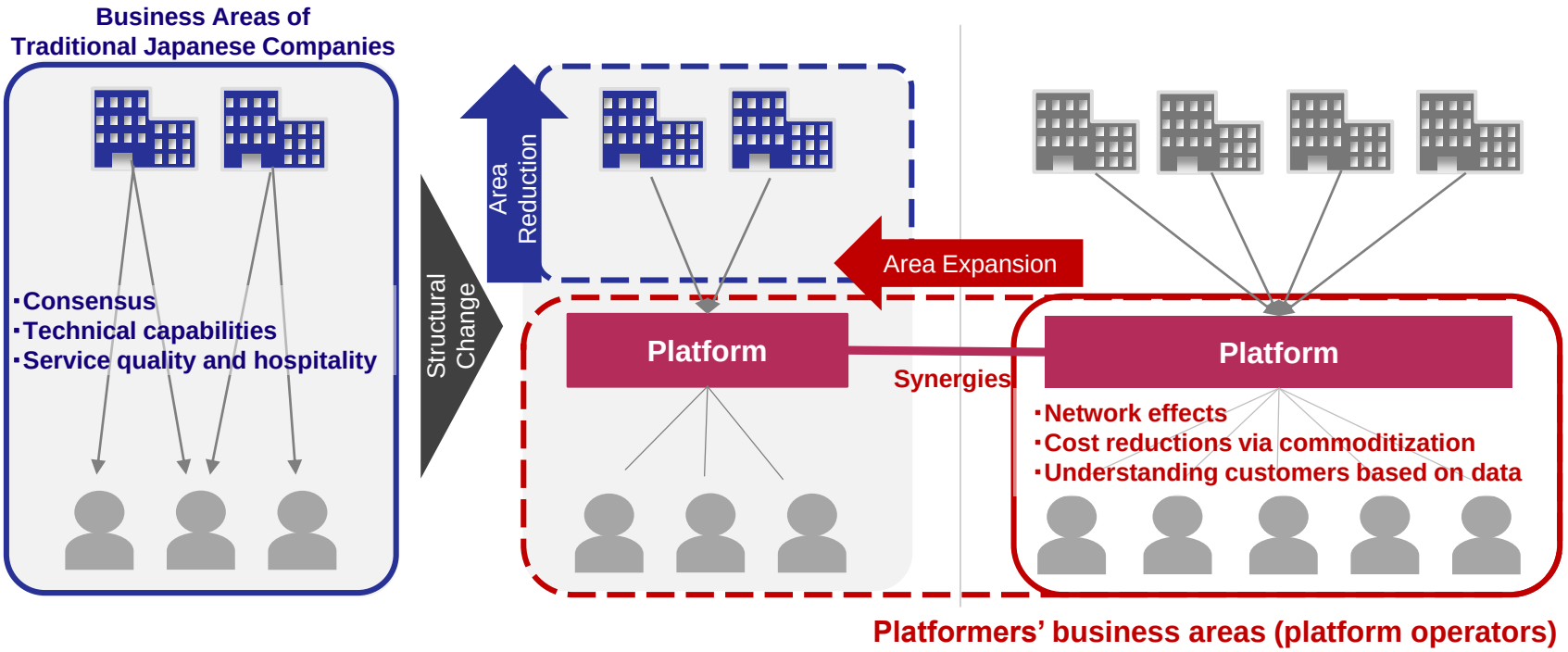
- In 2019, Google announced a demonstration of "quantum supremacy" showing that the computer power of a quantum computer exceeded that of a conventional computer (see note).
- In this demonstration, the "Sycamore" computer was equipped with 53 qubits.

Note: IBM has disputed this announcement by Google
Source: Compiled by Mizuho Bank Industry Research Department based on various published materials

(Reference) Changes in Industrial Structure and the Rise of Platformers due to Technological Evolution

- With the evolution of technology, the digitalization of everything has progressed, and the business model that utilizes the derived data has developed.
  - With digitalization, many processes in the value chain have been commoditized, and the industrial structure has changed to utilize low-priced services (platforms) provided by digital platforms such as GAFA.
  - The value of the platform increases as the number of users increases (network effect), so platformers pursue scale expansion beyond the boundaries of the industry.
- In the future, platformers' business areas will continue to expand as social acceptance increases.
  - Involvement in platforms and relationships with platformers will be important factors in business strategy.

Changes in Industrial Structure due to Platformers



Source: Compiled by Mizuho Bank Industry Research Department

By 2050, the Digital and Social Native Generations will Reach 50% of the Total Population

- Social acceptance is also required for the spread of a technology, and when it comes to digital technologies, Generation Z and later are digital natives and will account for half of the population by 2050. There will be a high affinity for digital technologies in all generations, and digitalization will be rapidly accelerating.

Changes in Japan's Population Composition by Age Group: 2020 ⇒ 2050

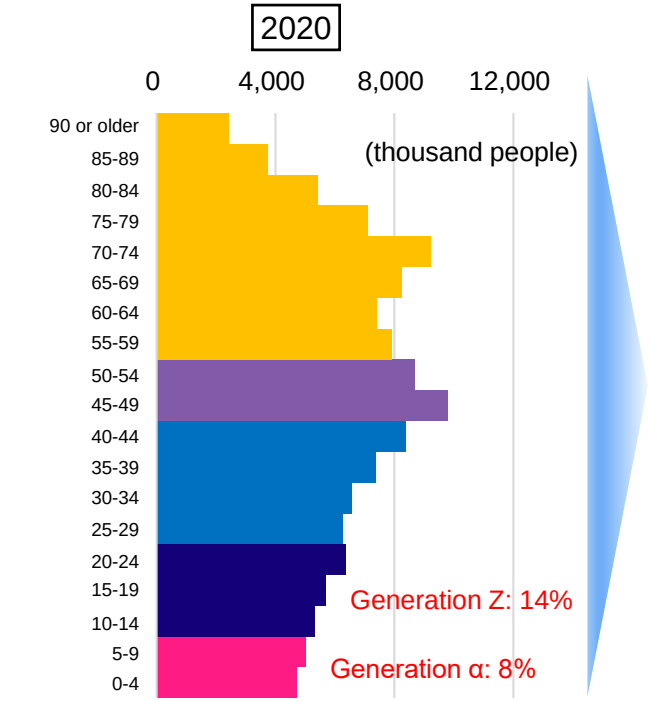
Before the Bubble Generation (born before 1965)

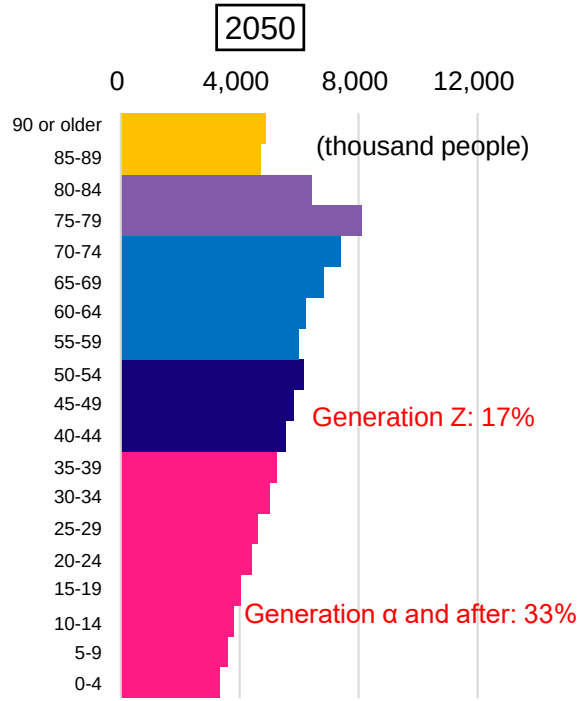
Generation X (born 1966 - 1980)

Generation Y (born 1981 - 1995) Digital natives (started using Win95 at age 18)

Generation Z (born 1996 - 2010) Social natives (Facebook became popular when they were 18)

Generation α (born 2011 -)





(Characteristics of Generation Z)

Generational Background

- Parents experienced the bursting of Japan's economic bubble and the financial crisis, while they experienced the Great East Japan Earthquake and COVID-19
- Their first cellphone was a smartphone, and they use a computer or tablet in class
- The internet has been a central part of their activities since they were born. It is natural to connect with people through social media

Behavioral Characteristics

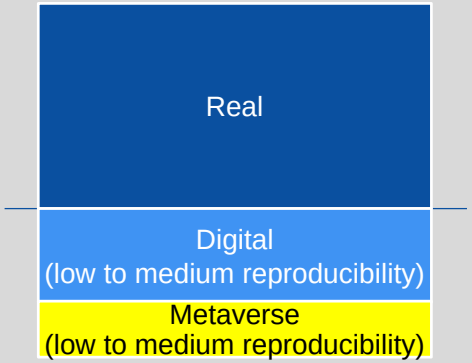
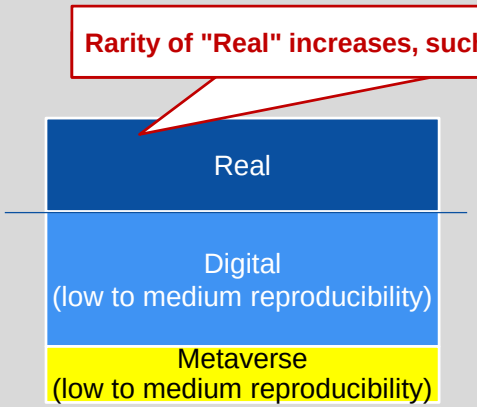
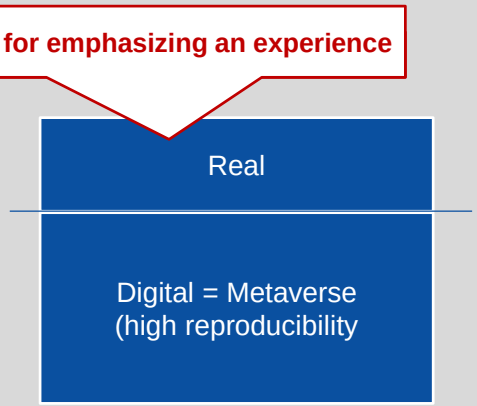
- Do not bother with ownership. Active in sharing
- Experiential consumption rather than material consumption. Emphasis on empathy rather than brands
- Adapts to new devices and features
- Thoroughly researches large amounts of information
- Respects diversity. Has multiple identities

Source: Compiled by Mizuho Bank Industry Research Department based on "Population Projection for Japan" by the National Institute of Population and Social Security Research

The Distribution of the Real and Digital Changes with the Development of Devices and Communications Technologies

- From a technical point of view, in 2050 the sophistication of communications technologies and related device technologies will enable experiences to be the same as in the real world (communication, purchasing goods and services, and entertainment) even when online (including in the Metaverse).

An online virtual space where anyone can communicate and conduct economic activities at the same level as or better than in the real world

	(1) Digitalization "Development"	(2) Digitalization "Acceleration"	(2)' Metaverse Spread
Content	☐ Continuation of digitalization trend that advanced due to COVID-19. ☐ Emphasis placed on communication in the real world. Work portions (other than for fun) are made more efficient by utilizing technology.	☐ Changes in infrastructure, regulations, and systems accelerate the flow of digitalization ☐ Same as on the left	☐ Reproducibility is improved via technological evolution, and people utilize it ☐ Communication without any feeling of oddness, even in the virtual world
Premise	☐ Primary devices are smart glasses/contacts (smartphones/PCs are limited). Mobile communications are 6G/7G (ultra-high speed, ultra-large capacity, ultra-low latency)		
Image of Distribution Between Real and Digital in 2050 (Where activities are being done)			
Related Parts in this Report	**Consumer services (retail/restaurants), automotive, mobility services, logistics (land transport), healthcare**		**Electronics, communications/media, IT**

Source: Compiled by Mizuho Bank Industry Research Department

Increase in Consumers' Free Time, and May Focus on Digital Activities

- With the utilization of technology, declining birthrates, and an aging population, consumers' free time will increase by approx. 3 hours/day, and the focus will be on how to use that free time.
  - Digital contact time will also increase, and it is expected that a portion of free time, work time, and schoolwork time will be "Immersive Time." For times other than when sleeping, people can be connected to the digital world in parallel with their real-world activities.

Changes in Daily Living Time (2016→2050 / Weekly averages / Average for all ages, male and female)

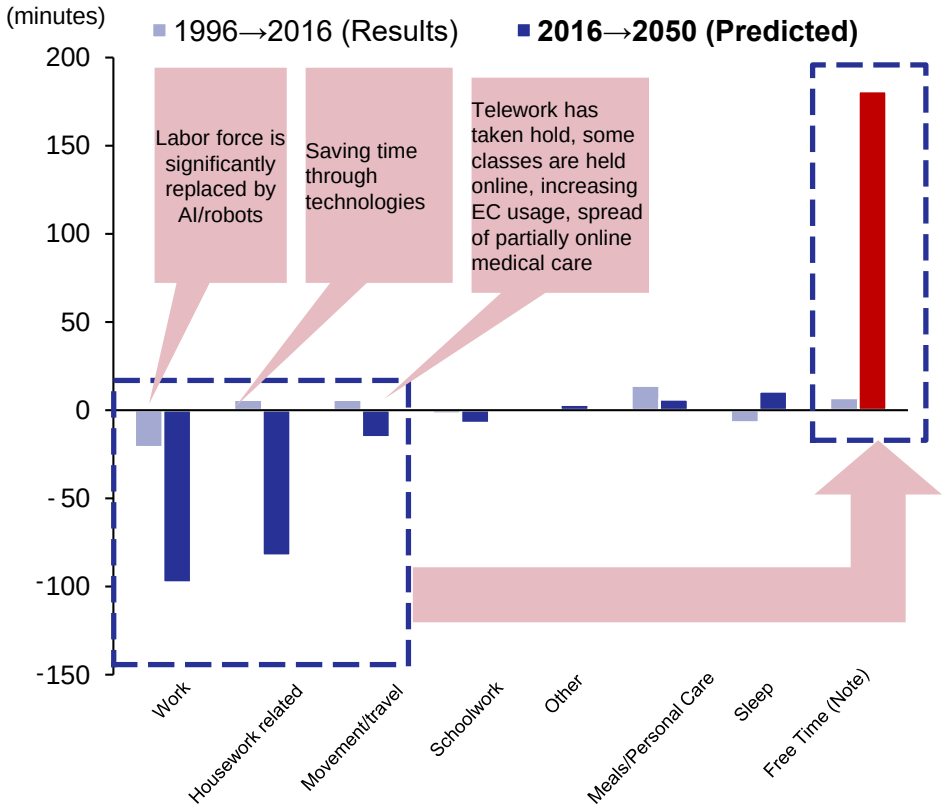
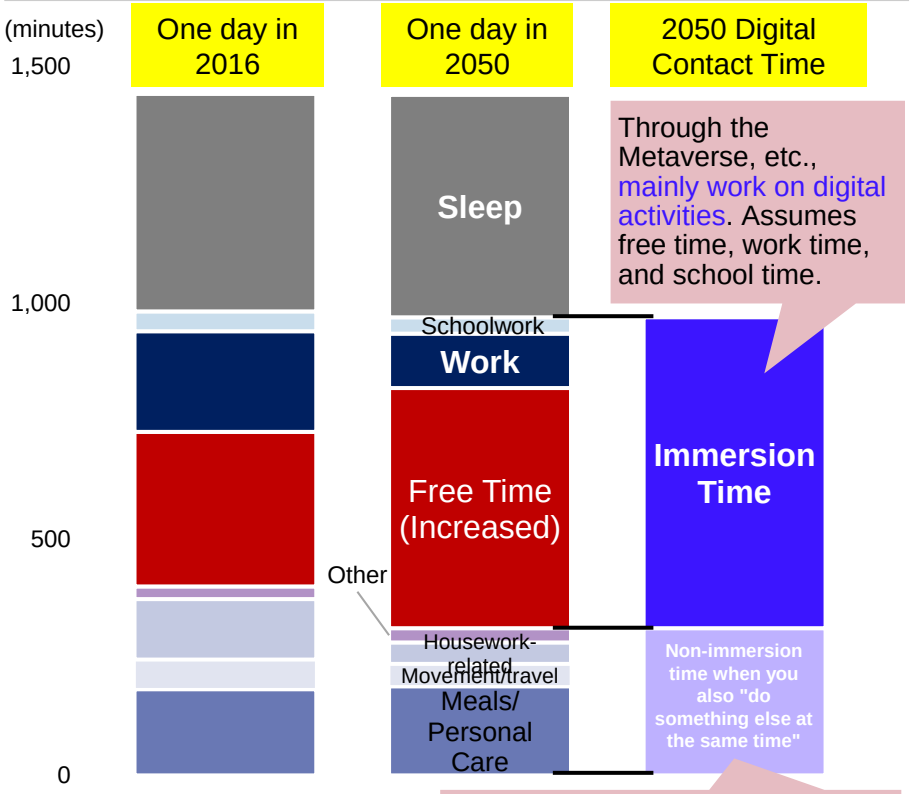


Image of Digital Contact Time in 2050

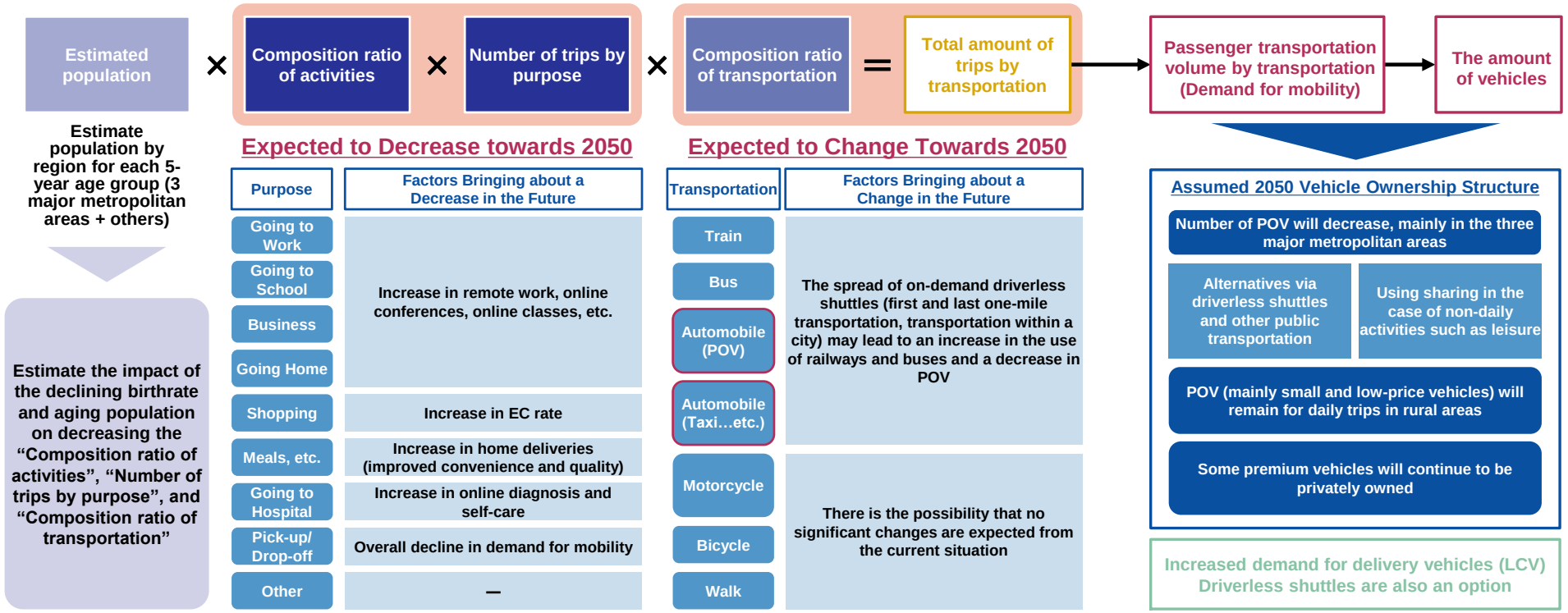


Note: Free time refers to "shopping," "TV, radio, newspaper, magazines," "resting, relaxing," "learning, self-development, training (other than schoolwork)," "hobbies, entertainment," "sports," "volunteer activities, social participation activities," and "dating, socializing."
Source: Both figures were Compiled by Mizuho Bank Industry Research Department based on the "Survey on Time Use and Leisure Activities" by the Statistics Bureau, Ministry of Internal Affairs and Communications.

Future Demand for Mobility and Stock of Vehicles in Japan

- In considering the structure of Japanese automotive industry in 2050, it is necessary to estimate the amount of vehicles.
  - It is assumed that there are three factors that will affect the future amount of vehicles: “Dynamics of Population”, “Demand for Mobility”, and “Transportation”.
- In 2050, it is expected that the amount of vehicles will decrease due to declining birthrates and the aging population, shrinking demand for mobility, reduction of POV (privately owned vehicles).
  - POV will be mainly composed of small and low-priced vehicles for daily trips and premium vehicles.

Future Demand for Mobility and the Amount of Vehicles in 2050

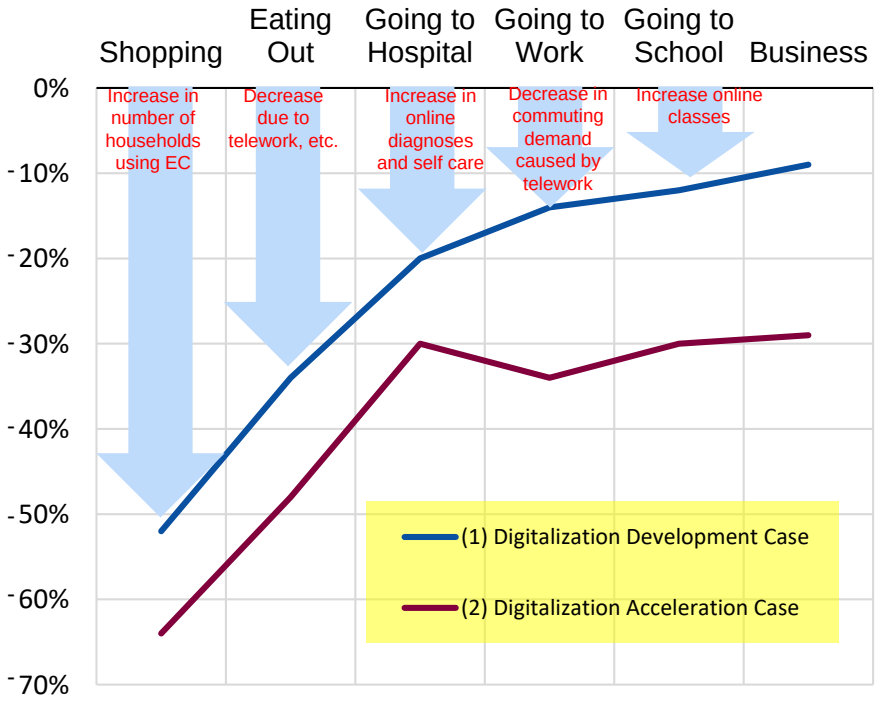


Source: Compiled by Mizuho Bank Industry Research Department

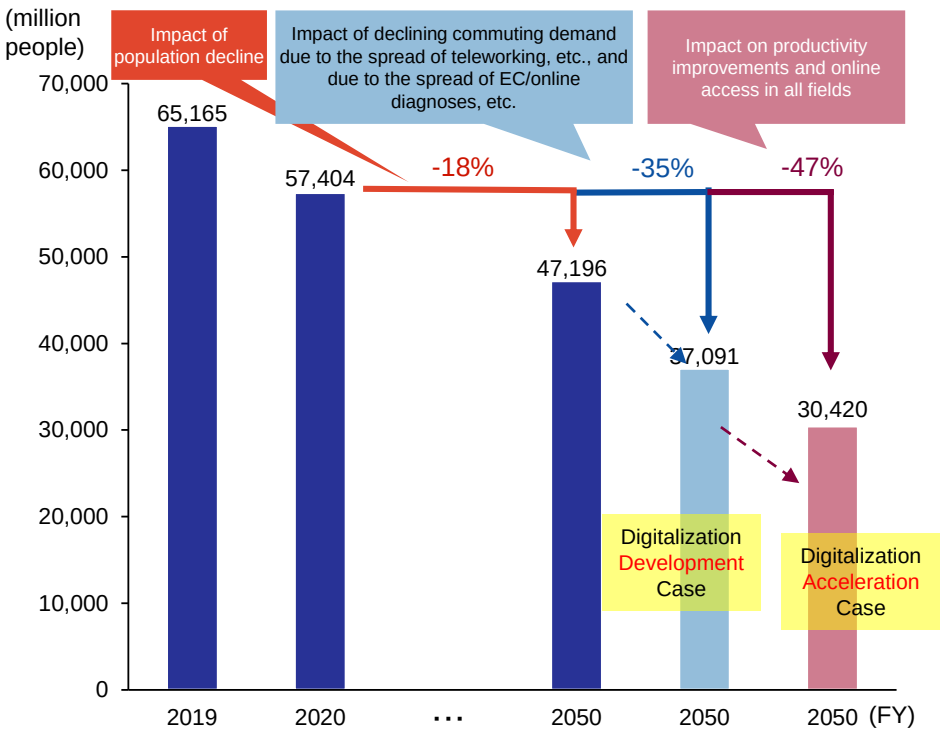
As of 2050, Passenger Vehicle Transportation Volume will Decrease from 30% to 50% from Current Levels

- Domestic passenger transportation volume by passenger vehicles (total of private automobiles and taxis) in FY2050 is expected to decrease by 18% from FY2020 to approximately 47.2 billion due to changes in population composition and decline.
- In the "(1) Digitalization Development Case (base case)", it will decrease by 35%, due to the decrease in commuting demand caused by telework, and the spread of EC and online medical care, etc. In the "(2) Digitalization Acceleration Case", which is expected to further reduce mobility demand, it will decrease by 47%.

Decrease in the Number of Trips by Purpose in FY2050 *FY2015→FY2050



Changes in Domestic Passenger Transportation Volume by Passenger Vehicle (Private Automobiles and Taxis)



Note: Until FY2020 shows actual results, and FY2050 is a forecast by the Mizuho Bank Industry Research Department.
Source: Compiled by Mizuho Bank Industry Research Department based on the "Survey on Motor Vehicle Transport" by the Ministry of Land, Infrastructure, Transport and Tourism, the "National Urban Transport Characteristics Survey" by the Ministry of Land, Infrastructure, Transport and Tourism, and "Population Projection for Japan" by the National Institute of Population and Social Security Research, etc.

(Reference) Two Scenarios for Considering Mobility Demand and Passenger Transportation Volume

- In addition to population decline, mobility demand in 2050 assumes the declining worldview due to the acceleration of food EC and a reduction in commuting demand caused by the spread of telework associated with the spread of COVID-19 pandemic as “(1) Digitalization Development Case“.
- Furthermore, “(2) Digitalization Acceleration Case" is also presented, in which mobility demand is reduced even more by productivity improvements and moving online in all fields.

World View of Mobility Demand in 2050

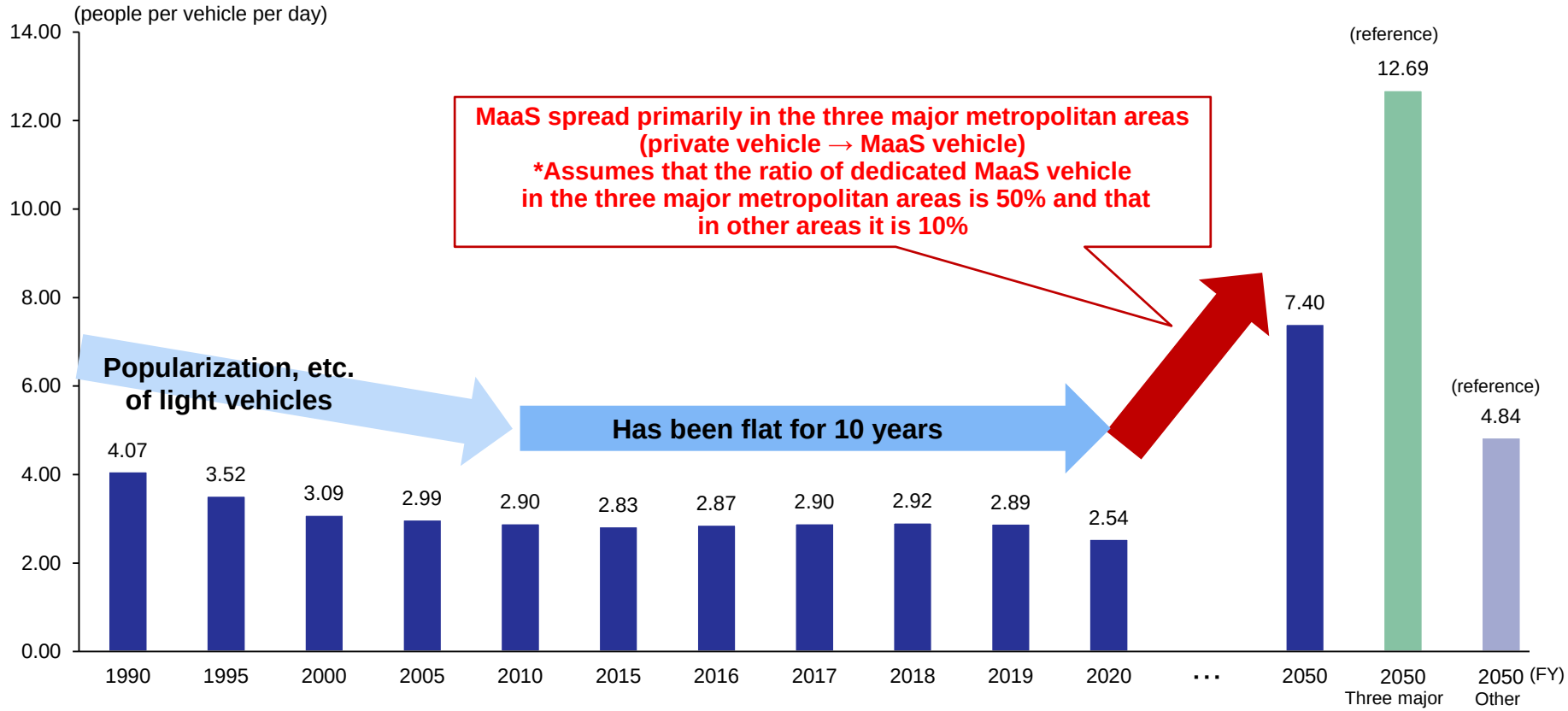
	(1) Digitalization Development Case Compared to Pre-COVID-19: approx. -10 to -20%	(2) Digitalization Acceleration Case Compared to Pre-COVID-19: approx. -20 to -40%
Going to Work	■ As an extension of the current situation, demand for commuting to work decreases due to telework taking hold.	■ In addition to the base case, the number of commuting days decreased due to productivity improvements.
Going to School	■ Under the current School Education Act, the number of days of attendance was assumed to be real-world attendance, but it was reviewed in the wake of COVID-19, and it is assumed that a portion of classes will be held online at some high schools and universities, etc.	■ Assumes that some classes at all educational institutions will be replaced with online classes.
Business	■ Decreases in parallel together with the decrease in demand for commuting to work.	■ In conjunction with the decrease in the number of days commuting to work, the number of outings related to work also decreases.
Shopping	■ As the number of households using EC increases, the number of outings decreases.	■ Assumes that food EC will increase even further when compared to the base case.
Eating Out	■ Even though demand for eating out for the purpose of spending leisure time increases, the demand for eating out will also decrease in conjunction with the decrease in going out due to telework taking hold.	■ Demand for eating out declines due to the expansion of EC and delivery demand associated with a relative decline in attractiveness of eating out.
Going to Hospital	■ The spread of online diagnoses mainly for medical diseases, which are easy to go online, and the increase in self-care by patients.	■ In addition to the base case, online diagnosis has become widespread among hospital outpatients, and self-care by the patients themselves also spreads.

Source: Compiled by Mizuho Bank Industry Research Department

Number of People Transported per Day by Passenger Vehicles (Private Automobiles and Taxis) will Increase Due to the Spread of MaaS in the Future

- In the early 1990s, the number of people transported by a vehicle per day was approx. four. Due to the spread of light vehicles, etc., the number of people transported by a vehicle per day has remained unchanged at around 2.8-2.9 since 2010.
- Assuming that in 2050, 50% of the vehicles in the three major metropolitan areas are dedicated MaaS vehicles, and that in other areas they are 10%, then the number of passengers transported by a vehicle per day is expected to be approx. seven (in the three major metropolitan areas it will be approx. 13, and in other areas it will be approx. five).

Number of People Transported Per Day by a Passenger Vehicle (Private Automobiles and Taxis)

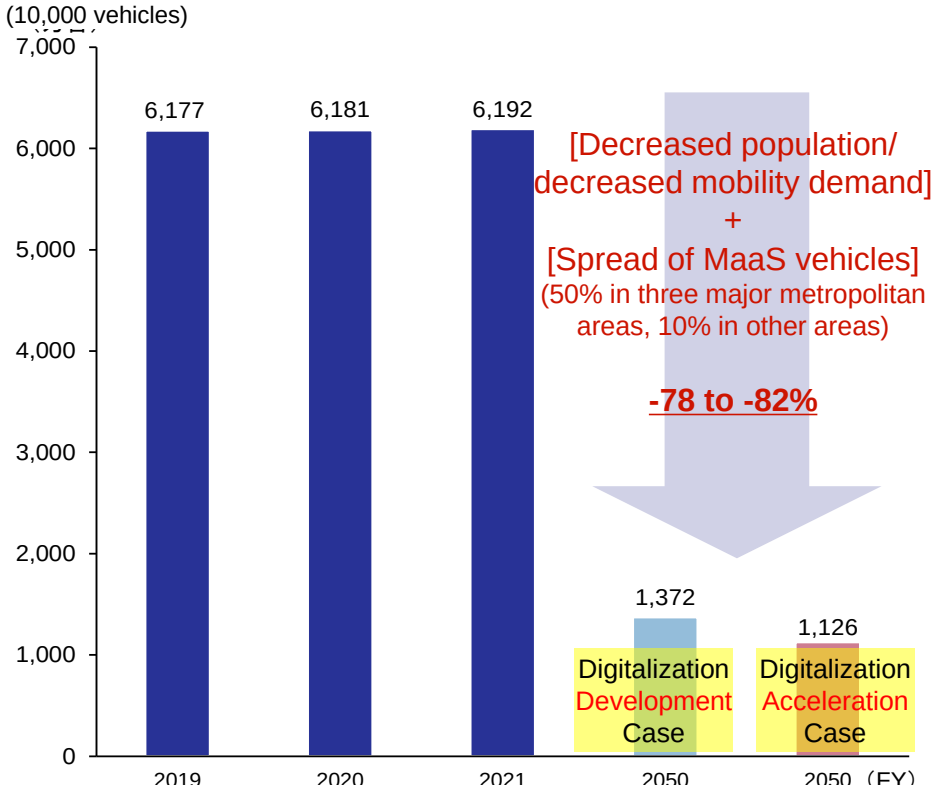


Source: Compiled by Mizuho Bank Industry Research Department based on the "Car Transportation Statistical Survey" by the Ministry of Land, Infrastructure, Transport and Tourism, the "National Urban Transport Characteristics Survey" by the Ministry of Land, Infrastructure, Transport and Tourism, and "Population Projection for Japan" by the National Institute of Population and Social Security Research

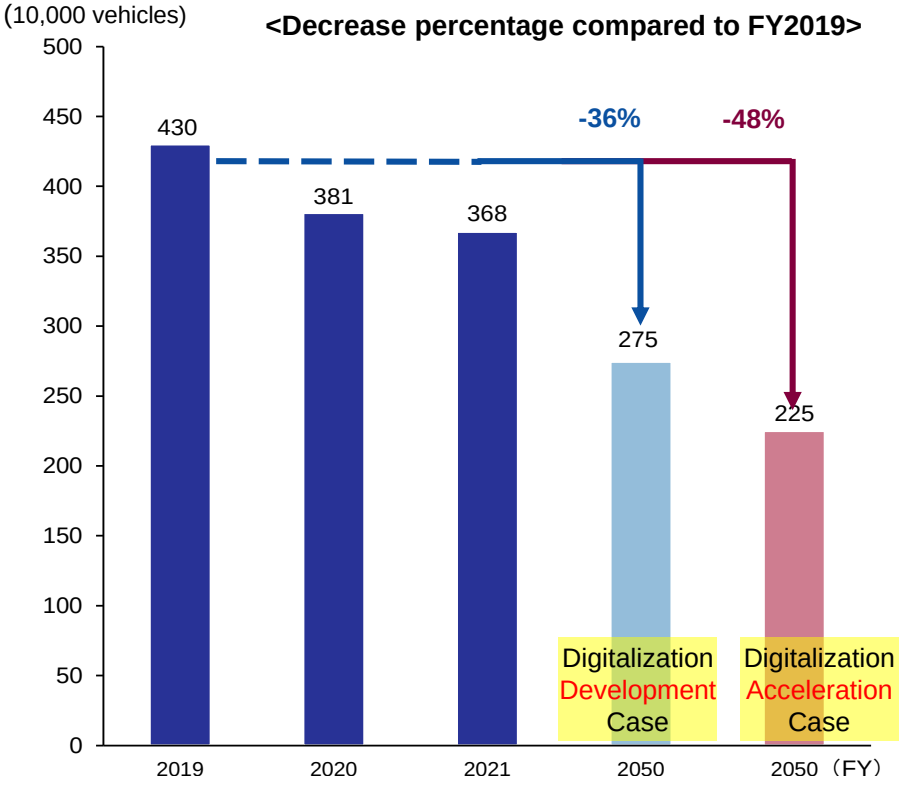
Domestic Passenger Vehicle Ownership Numbers and Sales Numbers May Sharply Drop in 2050

- Assuming that the penetration rate of dedicated MaaS vehicles in 2050 is 50% in the three major metropolitan areas and 10% in other areas, then it is expected that the number of owned passenger vehicles (the number of vehicles required to meet mobility demand) will decrease by approx. 80% when compared to FY2021.
- As a result of estimation assuming that the useful life of a vehicle will be shortened because of the decrease in privately owned vehicles due to the spread of MaaS, passenger car sales are expected to decline by up to 48% when compared to pre-COVID-19 FY2019, which will require a fundamental overhaul of the traditional automotive business model.

Forecast for Domestic Passenger Vehicle Ownership in 2050



Forecast for Domestic Passenger Vehicle Sales in 2050



Source: Compiled by Mizuho Bank Industry Research Department based on the "Car Transportation Statistical Survey" by the Ministry of Land, Infrastructure, Transport and Tourism, the "National Urban Transport Characteristics Survey" by the Ministry of Land, Infrastructure, Transport and Tourism, and " Population Projection for Japan" by the National Institute of Population and Social Security Research

Local Production for Local Consumption is Progressing in the Automotive Industry to Achieve Carbon Neutrality

- In the automotive industry, in the medium-term it is expected that the local production for local consumption of complete vehicle manufacturing will progress globally, caused by shift to BEV. The background for this is that governments and major companies in each country are trying to lock in the battery supply chain and value chain.
  - In the longer term, it is assumed that the commoditization of vehicles (hardware) will also promote the local production for local consumption of complete vehicle manufacturing.

Two Factors and Three Points for the Global Progress of Local Production for Local Consumption of Complete Vehicle Manufacturing

	Locking In the Battery Supply Chain/Value Chain	Commoditization and Standardization of Vehicles (Hardware)
	Local Production for Local Consumption of Batteries = Local Production for Local Consumption of Complete Vehicle Manufacturing	Added Value Shifts to Production Technologies and Know-How
Environmental Regulation	✓ Batteries are critical to achieve CN, and the governments of major countries are aiming for consolidating production facilities and technology in their own territory ✓ Concerns from a LCA perspective that battery imports will increase CO2 emissions.	✓ Concerns that importing complete vehicles will increase CO2 emissions from the perspective of LCA
Protecting Employment	✓ Need to absorb via battery manufacturing the decrease in employment caused by shift to BEV	✓ Reducing import and increasing domestic production are essential to mitigate the decrease in employment caused by shift to BEV ✓ If new vehicle sales will decline in other countries over the long-term, then import may decrease further
Economic Rationality	✓ Batteries have high logistics costs, so it is rational to produce them in the vicinity of a complete vehicle manufacturing sight ✓ Locking in used batters = Reuse and recycling can reduce battery costs and secure natural resources.	✓ Local production for local consumption, which can maximize cost merits, is superior by consolidating complete vehicle manufacturer and commoditization of vehicles (hardware) ✓ There is a high probability that manufacturers will be supported by governments from the perspectives of environmental regulations and protecting employment.

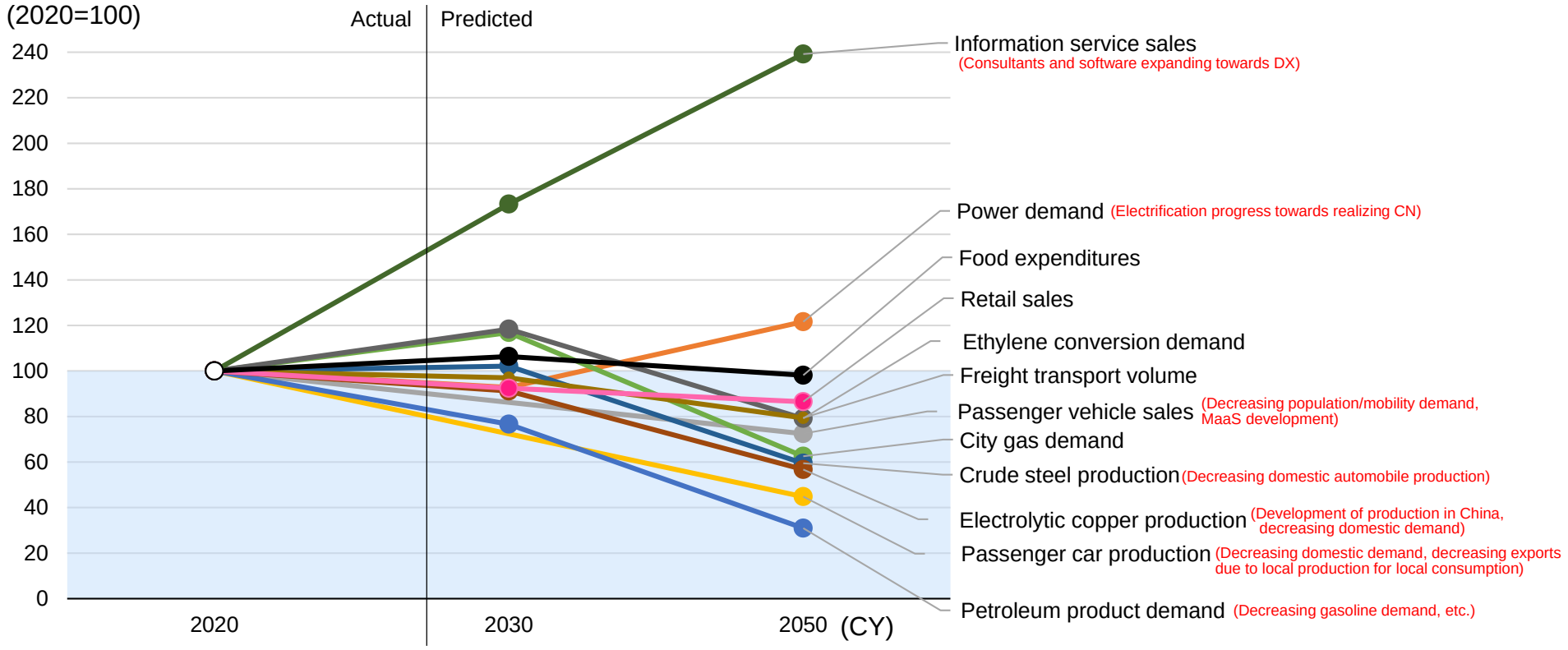
Source: Compiled by Mizuho Bank Industry Research Department

Supply and Demand Outlook for 2050 - For Many Japanese Industries, the Amount of Activity from Existing Domestic Business is Declining

- Needs for energy-intensive products such as automobiles (passenger vehicles) and petroleum products (gasoline, etc.) are declining. Material industries such as steel will also be affected.

Demand Outlook for Japanese Major Industries

Refer to the Appendix for the Demand Outlook for Each Industry



Note: Forecast by the Mizuho Bank Industry Research Department for 2030 and 2050
Source: Compiled by Mizuho Bank Industry Research Department based on various statistics

[Chapter I Summary]
Changes in Society, Consumers, and Industrial Structure Towards 2050

Changing Trends

Population Declining/Aging | **Realizing Sustainability** | **Ensuring Economic Security** | **Technological Evolution**

The changing trends are accelerating in response to the US-China conflict since 2018, COVID-19 pandemic, and the crisis in Ukraine

Changes in Society and Consumers Towards 2050

(1) Living Time: Reduced work and housework, increased free time, and increased digital contact. While enjoying playing in the digital world, emphasis is also placed on the physical aspect (=experiences).
(2) Space: Increased relative importance on the digital/virtual world (Metaverse). Real-world/experiences become a rarity. Transcending borders and languages through the spread of the Metaverse.
(3) Consumption: Consumption of goods and services is divided into fun and labor.
(4) Movement: Need for movement has diminished due to the progress of digitalization. People, goods, and services move through the establishment of autonomous driving technologies. Liberation from close proximity to work and residence.
(5) Work: With the spread of AI diagnosis and the development of regenerative medicine, etc., healthy life expectancy has been extended and a "lifetime of active work" has been realized. Affluence and health without anxiety. While enjoying digital ways of playing, also emphasize physical ways of playing (=experiential value).
(6) People: Increasing need for "advanced human resources" with technology-related expertise, and companies try to secure human resources by securing specialized human resources in other countries and by rehiring "relearning" human resources. AI replaces production, distribution, and office work, and humans concentrate on creative parts.
(7) Things: Conversion from ownership to usage. Circulation that includes recycling. Production and distribution of goods is automated. From mass production to a high-mix, low-volume production system.
(8) Money: Investment gathers in intangible assets (knowledge and information, etc.). Substitution from labor to capital progresses, and labor share declines.
(9) Information: Data collected from every aspect of consumers' daily lives is thoroughly utilized in each aspect of production activities via the utilization of AI and robots.
(10) Energy: Achievement of significant decarbonization. Declining needs for energy-intensive products such as car engines, gasoline, and steel.

Changes in Industrial Structure Towards 2050

(1) Electric Power: 20% increase in electricity demand. 60% renewable energy ratio. Progress on decentralization.
(2) Oil and Gas: Decreased demand due to electrification (70% decrease for petroleum products, 40% decrease for city gas). Fuel conversion to non-electrical energy.
(3) Steel: 40% reduction in crude steel production, change in manufacturing method to low-carbon process.
(4) Non-Ferrous Metals: 40% reduction in electrolytic copper production. Portion for exports goes to local production of goods.
(5) Chemicals: 30% reduction in domestic demand. Consolidation of basic products, process changes, strengthening downstream fields, etc.
(6) Food: Changes in raw material procurement SC, new methods of providing food.
(7) Automotive: Significant decrease in domestic production. Industrial structure that is not tied to hardware, business model that does not sell cars, PF for software and hardware development.
(8) Electronics: Stimulating demand in new areas related to humans' senses.
(9) Communications/Media: Communications infrastructure has mobile, off-road, and home-based connections, as well as non-terrestrial connections. Most advertisement is on the internet.
(10) IT: Expansion of services such as consulting, formation of software market even domestically in Japan.
(11) Consumption Services: EC ratio is 40%. Involuntary shopping will disappear. Unbundling and re-bundling of distribution functions.
(12) Mobility Services: Integration of daily life and mobility services
(13) Logistics: Decrease in things to carry. Complete automation of basic operations.
(14) Healthcare: Diversification of needs and shortage of human resources for healthcare.

Future Created by Changing Trends

Future Capturing Change and Leading to Growth

Two Futures

Future that is an Extension of the Current Situation — Chapter II

Ideal Form of Japanese Industry in 2050 — Chapter III

Source: Compiled by Mizuho Bank Industry Research Department

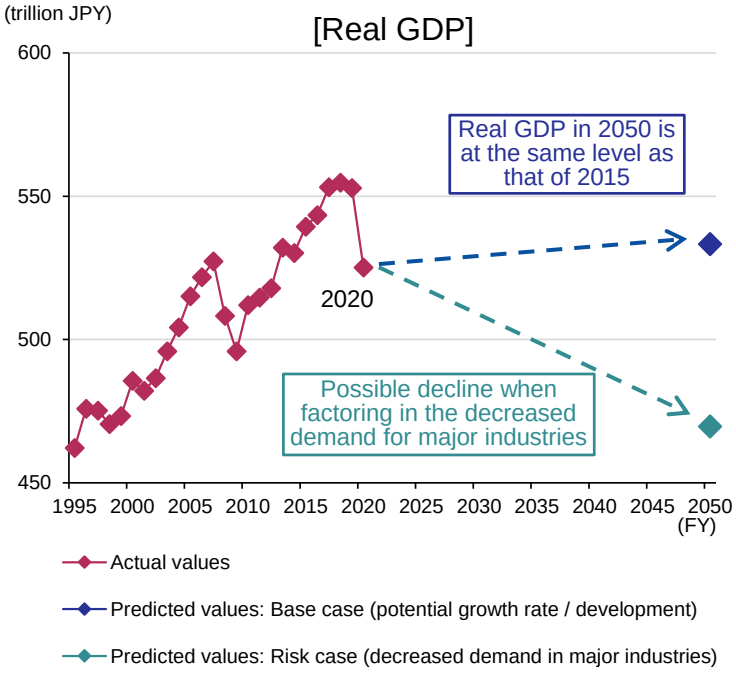
II. Future that is an Extension of the Current Situation

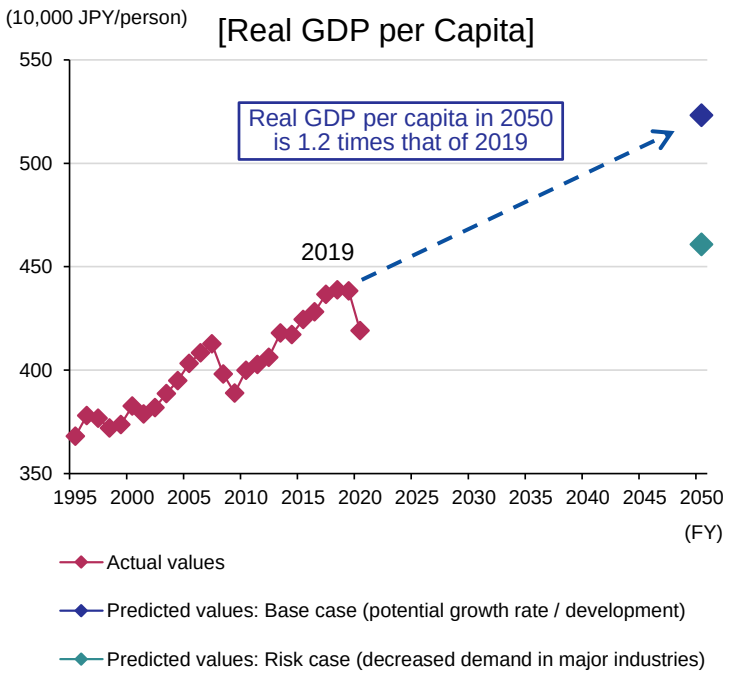
- Impacts of Lower Demand for Major Products
- Risks in Advancing CN
- Increased Imports of Resources and Materials
- Pressure on Household Budgets and a Worsening Trade Balance
- Increased Difficulty in Maintaining Health Care System

Japan's GDP May Fall Due to Lower Demand in Major Industries

- In the future, Japan will experience negative growth from the 2030s due to a significant decrease in the working-age population and due to stagnation in labor quality, the amount of capital input, and productivity growth (base case). Real GDP per capita is expected to remain 1.2 times that of 2019 by 2050.
- On the other hand, in terms of demand for the products and services of major industries, in addition to shrinking domestic demand, it is expected that exports and domestic production will decline due to the progress of local production for local consumption in the manufacturing industry (risk case). Compared to the above base case, real GDP per capita may decrease by 600,000 JPY, the required number of employees may decrease by approx. 7.00 million. (see note)

Japan's Real GDP





Note: Predicts the required number of employees based on labor productivity that was calculated from potential growth rates that incorporate underlying decreases in working-age population and working hours.

Source: Compiled by Mizuho Bank Industry Research Department based on ”System of National Accounts" by the Cabinet Office, the "JIP Database" by the Research Institute of Economy, Trade & Industry, and "Population Projection for Japan" by the National Institute of Population and Social Security Research (medium birth rate)

(Reference) Impact Assuming that the Added Value of the Automotive Industry, as of the Current Time, is Halved *Mechanical estimation

- We calculated the macro impact if the added value of the Japanese automotive industry is halved at this point.
  - It was calculated mechanically by dividing the change in each industry's added value by each industry's labor productivity (2018 results).
- The impact on added value and on the number of employees is large in manufacturing industries such as transportation machinery, steel, and non-ferrous metals.
  - On the other hand, from the perspective of the impact on the added value itself, there are also impacts on non-manufacturing industries such as automobile sales and leasing industries.

Primary Spillover Effects for Major Industries in an Input-Output Table

Industry	Real Added Value in 2018 (billion JPY)	No. of Employees in 2018 (thousands of people)	Impact of Halving the Added Value of the Automotive Industry			
			Real Added Value (billions JPY)	(vs. Added Value in 2018, %)	No. of Employees (thousands of people)	(vs. No. of Employees in 2018, %)
Transportation Machinery	15,654	1,328	-5,503	(35.2)	-467	(35.2)
Steel	7,063	294	-529	(7.5)	-22	(7.5)
Non-Ferrous Metals	1,920	171	-116	(6.1)	-10	(6.1)
Mining	210	43	-8	(3.9)	-2	(3.9)
Other Manufacturing Industries	11,077	2,183	-278	(2.5)	-55	(2.5)
Electrical Machinery	8,830	627	-166	(1.9)	-12	(1.9)
Electric power/Gas/Water Industries	8,842	655	-142	(1.6)	-11	(1.6)
Metal Products	4,006	862	-57	(1.4)	-12	(1.4)
All Industries	476,655	69,312	-7,979	(1.7)	-744	(1.1)
Manufacturing Industries	107,312	10,687	-6,978	(6.5)	-601	(5.6)
Non-Manufacturing Industries	369,273	58,615	-1,001	(0.3)	-143	(0.2)

Note 1: The "number of employees" shown here does not match the number of employees in the "Labor Force Survey" by the Ministry of Internal Affairs and Communications because it doubles the number of workers who work side jobs

Note 2: The estimated impact on the number of employees was calculated mechanically by dividing the change in each industry's added value by each industry's labor productivity (2018 results)

Source: Compiled by Mizuho Bank Industry Research Department based on "Extended Input-Output Table" by the Ministry of Internal Affairs and Communications and the "JIP Database" by the Research Institute of Economy, Trade & Industry

The Realization of CN Involves Large Investment and Expenses, and Major Changes in Industrial Structure

- The realization of CN involves large investment and expenses, and changes in industrial structure. As a result, there is the risk that it will lead to worsening household budgets, decreased industrial and corporate competitiveness, and decreased national sustainability.
- If CN is not realized because it has a large impact on each economic entity, then there are risks that activities will be hindered due to rising temperatures and intensifying disasters, etc.

Efforts for the Realization of CN and Possible Risks

Efforts for the Realization of CN	Changes if Effort Proceeds	Possible Risks
Shift to Clean Power Sources Expansion of renewable energy, reduction in thermal power generation, restart of nuclear power	**Large Investment and Expenses (transition costs, emission compensation)** New expansion of power sources, power grid expansion, raw materials and fuel/processing/converting supply chains, CO2 reuse and offsets, taxing carbon emissions	**Worsening Household Budgets (worsening employment, decreased income, increased spending)** Rising electricity prices, rising product prices
Progress in Electrification Shift to BEV, shift to ZEB/ZEH, etc.	**Destabilization of Product Procurement and Supply (disposal of infrastructure equipment, etc.)** Increase electrification rate, concerns about insufficient power supplies, scarcity of fossil fuel resources, disposal of basic material equipment that consumes significant energy, and increased dependence on imports (hydrogen, minerals, basic raw materials and fuels)	**Decreased Industrial and Corporate Competitiveness (worsening profits and cost structures)** Reduced sales (reduced demand, inability to convert environmental costs into sales prices, etc.), increased costs (procurement of raw materials and fuels), and worsening cost structures
Realization of Lifecycle CN Converting nuclear fuel materials, implementing recycling	**Changes in Industrial Structure (decreases in demand and production, input structure)** Decreased product demand, and transformation of the automotive industry pyramid due to the shift to EVs, etc.	**Decreased National Sustainability (decreased savings, loss of industrial base)** Loss of industrial base (industrial agglomeration/clustering, manufacturing bases, R&D bases), further hollowing out of Japan domestically

If CN is not realized because it has a large impact on each economic entity, then there are risks that activities will be hindered due to rising temperatures and intensifying disasters, etc.

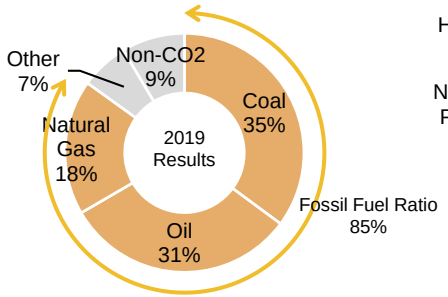
Source: Compiled by Mizuho Bank Industry Research Department

Investments Required in Each Industry Towards Energy Supply Systems Adapted to CN

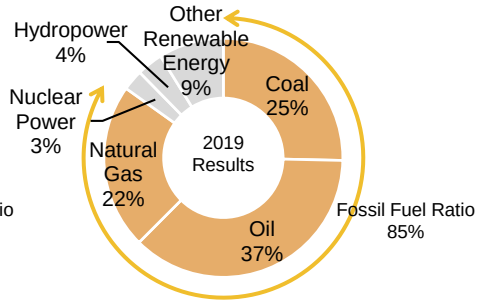
- In order to realize CN, it is necessary to change energy supply structures that depend on fossil fuels, which are the primary factor for GHG emissions.
  - There is an urgent need to construct energy supply systems that are adapted to CN, including in cases where CO2 is recovered while continuing to use fossil fuels.
- Each industry is expected to invest in converting their existing businesses and acquiring new opportunities while looking ahead to energy conversions.

Image of Changes in Energy Supply Structures due to CN

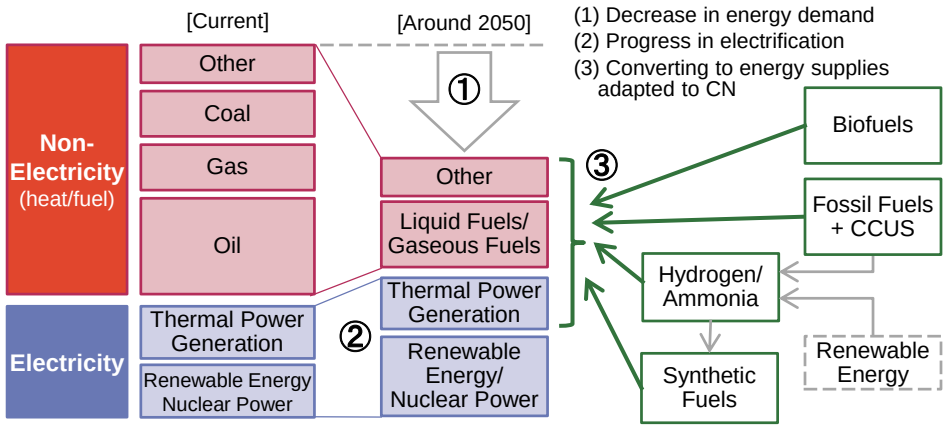
<Breakdown of Japan's GHG Emissions>



<Breakdown of Japan's Primary Energy>



<Image of Changes in Final Energy Supply Structure>



Note: Blue text in the figure on the right are those items that are highly related to changes in energy supply structure

Source: Compiled by Mizuho Bank Industry Research Department based on Total Energy Statistics, Ministry of the Environment materials, and Japan Business Federation materials

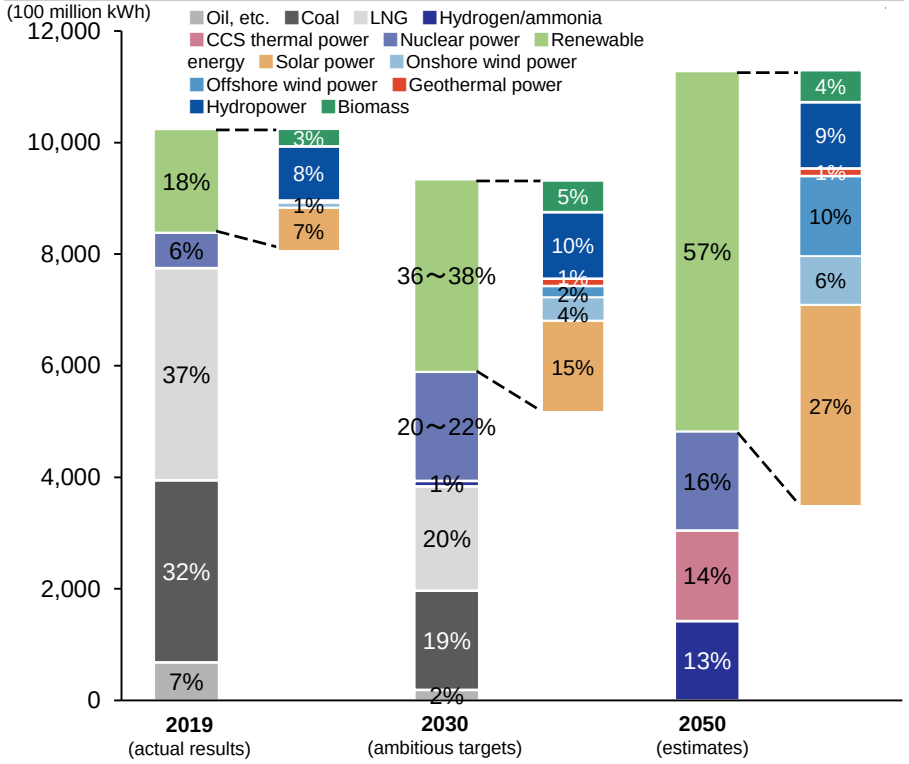
Investment Fields Towards CN in Each Industry

Electric Power	Renewable energy power sources (solar power, onshore/offshore wind power, next-generation solar power, etc.), thermal power generation (hydrogen/ammonia, biomass, CCUS), next-generation nuclear power, strengthening the power grid, storage batteries, shift to advanced supply and demand adjustments (DR)
Oil and Gas	Construction of hydrogen/ammonia SCs, methanation, synthetic fuels, e-fuel, SAF, green LP gas, CCUS, waste plastic recycling
Steel	Hydrogen utilization (COURSE50, SuperCOURSE50, direct hydrogen reduction), utilization/enlargement of electric furnaces, CCUS, ferro-coke, scrap utilization
Chemicals	Heat source conversion (hydrogen/ammonia utilization, electrification, high-efficiency naphtha decomposition furnaces), raw material conversion (biomass, methanation, artificial photosynthesis, CCUS), raw material recycling (chemical/material recycling)
Cement	Heat source conversion (biomass, hydrogen/ammonia, electrification), CCUS (recycled carbon cement production)
Paper and Pulp	Heat source conversion (biomass, hydrogen/ammonia, electrification), cellulose nanofibers, plastic replacement
Automotive	Electric vehicles (EV, PHEV, HEV, FCV), storage batteries (nickel, cobalt, lithium, copper), charging/hydrogen stations, synthetic fuels (e-fuel)
Logistics	FC trucks, CN-fueled ships, aircraft SAF utilization/electrification, hydrogen/ammonia SC construction, formation of CN ports
Electronics and Communications	Power semiconductors, communications infrastructure (data centers, base stations), 5G/6G, photonics (IOWN)
Consumer and Household	Electrification, ZEB/ZEH, BEMS, shift to wooden building construction, stable operation of the Community Energy Management System (CEMS)
Negative Emissions	CCUS, DACCS, BECCS, forestry measures

Electric Power Industry May Need to Invest Trillions of JPY in Renewable Energy by 2050

- On the assumption of decarbonization of the power sector, this slide details a simulation of a power source composition that will meet electricity demands in 2050.
  - While renewable energy centered around solar and wind power is expected to expand significantly, power source composition that includes nuclear power and zero-emission thermal power is assumed.
- The investment scale necessary to realize the below power source composition was calculated from current costs for each power source and target costs.
  - Even if only the capital costs for renewable energy are considered, it is estimated that trillions of JPY in investment will be required.

Outlook for Power Source Composition (2030 Target and 2050 Estimate)



Note: Power source composition (power generation amount) and installed capacity are calculated assuming annual power supply and demand
Source: Compiled by Mizuho Bank Industry Research Department based on various materials

Image of Installed Capacity Outlook and Scale of Investment Amount for Each Renewable Energy Power Source

Power Source Type, etc.	Assumed 2050 Scenario		
	Introduction Amount, etc.	Introduction Scenario	Investment Scale (capital costs)
Solar Power	260GW	Demand areas (homes, large facilities): 107 GW, Non-demand areas (rundown agricultural land, farms): 153 GW	30-51 trillion JPY
Onshore Wind Power	41GW	Introductions in grasslands, rundown agricultural lands, and mountains/forests where constant wind speeds (5m/s) can be secured	9-13 trillion JPY
Offshore Wind Power	45GW	Target value from Vision for Offshore Wind Power Industry	11-23 trillion JPY
Geothermal Power	2GW	2030 energy mix level	3 trillion JPY
Hydropower	51GW		
Biomass	7GW		
Strengthening Power Grid	—	Required investment amount in Master Plan	2-5 trillion JPY

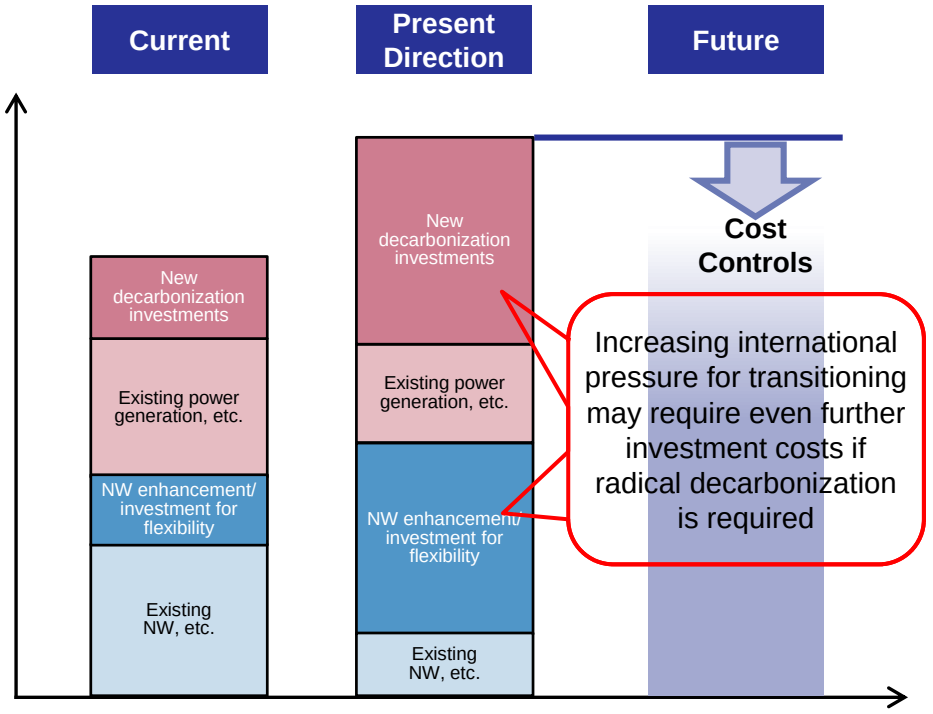
With Investment in and Maintenance of CN Power Sources, Power Costs Are Likely to Rise

- In order to realize carbon neutrality, it is necessary to maintain, renew, and strengthen the transmission and distribution networks that support decarbonization of power sources and the introduction of renewable energy, as well as to secure flexibility, so costs are likely to rise.
  - A scenario analysis conducted by the Research Institute of Innovative Technology for the Earth (RITE) shows that electricity costs in 2050 (see note 1) will be 24.9 JPY/kWh, which is an increase from current costs of 13 JPY/kWh.
- If it becomes difficult to realize the power source transition story that Japan has laid out, then there is the possibility that further cost burdens will occur.

2050 Scenario Analysis by RITE

Case	Reference Value Case (see note 2)	100% Renewable Energy Case
Power Demand	1.35 trillion kWh	1.05 trillion kWh
Power Source Composition	Renewable energy: 54% Nuclear power:10% CCS thermal power: 23% Hydrogen, etc.:13%	Renewable energy:100%
Power Cost	**24.9 JPY/kWh**	53.4 JPY/kWh
Notes	• The above power costs do not include sending end power costs (network costs). • **Estimated power costs for 2020 is approx. 13 JPY/kWh.**	

Image of Medium to Long-Term Direction for Investments in Power Infrastructure



Note 1: Power cost = Marginal cost of power (power cost at the sending end, with transport charges of approx. 10 yen/kWh added to retail power charges.)
Note 2: Scenario presented at the 35th Strategic Policy Committee of the Advisory Committee for Natural Resources and Energy by the Agency for Natural Resources and Energy, which will serve as a guidepost for future studies. Assumes that 50 to 60% of the power generated in 2050 will be covered by renewable energy.
Source: Compiled by Mizuho Bank Industry Research Department based on various published materials

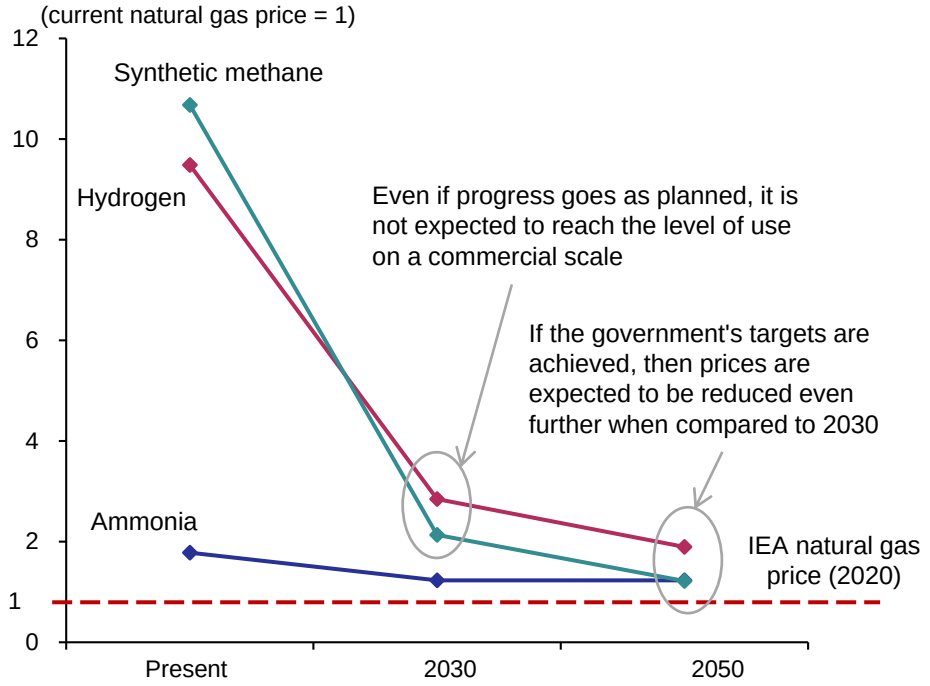
Reducing the Cost of Energy Adapted to CN Requires Time, with Commercial Use Expected around 2050

- Although the price of zero-emission energy such as hydrogen, ammonia, and synthetic methane are currently expensive, they are expected to decrease towards 2050 due to technological advances, etc., and their price difference with fossil fuels will narrow (the price level of fossil fuels has a large effect).
  - The price of fossil fuels is expected to decrease, but it is expected that costs for them will increase when compared to the present because of additional CN countermeasures such as CCUS.
- The current target is that the costs of hydrogen and synthetic methane around 2030 will be high, and commercial-scale use is expected to proceed over a long period of time.

Future Energy Price Trends in Japan

Energy		Price (JPY)		
		Present (2020)	2030	2050
Hydrogen (JPY/Nm3)	Green Growth Strategy	100	30	20
Ammonia (JPY/Nm3)	Public-Private Council on the Introduction of Fuel Ammonia	25	Upper 10s level	—
Synthetic Methane (JPY/Nm3)	Green Growth Strategy	350	70	40
[Reference] Crude oil ($/bbl)	APS	42	67	64
	NZE	42	36	24
[Reference] Natural gas ($/MMBtu)	APS	7.9	7.6	6.8
	NZE	7.9	4.4	4.2

Forecast for Price Changes vs. Current Natural Gas Prices (based on calorific value conversion)



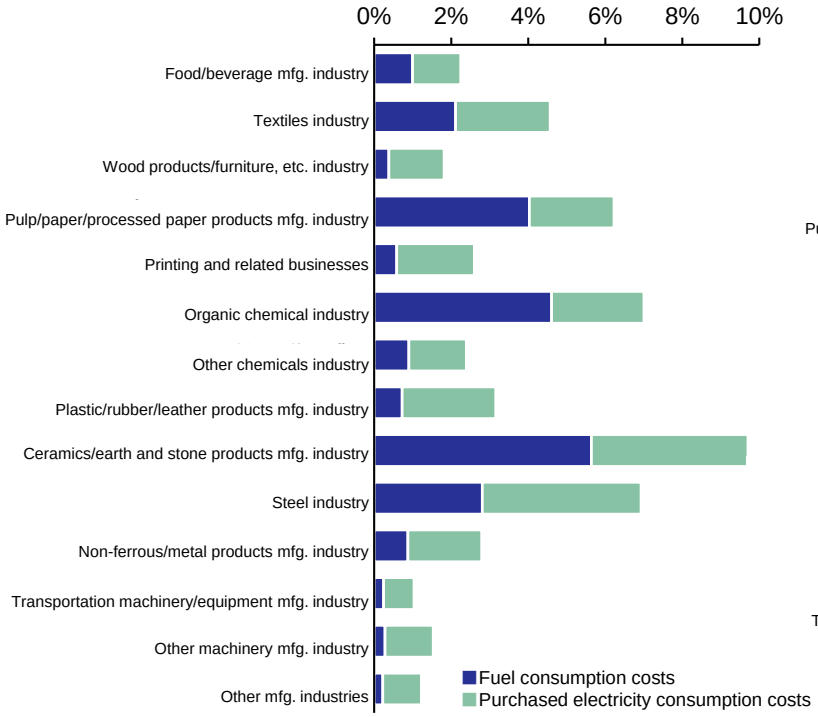
Note: APS (Announced Pledges Scenario): Scenario when all government-announced pledges are implemented. NZE (Net Zero Emission by 2050 Scenario): Scenario assuming achievement of net zero by 2050

Source: Compiled by Mizuho Bank Industry Research Department based on IEA, *World Energy Outlook 2021*, Green Growth Strategy, and the Interim Report by the Public-Private Council on the Introduction of Fuel Ammonia, etc.

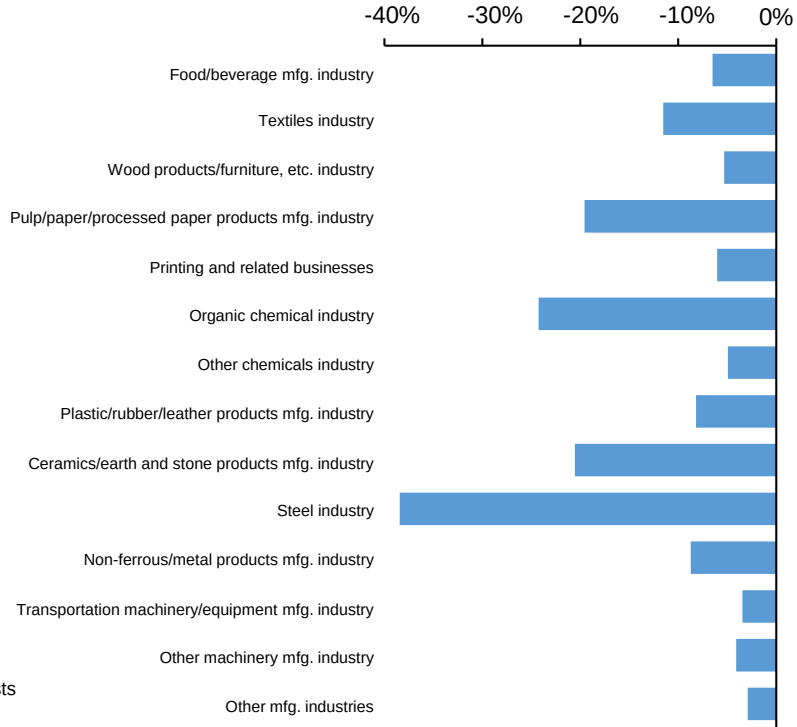
If Fuel/Electricity Consumption Costs Double Due to the Current Cost Structure, then Added Value of the Manufacturing Industry Will Decrease by Up to 40%

- As for the breakdown of the manufacturing industry's average production value in industrial statistics, added value accounts for 31.8%, and energy costs (fuel consumption costs, purchased electricity consumption costs) account for 3.1%. In particular, the material industries such as steel, petrochemicals, ceramics (cement), and paper/pulp have high energy cost ratios that will have a large impact on added value when prices rise.
- It will be necessary to pass on prices when energy costs rise, but it may be difficult to pass these costs on in industries that are exposed to international competition.
  - From the perspective of Japanese industry's international competitiveness, it is important to keep fuel costs and electricity prices at an appropriate level when compared to overseas countries.

Ratio of Energy Costs to Production Value



Estimated Added Value when Energy Costs Double



The impact of rising energy costs is significant, especially for material industries

Costs will be passed on to downstream industries, and **it will be necessary for the costs to be appropriately borne by the entire supply chain**

However, if an industry, or its downstream industries, is **exposed to international competition, there are issues in passing on prices**

Relative to energy cost levels in overseas countries

Note: Takes the average value of FY2017-2019 results. The added value calculation calculate the rate of decrease when energy cost doubles (fuel consumption costs, purchased electricity consumption costs)

Source: Both figures were Compiled by Mizuho Bank Industry Research Department based on the “Industrial Statistics 2020” by the Ministry of Economy, Trade, and Industry

(Reference) Estimated Raw Material and Fuel Costs for Hydrogen-Reduced Iron in the Steel Industry

- Estimated cost changes when converting from a blast furnace process to 100% hydrogen-reduced iron to support CN for the steel industry.
  - Costs are expected to significantly increase by switching from in-house power generation via blast furnace byproduct gases to CN power (external procurement) and from coal to hydrogen as a reducing agent.

	Existing Blast Furnace Process			100% Hydrogen-Reduced Iron + Electric Furnace (at current costs)			2050 Forecast	
	Basic Unit	Unit Cost	Basic Unit Cost	Basic Unit	Unit Cost	Basic Unit Cost	Unit Cost	Basic Unit Cost
Coking Coal (reduction amount)	385 kg	14,301 JPY/t	5,505 JPY/t	0	–	0	–	0
Coking Coal (byproduct gas)	315 kg	14,301 JPY/t	4,505 JPY/t	0	–	0	–	0
Grid Power	140 kWh	12.5 JPY/kWh	1,750 JPY/t	1,049 kWh	12.5 JPY/kWh	13,113 JPY/t	25 JPY/kWh	26,225 JPY/t
In-House Power Generation	177 kWh	0 JPY /kWh	0 JPY/t	0	–	0	–	0
Hydrogen	0	–	0	1,491 Nm3	100 JPY/Nm3	149,100 JPY/t	20 JPY/Nm3	29,820 JPY/t
Total			11,760 JPY/t			162,213 JPY/t		56,045JPY/t

+150,453 JPY/t

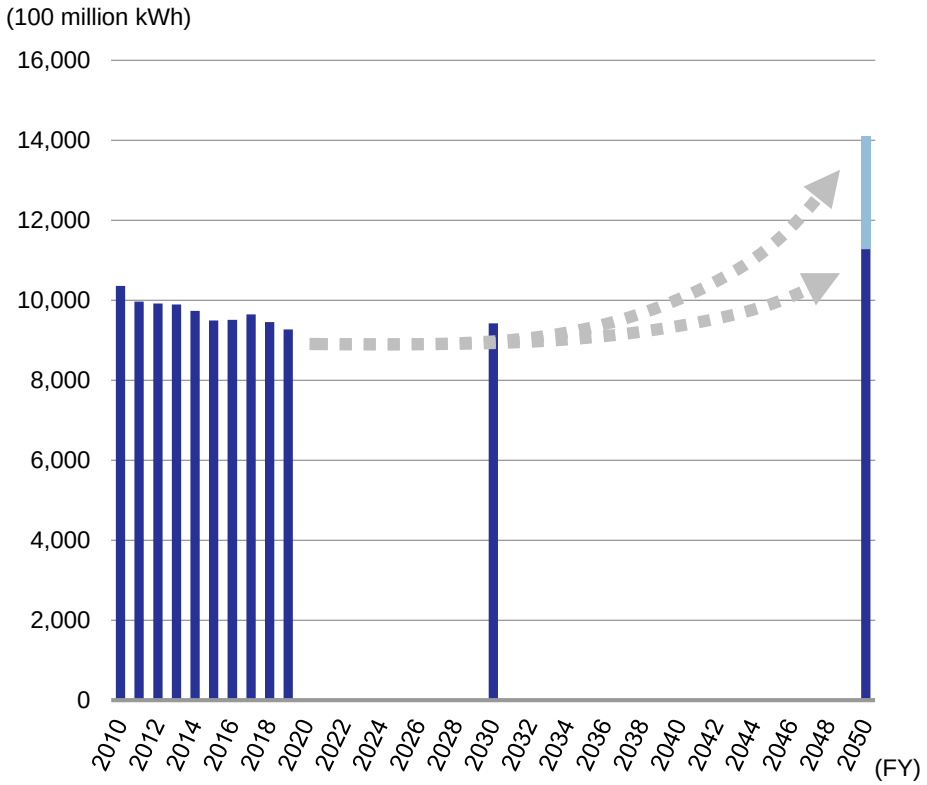
+44,285 JPY/t

Note 1: [Basic Unit Costs] For coking coal, grid power, and hydrogen: From The Japan Iron And Steel Federation materials; In-house power generation: Calculated by dividing blast furnace steelmaking in-house power generation consumption amount (General Energy Statistics) by the amount of crude steel in a blast furnace.
Note 2: [Actual Unit Costs] Coking coal cost: Average import price from 2015 to 2019 (Trade Statistics); Grid power cost: Calculated by dividing the purchased electricity consumption costs for the steel industry (Industrial Statistics) by the business power consumption amount for the steel industry (General Energy Statistics)
Note 3: [Future Unit Costs] Grid power: Estimated marginal cost of power in 2050 via RITE. Grid costs were not included.
Source: Compiled by Mizuho Bank Industry Research Department based on The Japan Iron And Steel Federation materials, the General Energy Statistics, the Industrial Statistics, and RITE materials

Forecast 2050 Domestic Electricity Demand - Dependence on electricity is Expected to Increase

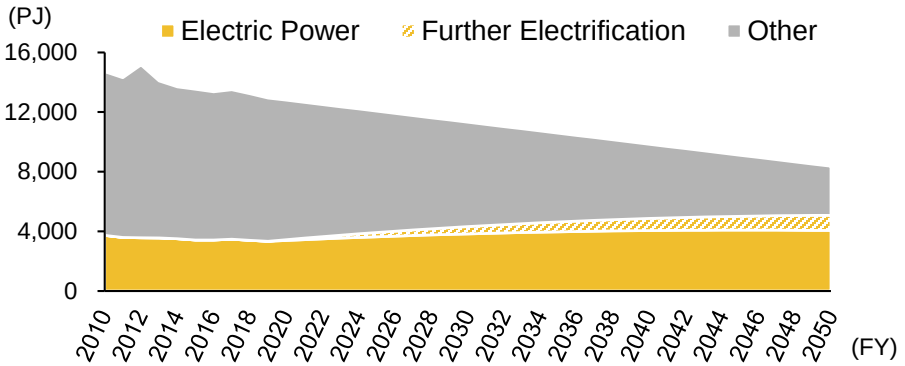
- In aiming to realize carbon neutrality by 2050, final energy consumption is expected to be significantly reduced, while electricity demand will increase due to progress in electrification, and in 2050 it is expected to be approx. 1.1 - 1.4 trillion kWh.
  - If electrification progresses even further in the industrial, commercial, transportation, and household sectors, and if the hydrogen demand in each sector is met by domestic electricity, then electricity demand may greatly increase.

Outlook for Domestic Electricity Demand

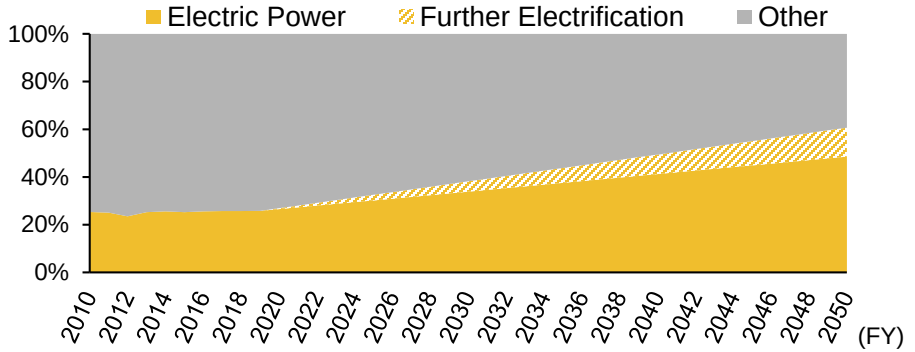


Note: Simply estimated as power demand = power generation amount
Source: Compiled by Mizuho Bank Industry Research Department

[Reference] Outlook for Final Energy Consumption



[Reference] Outlook for Electrification Rate in Final Energy Consumption

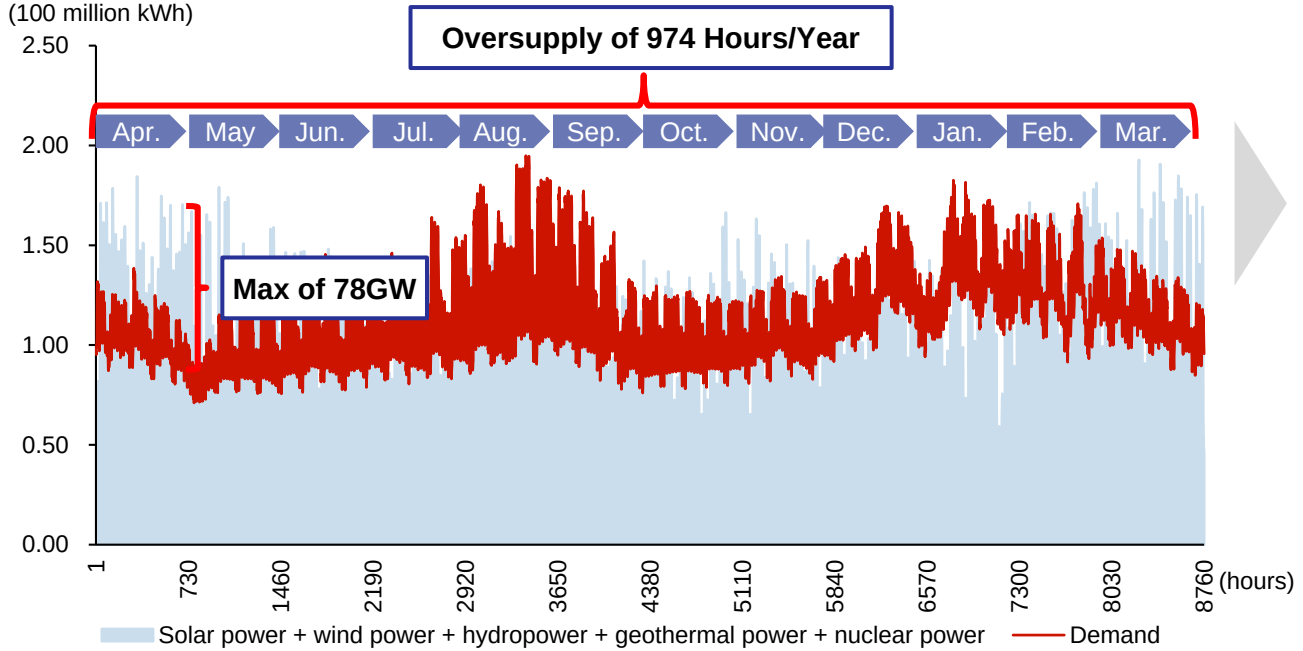


Note: The final energy consumption in 2050 set in this estimation and a transition image of the portion of the final energy consumption to realize the electric power ratios assuming that they change linearly from the present

Amidst an Expansion in Renewable Energy that is not Suitable for Output Adjustments, Appropriate Control of Supply and Demand is Important

- In 2050, balancing of grid electricity will be realized by appropriately controlling both fluctuating supply and demand.
- Based on current electricity supply and demand, when estimating hourly power demand in the 2050 cross section and the power supply from solar power, wind power, hydropower (excl. pumped storage), geothermal power, and nuclear power, which are not suitable for output adjustments, there will be oversupply for 974 hours per year, with surplus power generation of up to 78 GW.
  - It will be necessary to utilize the power adjustments by pumping water for water storage, storage batteries, and demand response, etc., as well as biomass, advanced operation of CCS thermal power, etc., and utilizing surplus power via hydrogen production.

Simple Analysis of Hourly Supply and Demand for FY2050



Oversupply Time Zones

- Pumping water up for water storage
- Charging storage batteries
- Demand generation via demand response
- Hydrogen production via water electrolysis
- Curtail biomass output, etc.

Insufficient Supply Time Zones

- CCS thermal power generation
- Hydrogen/ammonia power generation
- Power generation via pumped water storage
- Discharging storage batteries, etc.

Note: Electricity demand is calculated as grid demand, is the value obtained by subtracting the power generation amount by solar power in demand areas from total demand (estimated by Mizuho Bank Industry Research Department).
For solar power, wind power, and hydropower (excl. pumped storage), the amount of power generated per hour is calculated based on power generation patterns in FY2020 and estimated power generation amounts in FY2050.
For nuclear power and geothermal power, the estimated power generation amount for FY2050 was evenly distributed across each hour.

Source: Compiled by Mizuho Bank Industry Research Department

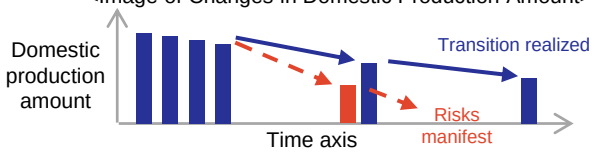
Possible Risks to Stable Domestic Supply, If Equipment Disposal/Scrapping Rapidly Progresses in High-Emissions Industries

- For domestic high-emission industries, the progress of trends such as large amounts of CN investment, increased energy costs, and strengthened regulatory policies may make it difficult for individual companies to cope with such trends, and may accelerate the disposal/scrapping of domestic manufacturing equipment beyond decreases in domestic demand.
- In addition to worsening the trade balance due to the increase in imports of substitute products, rapid equipment disposal/scrapping is a risk factor for stable domestic supply, including the impact on downstream user industries and consumers, increased risks of price fluctuations, and dependence on specific importers.

Factors that could Accelerate Equipment Disposal/Scrapping Toward CN

Investment/ Costs	➢ Decline in profitability and international competitiveness due to increased energy costs ➢ Avoidance of new investment due to large investment burden and expected decreases in domestic demand
Policy (regulations, etc.)	➢ Increased cost burden due to the strengthening of CP policy, etc. ➢ Increased electricity procurement costs due to tightened regulations on in-house power generation of thermal power
Investors (finance)	➢ Reduction of production beyond demand due to excessive GHG reduction requests by investors ➢ Curbing of investment and lending to high-emission industries by investor-side CN response

<Image of Changes in Domestic Production Amount>



Risks of Rapid Equipment Disposal/Scrapping on Stable Domestic Demand

	Assumed Equipment	Export Ratio and Characteristics	Import Ratio and Characteristics	Risk Factors in Stable Domestic Supply if Equipment Disposal/Scrapping Progresses
Petroleum products	Refinery	16% Surplus is exported to Australia and other countries in short supply	23% Individual import of naphtha and other deficient products	✓ Risks of delay in supply of daily necessities (gasoline, kerosene, etc.) ✓ Concerns about an effect on the stable procurement of petrochemicals raw materials ✓ Risk of dependent on the Middle East and other import source ✓ Impact of overseas supply/demand and production trends on individual product prices
Petro-chemicals	Ethylene Plant In-House Power Generation	43% Exports adjusted for global supply and demand trends	17% Import of some raw materials	✓ Concerns that domestic production of medical, food, and other necessities and functional chemical products will become impossible, affecting downstream user industries ✓ Risk of dependent on imports from S. Korea and ASEAN, etc.
Steel	Blast Furnace/ Converter Furnace System Coking Furnace In-House Power Generation	41% Exports of semi-finished products processed downstream overseas increased.	11% Some general-purpose products are imported from S. Korea, etc.	✓ Qualitative risk of delays in the procurement of products that meet standards and specifications ✓ The difficulty of timely and appropriate delivery will worsen the productivity of downstream user industries ✓ Prices may be exposed to fluctuations in global steel supply and demand (highest/lowest thin-plate prices since 2020→1.9x in Japan, 4.1x in the US)
Cement	Clinker Manufacturing In-House Power Generation	19% Primary purpose is to maintain equipment utilization rate	0% Imports are almost nonexistent and difficult	✓ Imports are essentially difficult (or expensive), so if domestic demand cannot be met, then there are concerns that supply will be insufficient ✓ Production in downstream user industries may be delayed
Paper and Pulp	Pulp/Paper Manufacturing In-House Power Generation	8% Demand for paperboard to overseas bases, etc.	5% Declining trend due to shrinking domestic demand	✓ Risk of insufficient supply of toilet paper and other necessities ✓ Domestic logistics and exports may stagnate due to shortage of cardboard ✓ Risk of becoming dependent on ASEAN and China, etc. for import sources

Note: Import/export ratios are 2020 results. The export ratio is the ratio of export volume to domestic production volume, and the import ratio is the ratio of import volume to domestic demand volume. Calculated based on indicators in each industry for petroleum products to fuel oil; steel to crude steel; petrochemicals to ethylene conversions; cement: cement; paper and pulp to paper and paperboard.

Source: Compiled by Mizuho Bank Industry Research Department based on Petroleum Association of Japan materials, The Heavy & Chemical Industries News Agency materials, The Japan Iron And Steel Federation materials, Japan Cement Association materials, and Japan Paper Association materials, etc.

CP is an Important Policy Tool, and Carbon Prices are Expected to Continue Rising Globally

- Japan's carbon price is low, as the global warming countermeasure tax is at 289 JPY/tCO2, but it is necessary to consider an integrated CP policy that includes implicit CP, such as energy taxation. For companies, it is important to be prepared for Japan's strengthening of CP policies for the realization of CN.
- Carbon prices are rising amidst a spread in CP policies, primarily in Europe, that encourage securing financial resources and changing behaviors. Carbon prices exceed 10,000 JPY/tCO2 in some cases.

Japan's CP Policy/Carbon Price

Explicit Carbon Pricing

Prices that are priced per unit amount for emitted GHG

Typical Example: **Carbon Tax** | **ETS**

<Current Situation in Japan>
Petroleum and coal tax (of which the **global warming countermeasure tax**)
・Carbon price: 289 JPY/tCO2
・Introduced as a carbon tax in 2012

Low level compared to other countries that have introduced a carbon tax

Implicit Carbon Pricing

Cost are incurred not for GHG emissions, but for compliance with energy taxation and emission reduction regulations

Ex.: Energy tax, FIT, subsidies, tax incentives

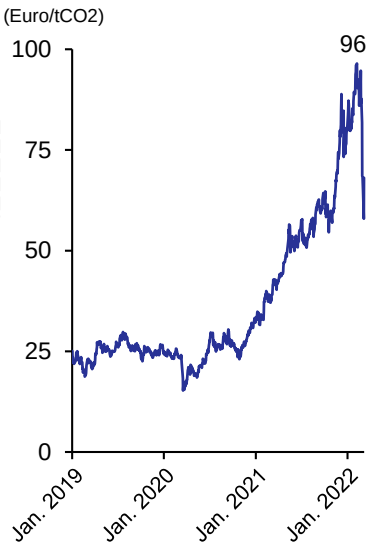
<Ref.: Japan's Energy Taxes>
Volatile oil tax, oil and gas tax, power development promotion tax, petroleum and coal tax, light oil take-back tax, aircraft fuel tax

Although carbon prices in Japan are low, it is necessary to consider the ideal CP policy as a whole, including implicit CP such as energy taxation

Global Results/Outlook for Carbon Prices

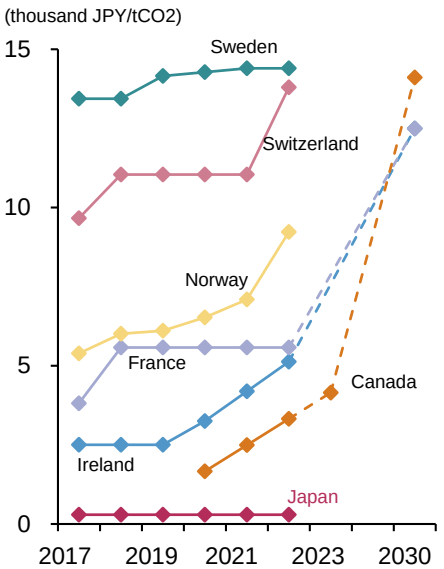
EU-ETS Carbon Price Results

Carbon prices have already soared in the EU as green policies have been strengthened



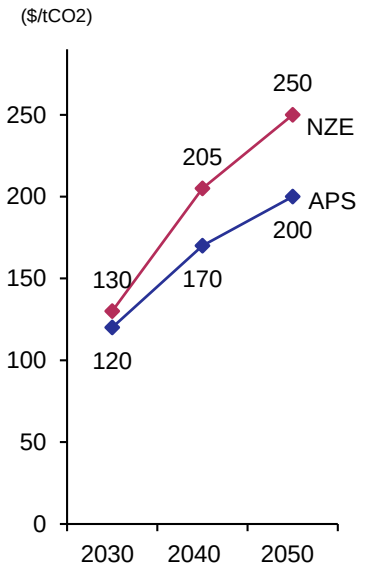
Carbon Tax Rates in Major Countries that have Introduce a Carbon Tax

Raising carbon tax rates in EU countries, etc. and presenting outlooks for 2030 are advancing



IEA Carbon Price Outlook (developed countries)

Carbon prices in developed countries will sharply rise towards 2050 (including implicit CP)



CP policy is an important policy measure for CN in terms of "**promoting behavior change**" and "**securing necessary investment resources**" .

Carbon prices are expected to rise in the future, taking into account increased CN compliance and reductions in tax revenue due to reductions in GHG emissions

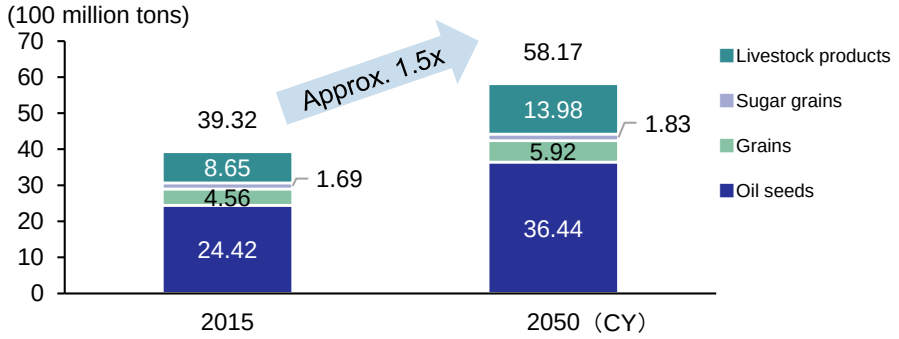
Source: Compiled by Mizuho Bank Industry Research Department based on IEA, Bloomberg, and Ministry of the Environment materials, etc.

Increased Global Food Demand Raises Concerns about Food Shortages and Rising Food Prices

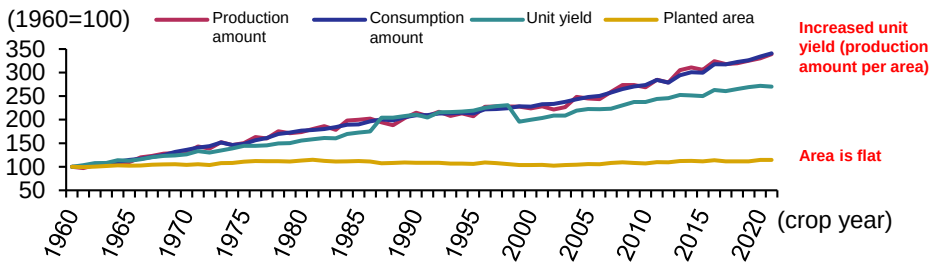
- In 2050 global food demand is expected to grow to 1.5 times the 2015 level.
- Until now, food supply has been covered primarily by increasing unit yields. In order to respond to increasing food demand, there are concerns that food prices will rise due to food shortages unless unit yields continue to rise.
- Japan's food self-sufficiency rate is relatively low, so if it is not improved then risks may become apparent both in terms of security quantity and in rising prices. Food prices in Japan, which are already soaring, may rise even further due to recent increases in raw material prices.

(World) Food Demand and Food Prices

Worldwide Food Demand Outlook by Item



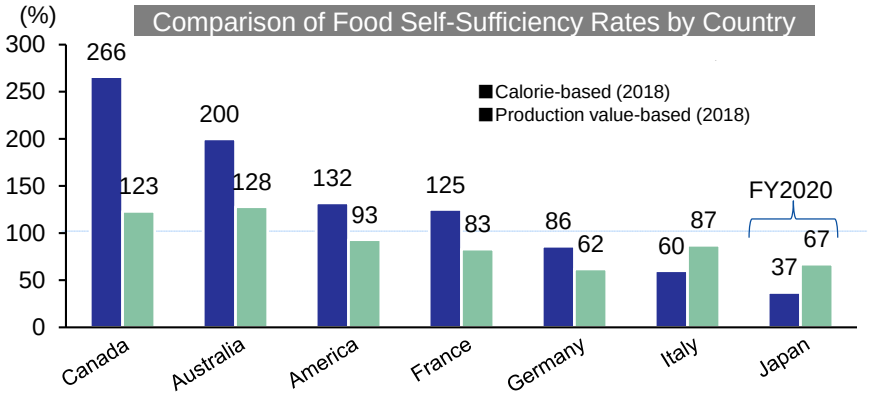
Changes in Worldwide Grain Supply and Demand, Unit Yield, and Acreage



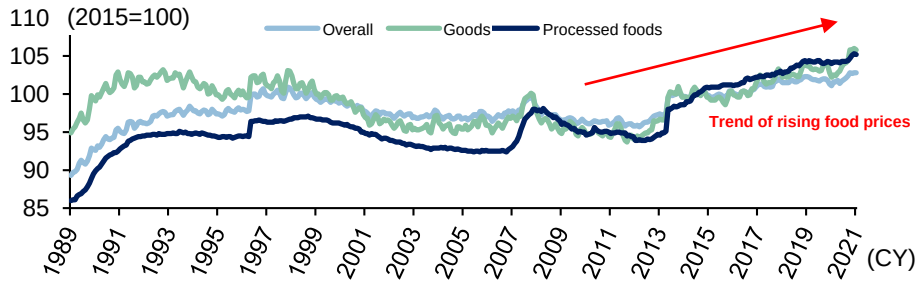
Note: Crop year is the year specified for each grain. For example, for wheat one crop year is from September to August of the following year
Source: Compiled by Mizuho Bank Industry Research Department based on the "JAPAN Ling-term World Food Supply and Demand Projection for 2050" by the Ministry of Agriculture, Forestry and Fisheries and the US Department of Agriculture

(Japan) Food Self-Sufficiency Rate, Consumer Price Index

Comparison of Food Self-Sufficiency Rates by Country



Trends in Consumer Price Index (Japan)

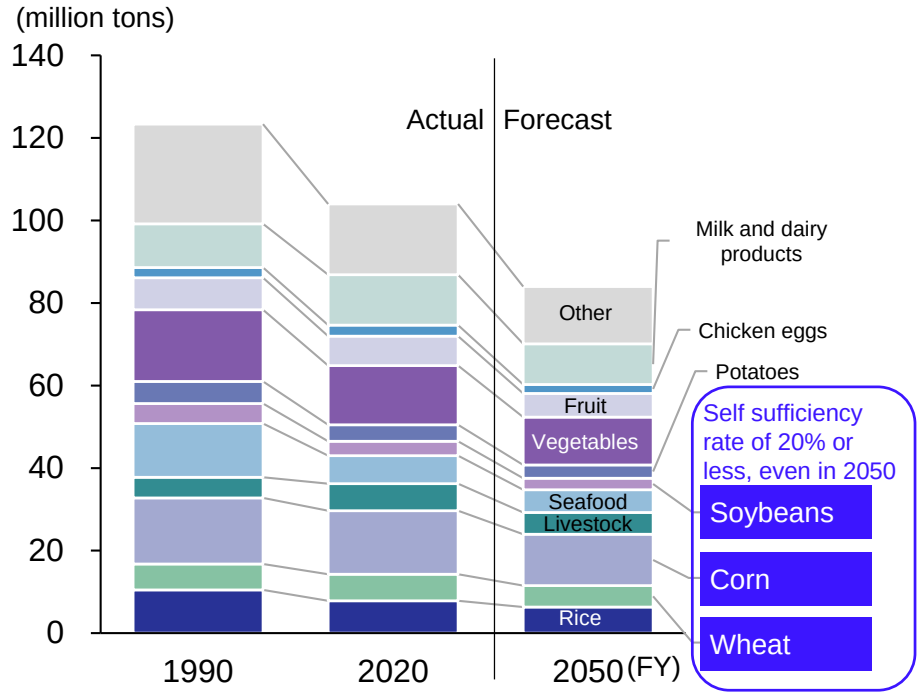


Note: Figures are calendar years (fiscal years for Japan only). Livestock products and processed foods were calculated in consideration of imported feed and imported raw materials.
Source: Compiled by Mizuho Bank Industry Research Department based on the Ministry of Agriculture, Forestry, and Fisheries and Ministry of Internal Affairs and Communications websites

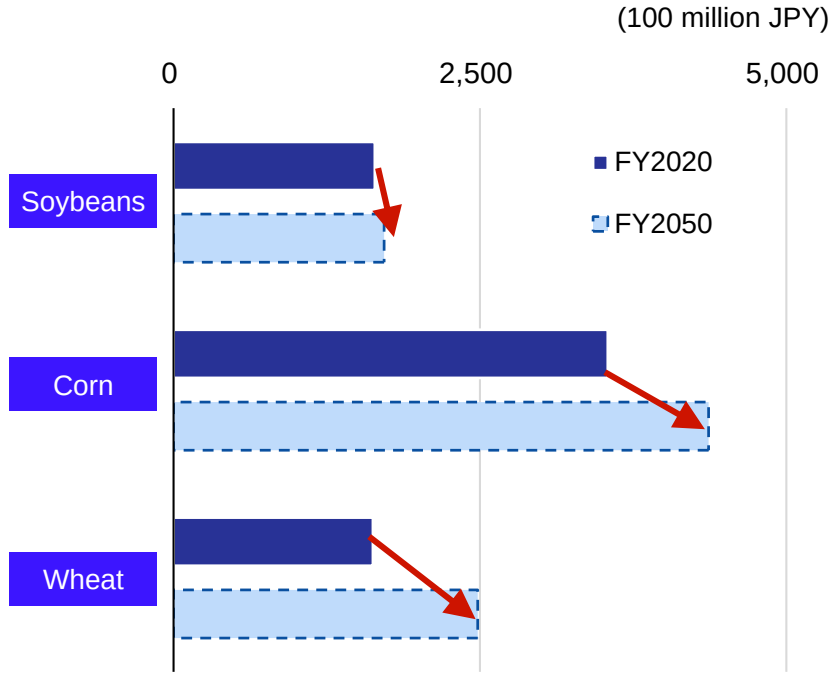
If Food Self-Sufficiency Rate Remains Low, There is a Risk that Food Imports will Increase

- Japan is one of the world's leading food importers, with most food demand being covered by imports. Consumption is expected to decrease in the future, primarily due to population decline.
- If the food self-sufficiency rate remains low, then there is the risk that unit import prices will rise due to a rise in food prices on a global scale and losing out in the competition for food, which would decrease import quantities but increase import values.

Domestic Food Consumption Outlook



Value of Grain Imports (Japan overall)

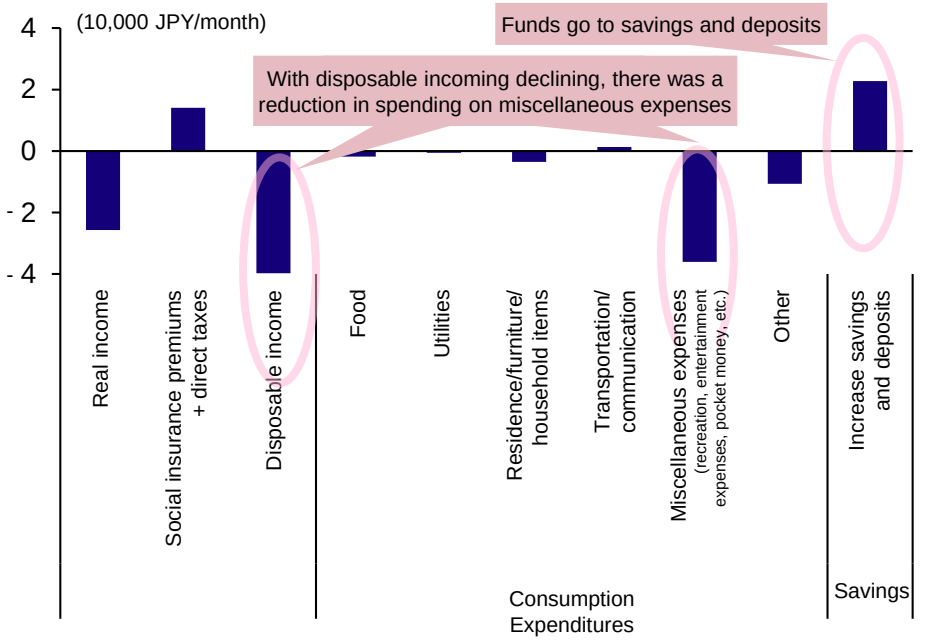


Note 1: The self-sufficiency rates for each food for 2050 are rice (128%), wheat (18%), corn (0%), livestock (65%), seafood (68%), soybeans (8%), potatoes (90%), vegetables (99%), fruit (47%), chicken eggs (120%), milk and dairy products (75%), and other (71%).
Note 2: It is assumed that import unit prices (import value ÷ import volume) in 2050 will rise to the same level as in 2008 (during the food crisis). Import unit prices vs. 2020 will be 2.0x for wheat, 1.6x for corn, and 1.4x for soybeans. Import unit prices were divided by annual exchange rates (TTB) for comparison.
Source: Both figures were Compiled by Mizuho Bank Industry Research Department based on the "Food Supply and Demand Table" by the Ministry of Agriculture, Forestry and Fisheries, Trade Statistics by the Ministry of Finance, and " Population Projection for Japan" by the National Institute of Population and Social Security Research

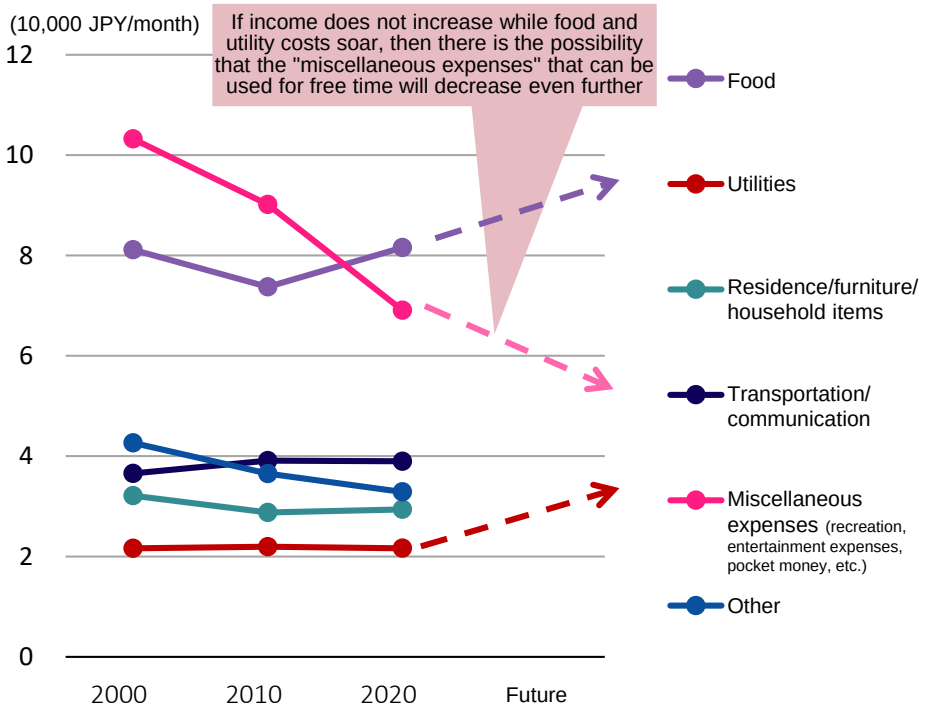
If the Cost-of-Living Increases Without an Increase in Income, then Money that can be Used in Free Time will Decrease

- Due to decreases in real incomes and increases in social security expenses, etc., per household disposable income decreased by approx. 40,000 JPY over 20 years.
- Consumption spending is continuing to decline. Living costs, such as for food and utilities, are flat, but expenditures for free time, such as miscellaneous expenses, are declining.
  - Due to concerns about the future, there is a tendency for funds to be used for deposits and savings.
- In the future, if living costs increase due to intensifying competition for food and resources, then there is a possibility that there will be no room for miscellaneous expenses.

Changes in Household Income and Consumption Expenditures (2000→2020; working households with two or more people)



Direction of Future Consumption Expenditures (working households with two or more people)

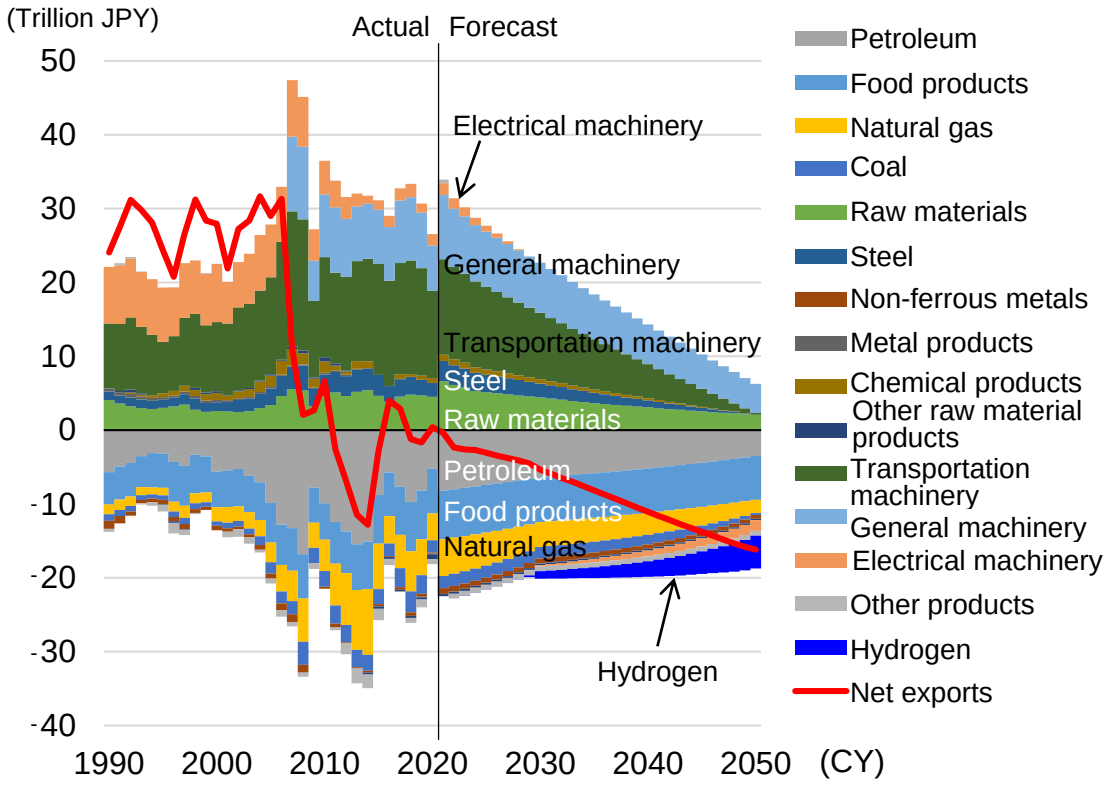


Note 1: Working households with two or more people. Monthly basis
Note 2: For each figure in 2020, the effect of the special benefit payment is deducted from the statistical figures.
Note 3: Figures after 2018 are corrected for the impact of a change in methods using fluctuation adjustment values and year-on-year nominal rate of increase/decrease.
Source: Both figures were Compiled by Mizuho Bank Industry Research Department based on "Family Budget Survey" by the Ministry of Internal Affairs and Communications

Japan's Trade Deficit May Increase, and it is Necessary to Improve the Self-Sufficiency Rate and to Increase the Income and Services Balances

- Imports of fossil fuel resources, such as oil and natural gas, will decrease towards the realization of CN, while imports of hydrogen will increase. The trade balance will become significantly negative because of a decrease in net exports of transportation machinery and continued imports of food products.
- In order to secure the current balance, it is essential to expand the income balance and the service balance in addition to further improving the energy and good food self-sufficiency rates.
  - In the manufacturing industry as well, it is necessary to switch to a service model that leverages existing strengths.

Japan's Trade Balance



Fossil Fuel Resources Trade Deficit Shrinks but Persists

- ✓ Demand for fossil fuel resources will remain reasonable, and prices will not significantly drop.
- ✓ Domestic consumption will decline, but the trade deficit will persist.

Imports of Non-Fossil Fuel Resources and Materials that Support the Realization of CN will Increase

- ✓ Hydrogen imports, which support the decarbonization of energy consumption, will increase. Furthermore, the prices of mineral resources and materials will remain high due to tight supply and demand, so import values will increase.

The Manufacturing Industry's Contribution to a Surplus will Decrease due to the Impact of Local Production for Local Consumption, etc.

- ✓ Automobiles, chemical products, and machinery will be locally produced for local consumption due to the perspectives of decarbonization, strengthening economic security, and capturing overseas demand.

Domestic Demand for Electrical Products will Increase, but Excess Imports will not Change

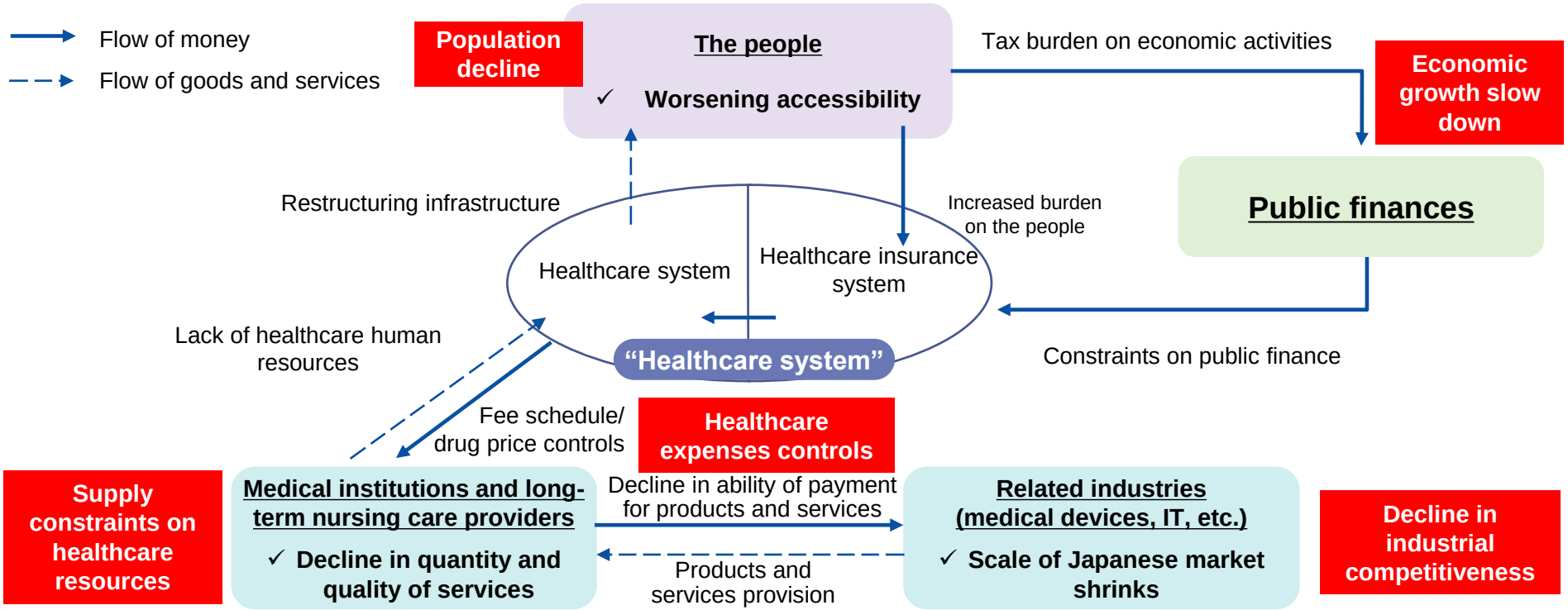
- ✓ While the number of equipped devices per person is increasing, overseas manufacturers are pinning down the market and there will continue to be an excess of imports.

Source: Compiled by Mizuho Bank Industry Research Department based on “Trade Statistics of Japan" by the Ministry of Finance

Maintaining the current healthcare system will lead to “the future to avoid,” and there is an urgent need for reform by changing the design concept

- While maintaining the basic design of the healthcare system, which is premised on population growth and economic growth, it will be difficult to sustain it simply by repeatedly making gradual revisions such as curbing benefits and increasing people’s burden. As a result, the reform of the healthcare system is likely to fall into a negative spiral.
- In order to ensure the sustainability of the system towards 2050, it is urgently necessary to move forward with changing to a design concept that is premised on a declining population and slowing economic growth. We need to start with reforming the system through measures such as the visualization of burden and resources aiming to make maximal use of constrained resources.

Image of “future to avoid" that is coming by maintaining the current healthcare system



Source: Compiled by Mizuho Bank Industry Research Department

In the Future, Industries and Companies will Lose Competitiveness, Public Finances will Become Less Sustainable, and Individuals will Continue to be Anxious

- If the country is unable to respond to the structural changes caused by changing trends, then individuals will not be able to feel affluence in their lives and will be anxious, and the country, with continuing sluggish consumption and investment, will not be able to ensure decarbonization and economic security. Industries and companies are concerned about a decline in international competitiveness.

A Future that Continues on the Current Path

- **Japan's GDP may fall below the potential growth rate** due to declining demand for major industries.
- If the automotive industry's added value decreases, **then it will spread to the added value and employment of other industries.**
- If CN is not realized, then there are risks that activities will be hindered due to **rising temperatures and intensifying disasters, etc.**
- Rapid conversion to CN will be accompanied by **an increase in investment burden, expanded dependence on electricity, and drastic changes in industrial structure.**
- If the cost of living increases without increases in income, then the **money that can be used for free time will decrease.**
- If self-sufficiency rate for resources and food are not increased, then the **trade balance will worsen.**
- **The health insurance system** could **fall into a negative spiral.**

National

- Stagnation of domestic investment due to sluggish consumption and decline in potential growth rate
- Trade deficits become normalized, and the current balance worsens
- Neither decarbonization nor resources/energy self-sufficiency can be realized
- Difficulty in maintaining the social security system under constraints on public finances

Industrial/ Corporate

- Worsening profits and declining international competitiveness due to the increased burden for achieving decarbonization
- Restrictions on investments for global expansion and productivity improvements
- Loss of domestic industrial base (clusters, core equipment)

Individual

- Decrease in money that can be used to meaningfully spend an increasing amount of free time
- Anxiety about the future due to the decline in the sustainability of social security systems such as medical care

It is necessary to take measures that will lead to individual growth and national development as industries and companies grow in response to changing trends

Source: Compiled by Mizuho Bank Industry Research Department

III. Ideal Form of Japanese Industry in 2050

- (1) Achieve Stable Procurement and Stable Supply of Energy/Resources, and Achieve the Decarbonization of Society as a Whole
- (2) Capturing Demand Globally by Providing Value away from Product Dependence while Utilizing Technological Capabilities
- (3) Utilizing Technology to Increase Productivity and Continue to Provide Life-oriented Services

Ideal Forms for Japanese Industries and Companies - Based on Structural Changes and Japan's Strengths and Challenges

- This chapter lays out a vision for the ideal forms of Japanese industries and companies, based on future structural changes and Japan's strengths and challenges.
- Realizing these ideal forms for Japanese industries and companies is likely to lead to individual growth and national development.

Changes in Society, Consumers, and Industrial Structure	Japan's Strengths	Japan's Challenges
• Emphasis on individual diversity • Emphasis on environment and value of experience • Transition from "goods" to "services"	• A domestic market of a certain scale with a population of more than 100 million • Manufacturing technologies (high functionality, quality, and safety), low carbon, energy saving, resource saving, recycling technology	• Increasing productivity (decreased domestic demand and labor shortages) • Shift to sustainable social security and infrastructure (financial resources, etc.) • Securing stable energy, resources, and food

Future Forms Based on Structural Changes and Japan's Strengths and Challenges

Ideal Forms for Japanese Industries and Companies

Ideal Form (1)

Realizing the stable procurement and supply of energy and resources, and the decarbonization of society as a whole

Stability, Independence, Environmental Harmony

- Clean energy
- Carbon-free hydrogen
- Synthetic fuels and synthetic methane
- Adjustments for power supply/demand
- CCUS solutions
- Solutions for low carbon production
- Comprehensive energy provisioning
- Overseas expansion of solutions
- Recycling
- Sustainable food

Ideal Form (2)

Capturing domestic and overseas demand by providing value for decarbonization products while utilizing technological capabilities

High Functionality and Problem Solving

- Planning and designing vehicles and services
- Application development
- Providing production technologies and mass production capabilities
- Comprehensive provision of materials
- Providing cutting-edge materials
- Optimal solutions for vehicle body structural materials

Ideal Form (3)

Utilizing technology to continue increasing productivity and providing services that are close to daily life

Efficiency, Diversity, Convenience, Value of Experience

- Joint ownership and maintenance of assets
- Personalized services
- Providing value of experience
- Proposing optimized logistics
- Matching services
- Community life services
- PF for services and contents
- Providing next-generation communications NW

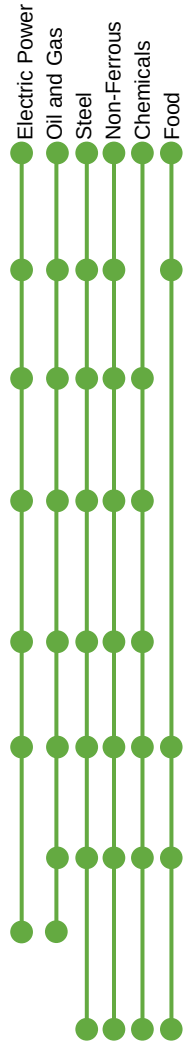
Ideally, these forms will lead to the growth of industries and companies, which in turn will lead to individual growth and national development.

Source: Compiled by Mizuho Bank Industry Research Department

[Ideal Form (1)]Achieve Stable Procurement and Supply of Energy/Resources, the Decarbonization of Society

- Clean energy production by maximizing the use of clean power sources, strengthening resource recycling, and fostering green/food tech companies.

		Initiatives Required for Japanese Industries and Companies		Japan's Strengths (red text) and Challenges
Research and Development	1	Technological Innovation for Self-Sufficiency	➢ **Foster green tech and food tech companies** (Establish technologies for batteries, semiconductors, and renewable energy. CO2 utilization technologies such as artificial photosynthesis. Smart agriculture, plant factories, and land cultivation) **[Common]**	➢ It is indispensable for establishing supply systems that do not rely on imported sources. **Japan leads in some technologies.**
Upstream Interests, Transportation, and Acceptance	2	Acquiring Resources from Overseas (SC Investment)	➢ **SC investment for providing CN fuel [Electric Power (thermal power), Oil and Gas]** ➢ Resources: Secure interests together for both public and private sectors **[Non-Ferrous (copper)]**	➢ Establishing supply chains with friendly countries while also making upstream investments. **The challenge is to secure a certain procurement scale.**
	3	Expanding Overseas Production	➢ **Integrated production** not only from processing, but also **from upstream [Steel]**	➢ **Integrating production up to downstream processes** located overseas. Import is also an option.
Manufacturing Processes	4	Supporting Manufacturing Equipment for Decarbonization and Resource Recycling	➢ **Optimization of owned equipment to secure stable supply, formation of optimal equipment, and cost reductions [Electric Power (power generation/transmission)]** ➢ **Investments, etc. for the realization of CN/CE** (optimal implementation of production processes, fuel conversion) **[Steel, Chemicals]**	➢ **Because the investment strength** of Japanese companies **is not large when compared to overseas companies, they make use of cooperation between companies and national support**
	5	Optimizing the Scale of Existing Assets	➢ **Appropriate fade-out of existing assets, optimization of production scale [Electric Power (coal-fired power), Oil and Gas, Steel, Non-Ferrous (copper), Chemicals]**	➢ **Systematically promoting further consolidation of domestic supply under a fair burden**
Products and Sales	6	Providing Low-Carbon, Decarbonized, and Resource Recycling Solutions	➢ **Maximal utilization of renewable energy and nuclear energy power generation [Electric Power]** ➢ **Provide low-carbon, decarbonized, and resource recycling solutions [Oil and Gas, Steel, Chemicals]**	➢ **Strengths in energy creation/storage/ savings, and in resource-saving solutions**
	7	Stimulating Demand for Decarbonization and Recycling	➢ **"Leading-Edge Alliance" that recognizes the value of GHG [Oil and Gas]**	➢ **Value visualization and consumer awareness shifts**
	8	Utilization of Consumer Data	➢ **Distributed network management that utilizes data [Electric Power]**	➢ **Developing rules for data utilization**
Channels	9	Realization of Recycling	➢ **Introduce domestically accumulated technologies to overseas smelters [Non-Ferrous (copper)]** ➢ Implement recycling for waste plastics, rubber-oil conversions, and material recycling **[Oil and Gas, Chemicals]**	➢ **Japan leads in some technologies** ➢ **Creating friends/partners for recycling loops**



Source: Compiled by Mizuho Bank Industry Research Department

[Ideal Form (2)] Capturing Demand Globally by Providing Value away from Product Dependence while Utilizing Technological Capabilities

- Construct new business models that are based on technological and planning capabilities, and expand businesses by capturing customers globally.

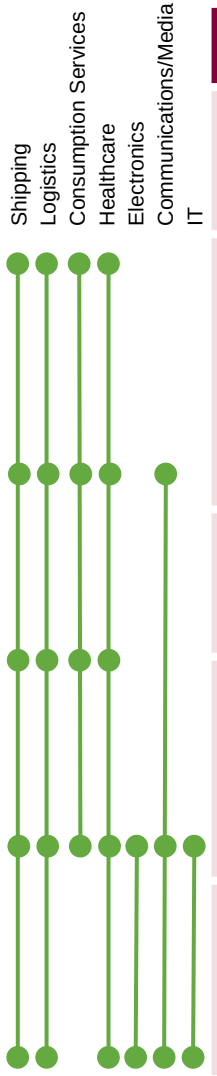
			Initiatives Required for Japanese Industries and Companies	Automotive	Electronics	Steel	Non-Ferrous	Chemicals	IT	Japan's Strengths (red text) and Challenges
Technology Development	1	Refining Technologies, Know-How, and Products	➢ **High-quality product development and lineup expansion** to solve social issues and respond to customer needs (providing safety, high quality, high functionality, low carbon) **[Common]** ➢ **Collaboration with ventures and other companies, consortium formation [Common]**	●	●	●	●	●	●	➢ **Possesses technical capabilities and know-how**. Maintaining technological capabilities and promotes commercialization
Planning, Design, and Development	2	Creating New Brands	➢ Create **new brands** that are not tied to physical objects **[Automotive]**	●	●					➢ **Utilizing brands accumulated** through product supply so far
	3	Developing Applications	➢ Enter the electric vehicle business and use EVs as tools for developing a company's own businesses **[IT]**	●					●	➢ **Accumulating and utilizing know-how**
Manufacturing	4	Optimizing Production and Development Capabilities that will become Legacy	➢ **Optimize production and development capabilities by integrating and reorganizing businesses [Automotive, Steel, Non-Ferrous (copper), Chemicals]** ➢ **Refine mass production technologies for standardization, commonization, and reducing costs [Automotive, Steel]**	●		●	●	●		➢ **Responding to negative impact of business contraction (employment problems, difficulty in procuring users)**
Provision of Sales and Services	5	Providing Services away from product dependence	➢ **Experience-oriented sales, marketing, and services** (providing subscriptions, leases, MaaS, and BaaS, etc. for operators and vehicles. Coordination and integration with experiences and service provision at travel destinations) **[Automotive]** ➢ Implement **contract/commission development in manufacturing. Horizontal development of technologies and know-how** (engineering, production technologies, low-carbon production technologies) **[Automotive, Chemicals]** ➢ **Extend to user areas** (design, development, processing) **[Steel, Chemicals]**	●	●	●	●	●	●	➢ **Collaborative utilization with external partners** ➢ **Securing capabilities that will be insufficient, and accumulating and utilizing know-how**
Global Expansion	6	Securing Company Scale for Global Expansion	➢ **Secure a critical mass** for ensuring sustainable growth, such as investment and research and development **[Common]** ➢ **Secure overseas customer bases and human resources, and promote them [Common]** ➢ **Concentrated investment of limited management resources [Common]**	●		●	●	●	●	➢ **Improving the feasibility of acquisitions** in light of competition with major global players ➢ **Mutually offset fields of specialization**
	7	Constructing Global Business Management Systems	➢ **Expand local production** that shows a commitment to supply products **[Common]** ➢ **Move from a division between domestic and overseas businesses to a further local production for local consumption model [Non-Ferrous (copper)]** ➢ **Research and development** that incorporates local needs. Deployment of **technology service** units that respond to users in detail **[Common]**	●	●	●	●	●	●	➢ **Responding to acquisition of funds, human resources, and customer base**

Source: Compiled by Mizuho Bank Industry Research Department

[Ideal Form (3)] Utilizing Technology to Increase Productivity and Continue to Provide Life-oriented Services

■ Responding to shrinking markets and constraints on public finances, as well as providing services that utilize technology.

		Initiatives Required for Japanese Industries and Companies		Japan's Strengths (red text) and Challenges
Improve Productivity	1	Optimization of Operations	➢ **Technology implementation** (combining humans and robots) **to respond to labor shortages and changing needs [Consumption Services]** ➢ **Optimization of services by utilizing information [Consumption Service, Logistics (land transportation)]**	➢ Responding to the fact that **many companies have no investment capability** even though they have improved their capital equipment ratio
	2	Optimization of Assets to Meet Changes in Demand Scale and Quality	➢ **Control overall demand through prevention and AI utilization, optimization of supply and demand matching [Healthcare]** ➢ **Optimization and restructuring of store scale** (to a scale that meets demand). Move towards new customer contact point in line with consumers who have adapted to digital services. Distribution infrastructure that is accessible to anyone in the living area. **[Retail]** ➢ **Transportation/storage functions utilize automated** vehicles/warehouses/machinery and robots **[Transportation]** ➢ Promote efficiency, including **spin-offs for communications infrastructure [Communications]**	➢ **Sharing a vision** in order to gain public understanding for data collection/utilization and supply reductions
	3	Shift to Large-Scale via Corporate Restructuring	➢ **Consolidation of players for infrastructure reconstruction [Retail/Logistics (land transportation)]** ➢ Reduction in various costs via **consolidation of asset-holding businesses and via joint holdings [Transportation, Logistics (land transport)]**	➢ **Further accelerating reorganizations due to decreased demand and a shortage of successors** due to the declining and aging population
Provide Technology-Utilizing Services from Users' Perspectives	4	Provide Services that Meet Diversifying and Decentralized Needs (Collaboration with PF)	➢ Construction of flexible mobility networks, including next-generation mobility. **Creation of mobility demand/experience through collaboration with destination layer. [Transportation]** ➢ Construction of distribution that can co-create surprise and joy **[Consumption Services]** ➢ **Data collection and deeper understanding of customers through collaboration with diverse platforms [Consumption Services, Media]** ➢ **Automatic cooking/delivery of personalized foods based on data [Food]**	➢ **Creating and developing platform companies**
	5	Develop Technologies, Strengthen Human Resources, and Secure Capabilities	➢ **Early-stage investment and development of technologies related to the progress of virtualization**, such as the development of equipment bearing in mind the introduction of photonics technologies, and contributing to the realization of quantum computers **[Electronics]** ➢ Acquisition of overseas customers and human resources, etc. via the acquisition of overseas companies, and skill conversions for domestic IT human resources **[IT]**	➢ **Strengths in some products and services** (materials and infrastructure)



Source: Compiled by Mizuho Bank Industry Research Department

IV. Efforts to Realize the Ideal Form

- Efforts Required of Industries and Companies
- Things Required of Industrial Policy and Industrial Finance

Efforts to Realize the Ideal Forms

*Items in red text are covered in this chapter

Ideal Forms for Japanese Industries and Companies	Efforts Required of Industries and Companies
①Realizing stable procurement and supply of energy and resources, and the decarbonization of society as a whole	1. Technological Innovation for Self-Sufficiency 2. Acquiring Resources from Overseas (SC Investment) 3. Expanding Overseas Production 4. Supporting Manufacturing Equipment for Decarbonization and Resource Recycling 5. Optimizing the Scale of Existing Assets 6. Providing Low-Carbon, Decarbonized, and Resource Recycling Solutions 7. Stimulating Demand for Decarbonization and Recycling 8. Utilization of Consumer Demand Data 9. Realization of Recycling
②Capturing domestic and overseas demand by providing value for decarbonization products while utilizing technological capabilities	1. Refining Technologies, Know-How, and Products 2. Creating New Brands 3. Developing Applications 4. Optimizing Production and Development Capabilities that will become Legacy 5. Providing Services for Decarbonization Products 6. Securing Company Scale for Global Expansion 7. Constructing Global Business Management Systems
③Utilizing technology to continue increasing productivity and providing services that are close to daily life	1. Optimization of Operations (Technology Implementation) 2. Optimization of Assets to Meet Changes in Demand Scale and Quality 3. Shift to Large-Scale via Corporate Restructuring 4. Provide Services that Meet Diversifying and Decentralized Needs (Collaboration with PF) 5. Develop Technologies, Strengthen Human Resources, and Secure Capabilities

Source: Compiled by Mizuho Bank Industry Research Department

[Ideal Form ①] Realizing Stable Procurement and Supply of Energy and Resources, and the Decarbonization of Society as a Whole

Industry	Ideal Form in 2050 (Direction)	Required Efforts (☐: Growth Realization; ■: Structural Reforms)
Electric Power	➢ Stable supply to large consumers through decarbonized power sources. Hydrogen supply that utilizes surplus electricity ➢ Stable operation of energy systems in a decentralized society	☐ Constructing of a value chain for zero-emission thermal power ☐ Supplying carbon-free hydrogen to non-electricity sector consumers ☐ Providing supply and demand balance adjustment and backup functions ☐ Transformation and diversification of services due to shift to platforms ■ Fade-out of inefficient coal-fired thermal power generation ■ Optimizing capital investments and reducing costs for electricity transmission businesses
Oil and Gas	➢ Comprehensive energy companies ➢ Specialized energy companies for decarbonization solutions ➢ CNaaS companies that comprehensively support the shift to CN ➢ Local platform/operator companies	☐ Supply chain investments for CN fuel supplies ☐ First Movers Coalition to secure final demand at an early stage ☐ Realization of CN business concepts ☐ Shift to local platforms and operators ■ Optimizing the scale of existing assets
Steel	➢ Local production for local consumption in overseas countries according to each country's regulations ➢ Overseas sales to Asian markets of low-carbon production technologies	☐ Converting from domestic and overseas division of labor model to a local production for local consumption model ☐ Securing iron sources by partially investing in overseas DRI plants ■ Development of and capital investment in improving the efficiency of domestic production to realize CN
Non-Ferrous Metals (Copper)	➢ Resources/Refining: Stable supply of raw materials ➢ Recycling: Contributes to a circular society	☐ Recycling: Automating pretreatment processes. Constructing raw material recovery networks ■ Smelting: Downsizing and reorganizing smelters ■ Resources: United public and private efforts to secure interests
Chemicals	➢ Stable and economical supply of basic raw materials	■ Optimizing the production of basic chemicals and optimally implementing green production processes. Cooperating with other companies in fuel conversion and recycling, etc.
Food	➢ Stable supply of food, and acquisition of growth and competitive advantage. Construction of sustainable value chains	☐ Extending upstream (smart agriculture, plant factories, land-based aquaculture)

Source: Compiled by Mizuho Bank Industry Research Department

[Ideal Form ②] Capturing Domestic and Overseas Demand by Providing Value for Decarbonization Products while Utilizing Technological Capabilities

Industry	Ideal Form in 2050 (Direction)	Required Efforts (☐: Growth Realization; ■: Structural Reforms)
Steel	➢ Carbon neutral production solution companies ➢ Downstream solutions companies that provide knowledge about multiple materials as value to demand industries	☐ Collaborating with other material companies that leverage common issues such as reduced domestic demand and CN ☐ Extending downstream business areas (processing, part design, prototype testing, etc.)
Non-Ferrous Metals (Copper)	➢ Processing: Maintaining and improving presence by manufacturing highly functional products	☐ Strengthening lineups and expanding sales channels ☐ Cooperation with other materials, and fusion with digital technologies (additive manufacturing, etc.) ■ Reorganization of the copper processing industry
Chemicals	➢ Solving social issues by supplying cutting-edge materials ➢ Acquisition of volume zones by licensing technologies	☐ Functional chemistry: Utilization of external functions (establishment of CVC and investments in VC), and collaborating with non-Japanese companies
Food	➢ Contributions to consumer health and well-being	☐ Extending downstream (EC, D2C, subscriptions)
Automotive	➢ Integrated solution providers that maximize intangible experience value (Concept of a business model that "does not sell cars," and shift to a platform for software and hardware development) ➢ Refining mass production technologies, and achieving both high quality and low cost	☐ Strengths in mass production and sales businesses = Maximal utilization of manufacturing capabilities ☐ Redefining the value that is required of a car and building new brands ■ Integrating and reorganizing commoditized areas and shrinking other areas
Electronics*	➢ Function as infrastructure for the Metaverse and respond to changes in the quality of demand in the physical space	☐ Investing resources in Metaverse areas and collaborations between companies ☐ Developing equipment with the introduction of photoelectric fusion technologies in mind ☐ Contributing to the realization of quantum computers

Note: *Electronics is mainly taken up in the chapters addressing the Metaverse
Source: Compiled by Mizuho Bank Industry Research Department

[Ideal Form ③] Utilizing Technology to Continue Increasing Productivity and Providing Services that are Close to Daily Life

Industry	Ideal Form in 2050 (Direction)	Required Efforts (☐: Growth Realization; ■: Structural Reforms)
Food	➢ Realization of consumer health and well-being	☐ Creating new businesses (alternative foods, personalized health foods)
Communications and Media*	➢ Increased presence in content applications and service platforms areas	☐ Strengthening app contents and platforms ■ Promoting greater efficiency, including spin-offs of communications infrastructure
IT*	➢ User activities become digital, and change is promoted as global standards are transformed ➢ Provide technologies and platforms for building and expanding Metaverse platforms	☐ Acquiring overseas customers and human resources, etc. via acquisitions of overseas companies ☐ Early-stage investment and development of related technologies ■ Skill conversion of domestic IT human resources
Consumption Services (Retail/Restaurants)	➢ Inclusive & co-creation of experience value ① Frictionless and inclusive infrastructure ② Co-creation of surprise and joy	☐ Shift to one-stop fusion of on-off in living areas ☐ Deepening collaboration with platforms ☐ Supplier engagement for CN
Mobility Services	➢ Provide flexible services in line with changes in the structure of supply and demand ① Integrate services, provide human-centric mobility services, and improve QOL ② Review asset holdings and reduce infrastructure costs	☐ Integrating services on both physical and cyber fronts ☐ Entering into asset management ■ Separation of asset holding and maintenance functions
Logistics	➢ Propose optimal logistics that utilize logistics information platforms ➢ Maintain and strengthen the power balance in actual transport and storage function provision portions via shift to an oligopoly of operators	☐ Strengthening system development (System Integrator (SIer) cooperation, platform construction, system human resources development) ☐ Effectively using assets (REIT utilization, leasing cooperation, etc.) ■ M&A in order to secure transportation volumes
Healthcare	➢ Transition to demand-oriented systems ① Controlling symptom onset via prevention, appropriate triage, and controlling total medical care demand in regions via curative medical care ② Optimization of supply and demand matching according to individual symptoms	■ Developing technologies that realize more efficient resource allocation through controlling aggregate demand via prevention and AI utilization and through networking and widening areas via telemedicine, etc.

Note: Communications/Media and IT are mainly taken up in the chapters addressing the Metaverse
Source: Compiled by Mizuho Bank Industry Research Department

[Food] Towards Reducing GHG Emissions and Improving Self-Sufficiency Rates in the Agriculture, Forestry, and Fisheries Industries

- For the food manufacturers with the largest proportion of raw material-derived emissions (Scope3), in the future it will be necessary to be involved in efforts to reduce emissions from agriculture and livestock. It will be difficult for companies to respond to this individually, and collaboration with related players will be required.
- It will also be required to take measures to grow domestic agriculture and improve domestic self-sufficiency rates by deepening efforts in agritech areas such as smart agriculture, plant factories, and land-based aquaculture.

Efforts to Reduce GHG Emissions in Agriculture and Livestock

Item	Main Reduction Measures	Related Players
Fuel Combustion (CO2)	• Utilization of renewable energy • Increased efficiency for agricultural production (smart agricultural)	• Energy companies • Agricultural machinery companies, etc.
Rice Farming (CH4)	• Extension of midseason field drainage • Development of rice varieties with low methane generation	• Seed/seedling companies • Research institutes, etc.
Gastrointestinal Fermentation (CH4)	• Breeding of cattle with low methane generation • Development of feeds to suppress methane generation	• Feed/material companies • Research institutes, etc.
Management of Livestock Excrement (CH4, N20)	• Development of management technologies • Development of feeds to control emissions • Composting • Energy utilization	• IT/systems companies • Feed/fertilizer companies • Chemical companies, etc.
Soil in Agricultural Land (N20)	• Reduction in chemical fertilizers • Microbial control and development of monitoring technologies	• Research institutes, etc.

Reductions in emissions from agriculture and livestock

Examples of Efforts for Smart Agriculture, Plant Factories, and Land-Based Aquaculture

Item	Examples of Efforts
Smart Agriculture	• Kubota: Development of automated agricultural machinery • Farmnote: Development of agricultural management systems • Nileworks: Development of agricultural drones
Plant Factories	• Spread: Operation of plant factories • Vitec: Management of plant factories • Mitsubishi Chemical: Operation of plant factories
Land-Based Agriculture	• Maruha Nichiro: Management of land-based aquaculture • FRD Japan: Management of land-based aquaculture • Umitron: Development of systems for aquaculture

Increased agricultural efficiency
Establishment and expansion of new food production methods that are not affected by weather or land

Industrialization of agricultural growth

Raising food self-sufficiency rate due to increased domestic productivity

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

[Oil and Gas] Supply Chain Investment for CN Fuel Supply

- In order to supply carbon neutral fuels, companies need to build supply chains for each product.
- SAF, synthetic fuels, and synthetic methane can utilize existing assets.
- However, future carbon neutral fuel demands are highly uncertain. To secure demands, companies need to find early adaptors for carbon neutral fuels.

Supply Chain Investment for Carbon Neutral Fuels

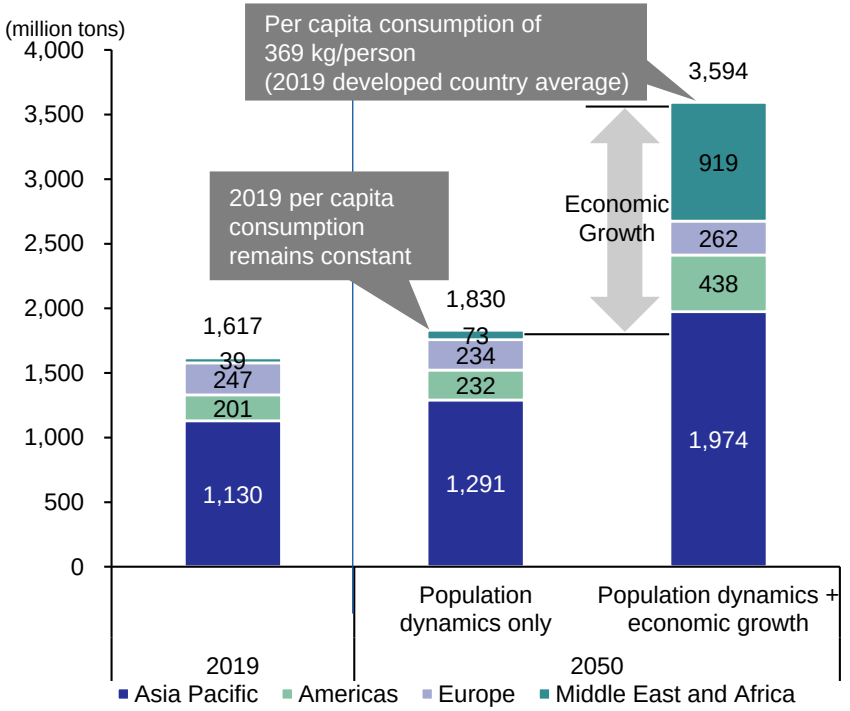
Carbon Neutral Fuel		Raw Materials	Production	Transportation and Supply Infrastructure	User Side
Liquid	Sustainable Aviation Fuel (SAF)	Vegetable oil, waste cooking oil, waste, cellulose, microalgae Necessary for procurement routes for each methods	Different equipment is required for each method, such as equipment for hydrogenation treatment and FT synthesis tanks	SAF can use existing jet fuel infrastructure	User side can use each carbon neutral fuels with existing equipment
	Synthetic Fuels	Hydrogen + CO_2 Hydrogen production equipment and supply of CO_2 as a raw material are needed	In addition to hydrogen production equipment (see below items), production equipment is needed such as FT synthesis tanks	Synthetic fuel can use existing liquid fuel infrastructure	
Gas	Synthetic Methane	Green hydrogen + CO_2 Renewable energy power sources, manufacturing equipment, and supply of CO_2 as a raw material for green hydrogen are needed	Green hydrogen production equipment and methanation equipment, etc.	Synthetic methane can use existing LNG infrastructure	
	Green Hydrogen	Renewable energy sources	Water electrolysis tanks	Hydrogen transportation and supply (e.g. liquefied hydrogen carriers, intake facilities, etc.)	New equipment for hydrogen are needed (e.g. hydrogen-fired power generation, hydrogen boilers, etc.)
	Blue Hydrogen	Raw material gases Requires natural gas or coal for gasification	Natural gas reformers, coal gasification equipment, and CO_2 separation/recovery/storage equipment, etc.		

Note: SAF: Sustainable Aviation Fuel
Source: Compiled by Mizuho Bank Industry Research Department based on "Green Growth Strategy Through Achieving Carbon Neutrality in 2050" by the Ministry of Economy, Trade and Industry

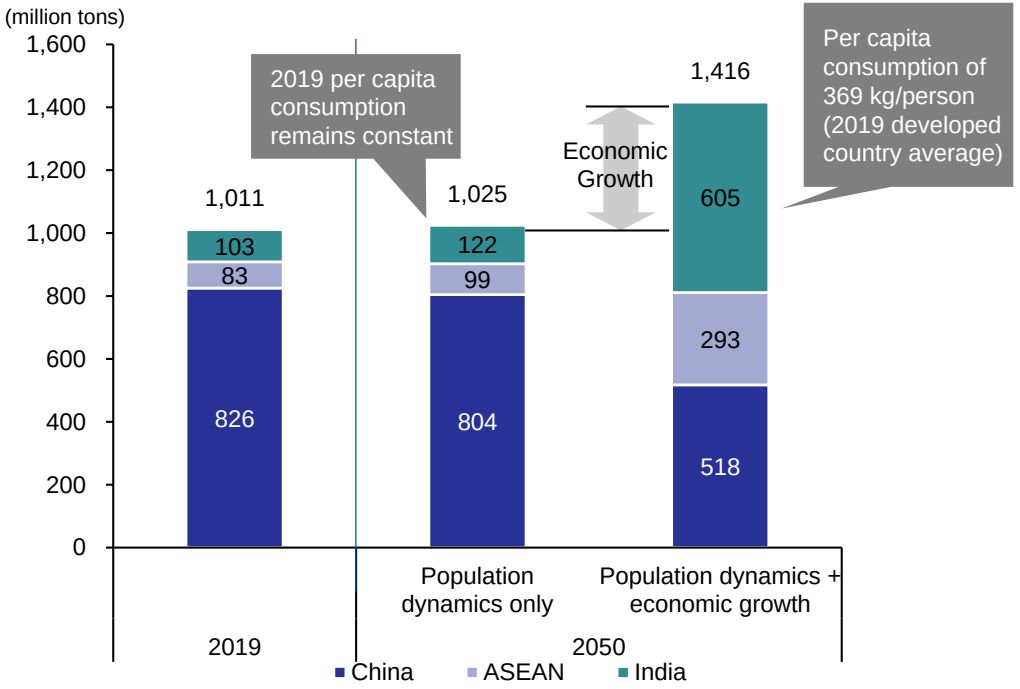
[Steel] Global Demand for Steel is Expected to Grow

- Global steel demand in 2050 is estimated to be 1.8 billion tons, assuming that per capita consumption does not change, or 3.6 billion tons, assuming that per capita consumption is on part with the current average in developed countries. Global steel demand in 2050 is expected to increase 1.1 to 2.2 times that of 2019.
- When factoring in the potential for economic growth, China's demand in Asia could be roughly halved due to economic maturity, while demand could reach approx. 300 million tons in ASEAN and approx. 600 million tons in India.
  - Economic growth contributes more than population growth, but there is ample room for long-term global steel demand expansion.

Estimated Global Steel Demand (Final Consumption Base)



Estimated Demand for Steel Products in Major Asian Regions (Final Consumption Base)



Note: Per capita consumption is actual domestic consumption, excluding indirect imports
Source: Compiled by Mizuho Bank Industry Research Department based on World Steel Association materials and UN materials

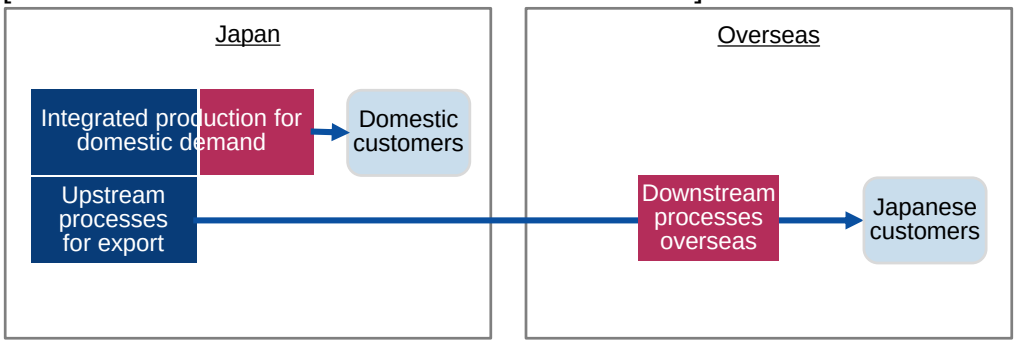
Source: Compiled by Mizuho Bank Industry Research Department based on World Steel Association materials and UN materials

[Steel] Further Progress in Local Production for Local Consumption to Capture Expanding External Demand

- Steel companies currently have a model with a domestic and overseas division of labor, which supplies semi-finished products produced in Japan to downstream processes overseas that are then provided to local Japanese customers. However, in aiming to respond to the expansion of protectionist trade and to capture demand for local customers, they are strengthening their conversion to a model with local production for local consumption. In order to capture expanding external demand, it will be necessary to further promote local production for local consumption.
- For carbon neutrality, there is also the option of investing in an overseas DRI plant, which is difficult to manufacture in Japan for the time being, and partially replacing iron sources.

Global Shift to Local Production for Local Consumption

[Domestic and Overseas Division of Labor Model]



[Local Production for Local Consumption Model]

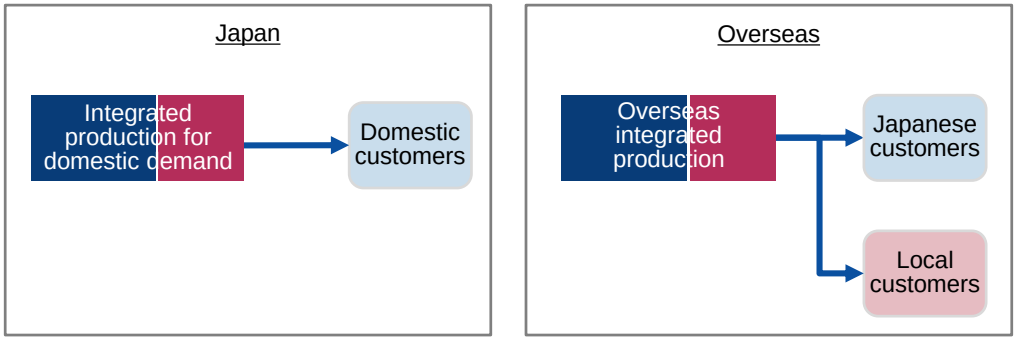
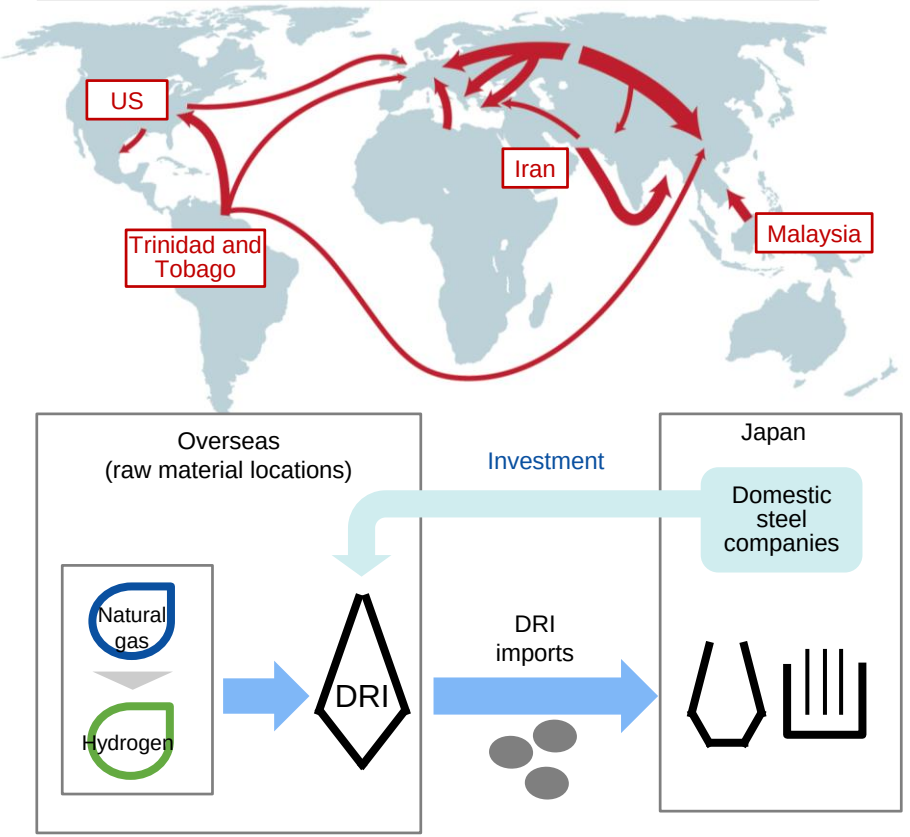


Image of Overseas DRI investment for DRI Trade Flow and Low Carbonization

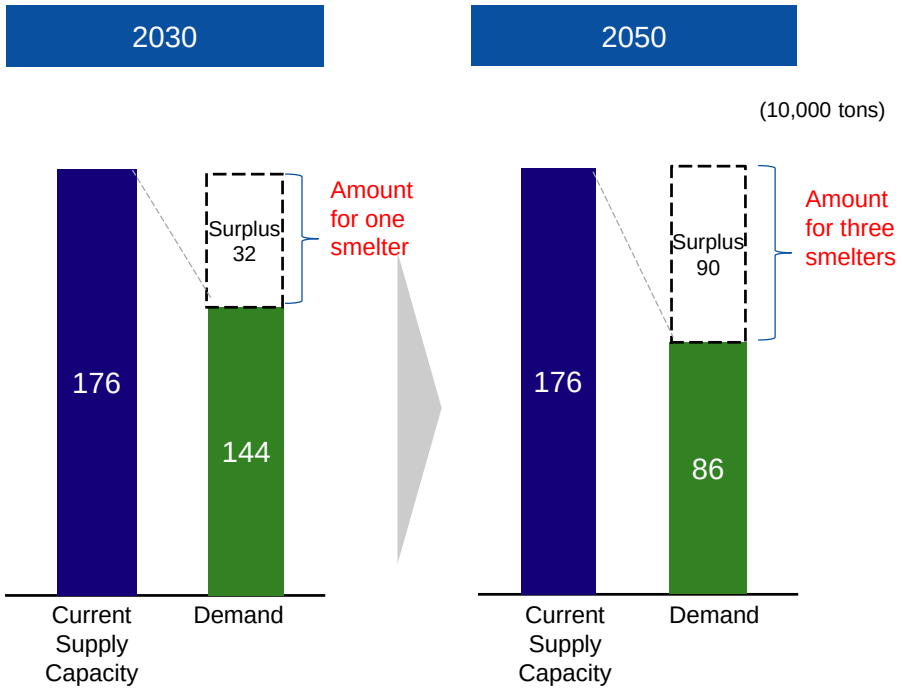


Source: Compiled by Mizuho Bank Industry Research Department

[Non-Ferrous Metals (Copper)] Image of Reorganization for Domestic Copper Smelters

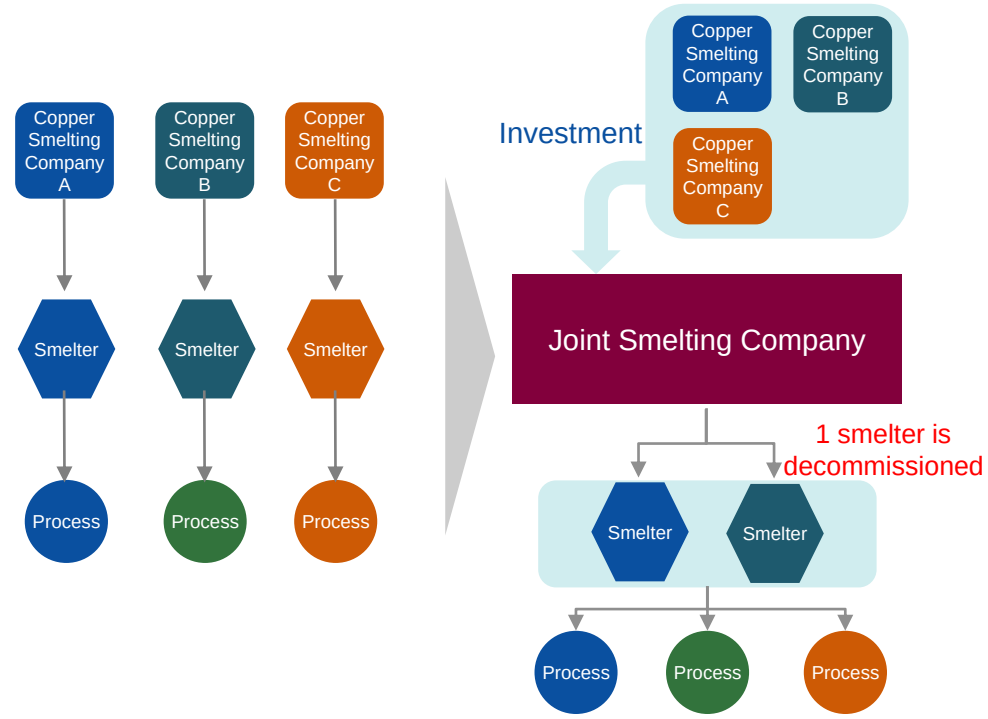
- Because there is essentially one domestic copper smelter for each company, deciding to decommission smelters is a correspondingly high barrier/hurdle. Additionally, when decommissioning smelters it costs money to take measures against soil pollution.
- Considering the balance between supply and demand, there is also the idea that it is necessary to reduce the number of smelters by one by 2030, and by three by 2050.
  - It is conceivable that copper smelting companies will merge with each other towards 2050 in order to optimize domestic copper smelters to meet domestic demand, and one strategy that can be inferred is to first establish a joint smelting company and manage it as a cost center across all the copper smelting companies.

Time Series Image of Downsizing



Source: Compiled by Mizuho Bank Industry Research Department

Joint Smelting Company Concept

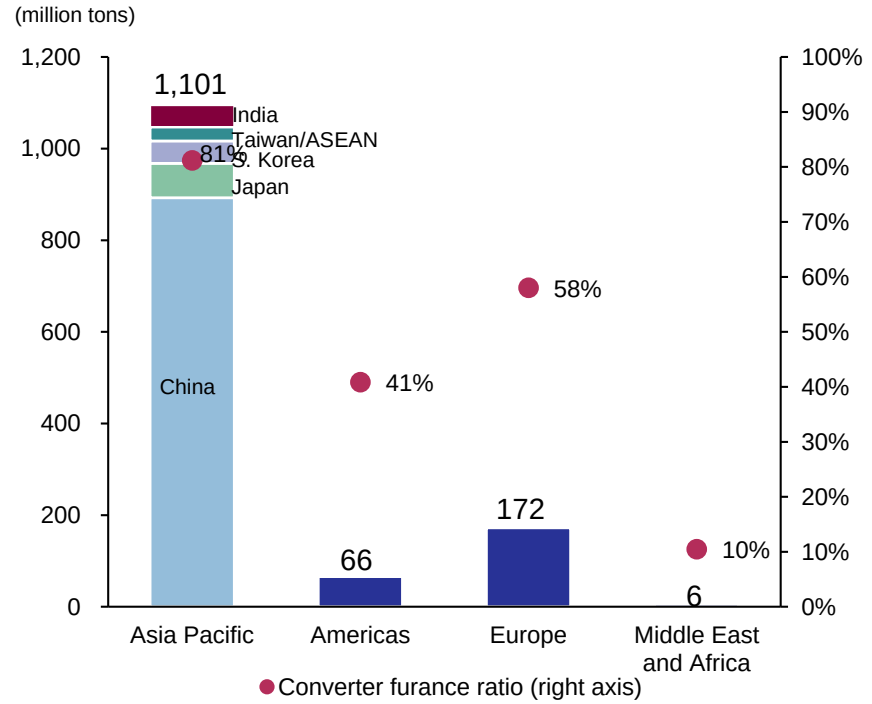


Source: Compiled by Mizuho Bank Industry Research Department

[Steel] Expansion of Overseas Businesses with Low-Carbon Technologies Utilizing Blast Furnaces

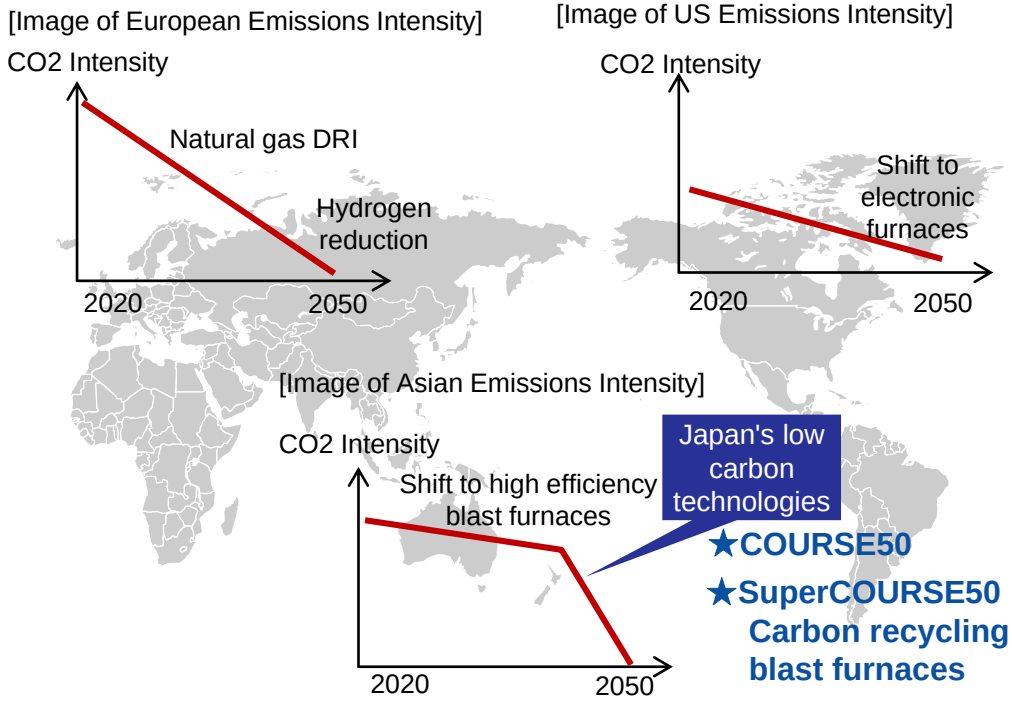
- In Asia, crude steel production via the blast furnace-converter method exceeds 1.0 billion tons, and more than 80% of crude steel production is produced in blast furnaces.
  - Blast furnace methods with high production efficiency are suitable for mass production at low costs, and for the time being ASEAN plans to continue the construction of new blast furnaces.
- While blast furnace methods are rational during periods of growing demand, they go against carbon neutrality, so the development of low-carbon technologies utilizing blast furnaces (which is a unique Japanese technology) as an engineering business in the future can simultaneously realize a stable supply of steel materials (which is indispensable for economic growth in emerging countries going forward) and a shift to low carbon, and can be a new business that meets market needs.

Crude Steel Production via Converter Furnaces



Source: Compiled by Mizuho Bank Industry Research Department based on World Steel Association materials

Image of Reductions in Emissions Intensity by Region

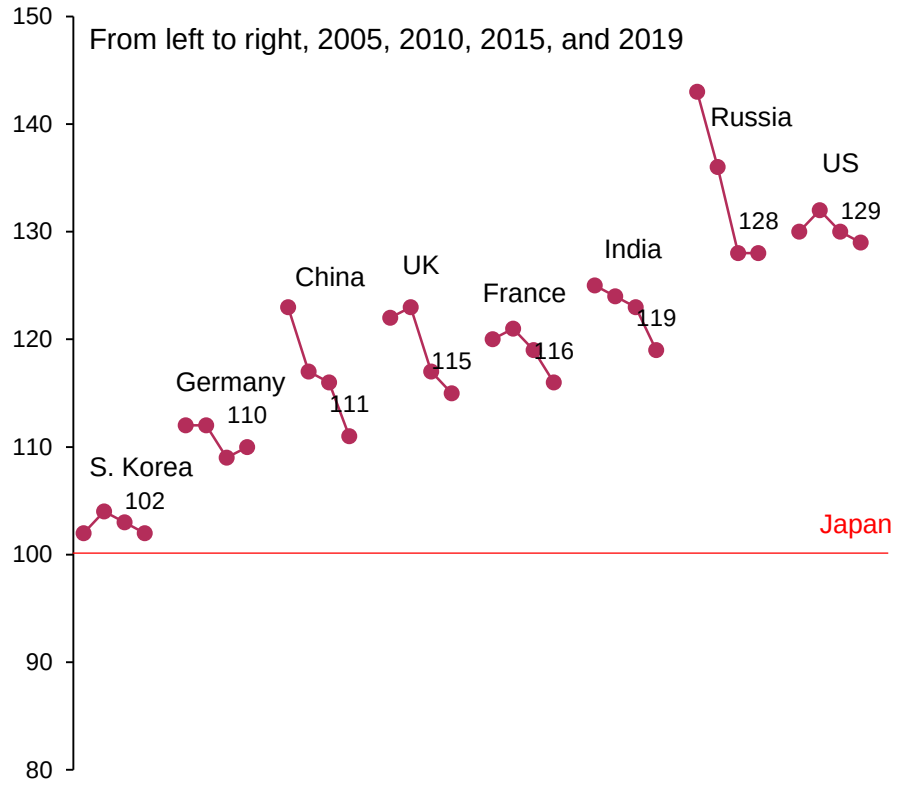


Source: Compiled by Mizuho Bank Industry Research Department

[Steel] Japan's Blast Furnaces have the Highest Energy Efficiency Level in the World

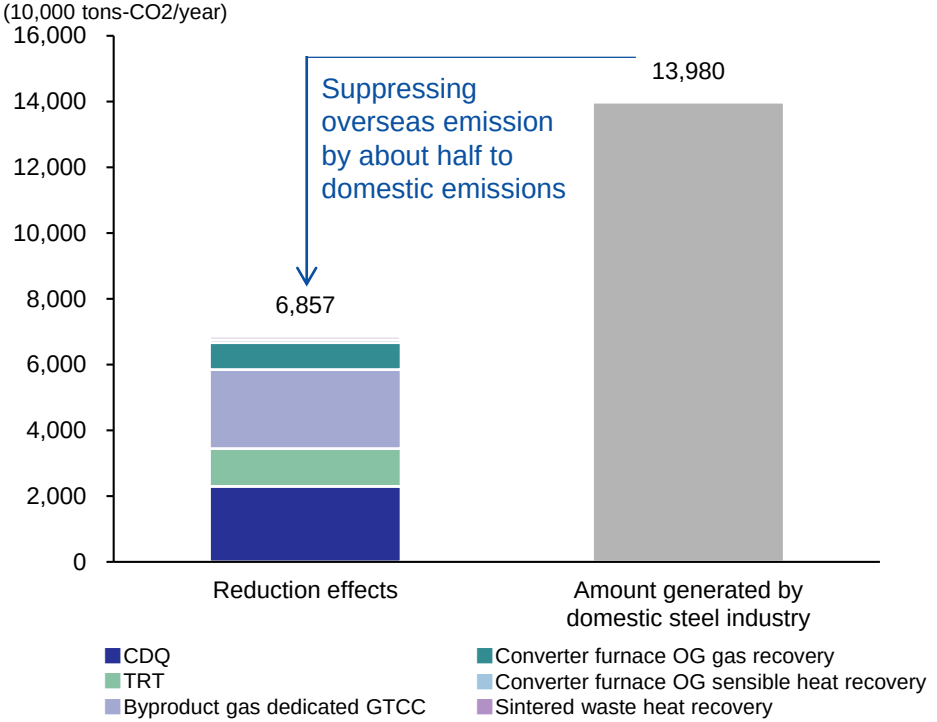
- Japan's converter furnace steel (blast furnace-converter process) maintains the highest energy efficiency level in the world.
- Energy-saving technologies, such as the effective utilization of by-product gases from coking furnaces and blast furnaces, are still being developed overseas as engineering businesses. The resulting CO2 reduction effect is approx. 7,000 tons/year, which contributes to emissions reductions on the scale of about half the amount of CO2 generated in Japan by the domestic steel industry.

Estimated Energy Intensity for Converter Steel (Japan = 100)



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

CO2 Reduction Effect from Introduction of Energy-Saving Equipment in Japan (FY2019 Results)



Note: CDQ: Coke dry quenching facilities; TRT: Top pressure recovery turbine generating systems; GTCC: Gas turbine combine cycle, OG: Oxygen converter gas recovery system

Source: Compiled by Mizuho Bank Industry Research Department based on The Japan Iron and Steel Federation materials

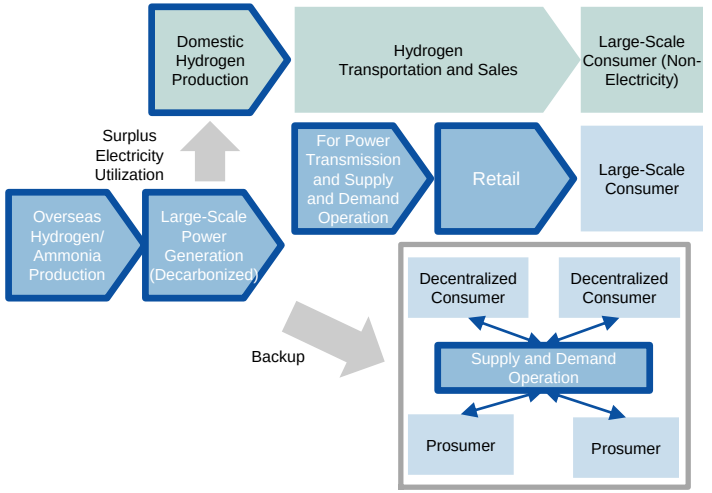
[Electric Power] Businesses will be Required to Demonstrate the Value of their Existence According to the Form of Energy Consumers

- Although the expansion of distributed power sources is irreversible, it is assumed that the world will continue to have a need for large-scale power sources, primarily for energy-intensive industries, and it is speculated that electricity companies can demonstrate the value of their existence in each area through the following.
  - Large-Scale Consumer Area: Stable supply to large-scale consumers through decarbonized power sources and improving energy self-sufficiency rate via hydrogen production that utilizes surplus electricity.
  - Prosumer Area: Stable operation of energy systems in a decentralized society where power generation and storage functions are partially shifted to the consumer side.

Electricity Companies' Core Competencies in the Future Image of the Electric Power Industry

Significance of the Electric Power Industry's Existence (So Far)	Stable Supply of Electricity to Industries and Households	Contribution to Ensuring Energy Security, Including Improving Self-Sufficiency Rate

Consumer Classification	Role to Play in the Future	Revenue Sources
Large-Scale Consumer Area	• Stable supply to large consumers through decarbonized power sources • Improve energy self-sufficiency rate via hydrogen production that utilizes surplus electricity	• Construct value chains for zero-emissions thermal power • Supply carbon-free hydrogen to non-electricity sector consumers
Decentralized Consumers (Prosumers)	• Stable operation of energy systems in a decentralized society	• Provide supply and demand balance adjustment and backup functions • Transformation and diversification of services due to shift to platforms



Source: Compiled by Mizuho Bank Industry Research Department

[Oil and Gas] “First Movers Coalition” to Secure Demand at an Early Stage

- Consumers who recognize the value of reductions in GHG emissions are essential for investing in supply chains for decarbonized solutions.
- However, the volume of the customers who recognize the value of reductions in GHG emissions are highly uncertain.
- First Movers Coalition is notable initiative to create demand of low-carbon technologies and solution.
- Launching an initiative similar to "First Movers Coalition" would be an effective measure to establish an early ecosystem & business models.

First Movers Coalition Framework for Stimulating Demand in Low-Carbon Technologies

Group	First Movers Coalition
Established	2021 (COP 26)
Founders	World Economic Forum (organization that manages the Davos Forum), and US Ambassador to the UN Kelly Croft
Purpose	Established for the purpose of stimulating demand in advanced low-carbon technologies that are needed for global decarbonization by 2050
Mission	Through the First Movers companies that support this framework, contribute to establishing emissions control measures in carbon-rich industries by 2030 and achieving net zero by 2050 by creating initial demand for the low-carbon technologies currently in the development stage.
Fields	Eight fields: Steel, cement, aluminum, chemicals, maritime shipping, aviation, truck shipping, and direct air capture (direct recovery of carbon dioxide from the atmosphere)

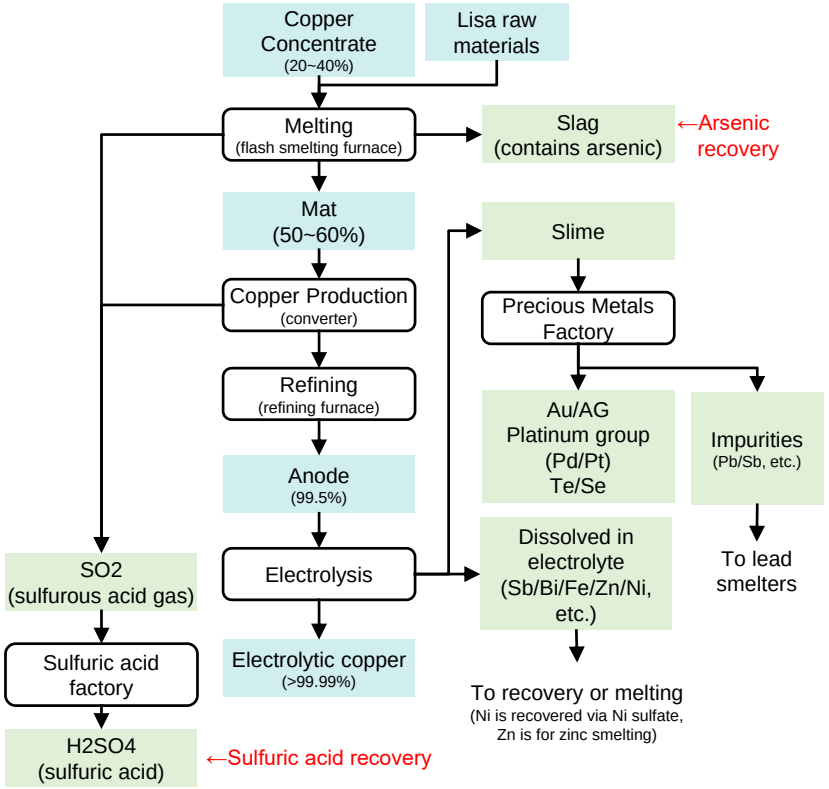
Participating Companies		
	A.P. Møller – Mærsk	Holcim
	Aker ASA	Invenergy
	Agility Logistics	Johnson Controls
	Airbus	Mahindra Group
	Amazon	Nokia
	Apple	Ørsted
	Bain & Company	ReNew
	Bank of America	Salesforce
	Boston Consulting Group	Scania
	Boeing	SSAB Swedish Steel
	Cemex	Trafigura Group
	Dalmia Cement (Bharat) Limited	Trane Technologies
		United Airlines
	Deloitte	Vattenfall
	Delta Air Lines	Volvo Group
	Deutsche Post DHL Group	Yara International
		Western Digital
	Engie	ZF Friedrichshafen AG
	Fortescue Metals Group	

Source: Compiled by Mizuho Bank Industry Research Department based on First Movers Coalition homepage

[Non-Ferrous Metals (Copper)] Japan's Strengths are Recycling Technologies and Environmental Technologies for Smelting

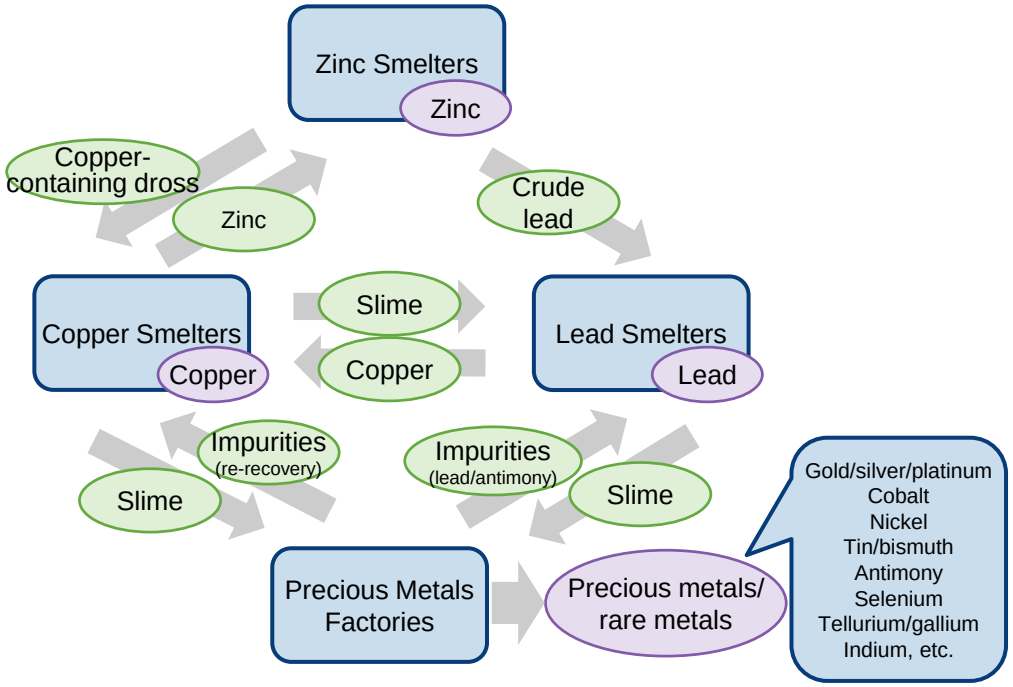
- The Japanese copper industry boasts strengths in recycling technologies and environmental technologies (recovering sulfuric acid and arsenic) at internationally high level smelters, in order to realize a resource-recycling society and to deal with supply chain disruptions, etc.
- One of the strengths of Japanese companies is that it is possible to recover large amounts of metals by exchanging intermediates and impurities between smelters, and in the future it is expected that this will evolve into a smelting network, changing from a company unit-based network to a network across companies (industry unit-based network).

Smelting Flow that Includes Recycling Processes (for Copper Smelting)



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

Image of Smelting Network Across Companies

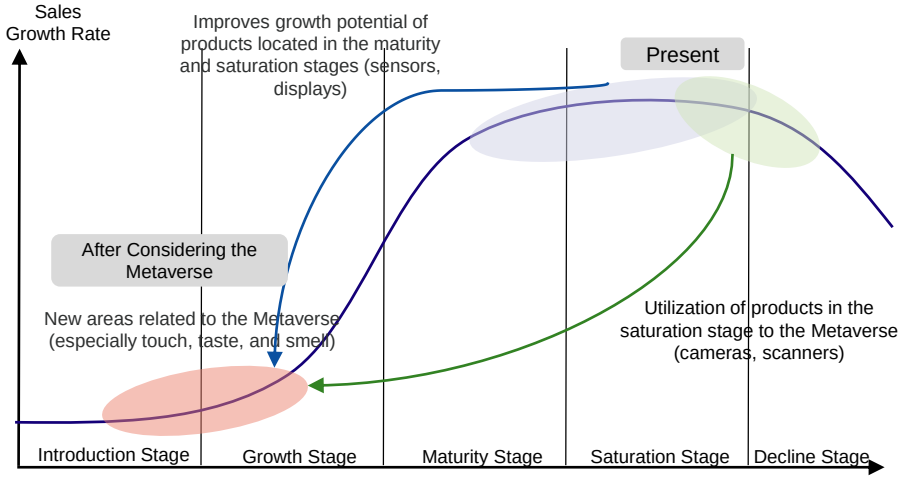


Note 1: Precious metals factories are typically attached to each company's smelter
Note 2: Dross: A thick, film-like or lumpy metal oxide floating in or on the surface of molten metal
Note 3: Slime: Fine particles containing valuable metals, such as gold and silver, that are generated in the electrolysis process
Source: Compiled by Mizuho Bank Industry Research Department based on various materials

[Electronics] Bold Resource Investments in the Metaverse as a Growth Area

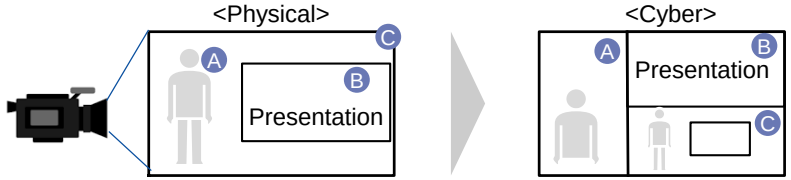
- In Metaverse worlds, not only will demand for new areas related to human senses be stimulated, but there may also be a boost to the growth of products that have already entered into maturity and decline stage.
  - For final product manufacturers and semiconductor/electronics component manufacturers, in consideration of the decreased priority in physical spaces and the possibility of substituting the device itself, it will be important to strengthen the development and manufacturing of the company's own products that will benefit from the spread of the Metaverse, and to conduct research and development with an eye on applying the company's technologies to the Metaverse.

Sales will Grow Again by Applying Companies' Products to the Metaverse



Canon: AMLOS（Activate My Line of Sight）

Cut out and display multiple types of video information from one camera's video



Source: Compiled by Mizuho Bank Industry Research Department

Responses in Physical Spaces where Demand Quality has Changed

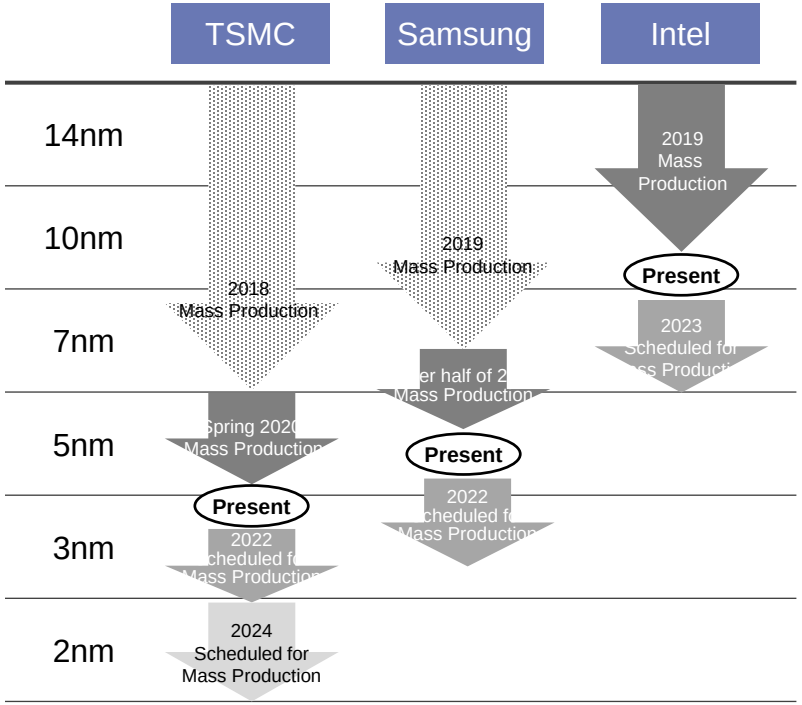
Changes in Preferences	Equipment Example	Necessary Response
Decrease in Priority of Physical Spaces (excl. Metaverse infrastructure)	■ Refrigerator ■ Washing machine ■ Vacuum cleaner ■ Microwave, etc.	■ Reduce equipment sizes ■ Emphasize low-medium function and low-priced products ■ Advance into industrial equipment ■ Shift from selling out business model to service providing model
Subdivision/ Specialization of Individual Demand	■ xR equipment ■ Sensors ■ Scanners, etc.	■ Development and manufacturing of equipment that emphasizes specific functions (motion reproduction, equipment that emphasizes specific sensations, etc.) ■ Accurate transfer of designs from physical to cyber
Replacement of Existing Equipment	■ xR equipment ■ PCs ■ Smartphones ■ Related parts, etc.	■ Collaborate with companies in devices that can be alternative terminals to access the Metaverse, such as cars, housing, and clothing

Source: Compiled by Mizuho Bank Industry Research Department

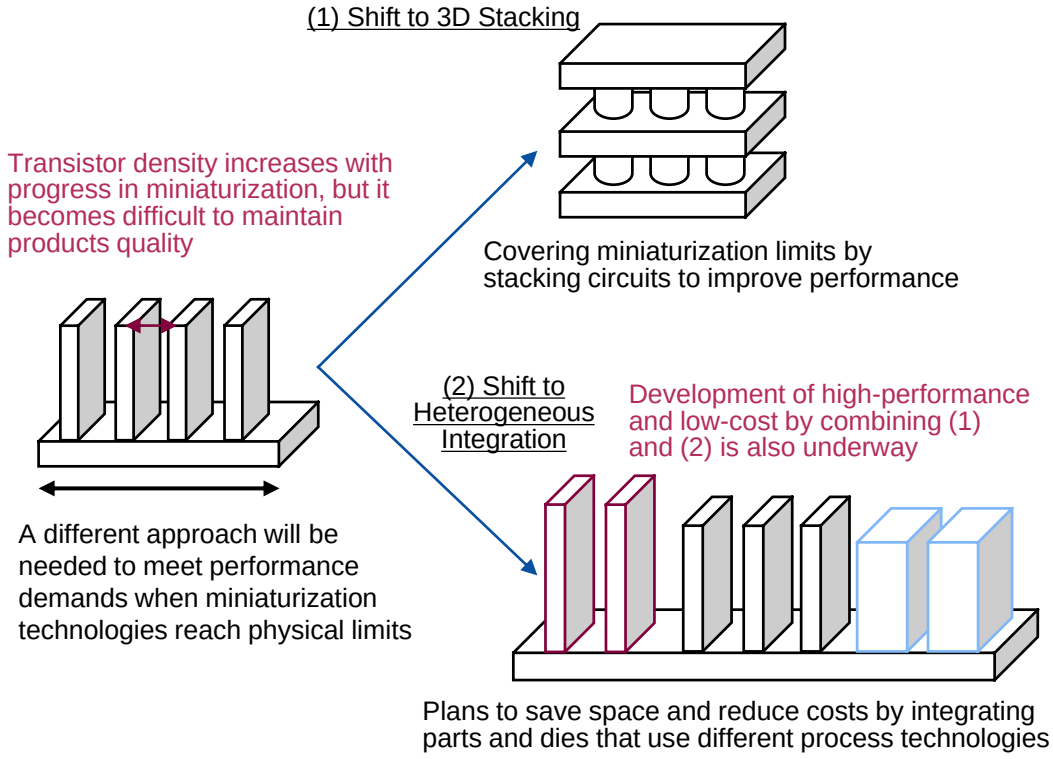
[Electronics] Increasing Expectations for Advanced Packaging Technologies

- Semiconductors have been miniaturized in order to meet performance and technical needs, but with further physical miniaturization becoming difficult, semiconductor companies are focusing on the development of packaging technologies to meet ever-increasing needs.
- Advanced packaging technologies will make it possible to realize ultra-high-speed processing and the compact and lightweight terminals required for the Metaverse by saving space and increasing functionality.
- 3D stacking and heterogeneous integration are the examples of Advanced Packaging Technologies that may contribute to resolving issues and extending functions.

Roadmap for Semiconductor Miniaturization



Conventional Semiconductor Packaging and Advanced Packaging Configurations (Model Diagram)



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

[Automotive] Types of Vehicles and Transformation of Business Model in the Automotive Industry in 2050

Types of Vehicles in 2050

Feature of vehicles in 2050

Zero Emission | Zero Fatality | User Experience

Vehicle = Environmentally friendly transportation that anyone can use at any time with sense of security, safety and comfort

Battery Electric Vehicle × Connected Vehicle × Autonomous Vehicle

It is essential to reduce increasing system costs and vehicle costs

Software Defined Vehicle × Sharing / Service × Multimodal Transportation

- ✓ By standardizing the development platform and improving openness, it will be possible to reduce development costs, lead time, and add variable functions quickly
- ✓ Reduction of initial costs and improvement of usability via MaaS and BaaS
- ✓ Expanding profit pool except new vehicles sales = cutting vehicles sales prices

Limiting use case and in vehicle functions = Cutting vehicle sales prices

Types of Vehicles in 2050

POV
- Small and low-price BEV for short-distance daily trips
- Medium and large BEV for long-distance trips between cities
- Premium vehicles enhancing the value of cabin interior space

Sharing Car

MaaS Vehicle
- Driverless electric shuttle (Level 4)

Transformation of Business Model in the Automotive Industry

Supply-Side Changes	Demand-Side Changes
✓ Decrease in new vehicles sales and production ✓ Reduction of model variation ✓ Consolidation of software development platform ✓ New functions will be developed and installed as Apps by OTA ✓ Consolidation of BEV platforms ✓ Standardization and commoditization of hardware, reduction in new development ✓ Increased system cost (autonomous driving, batteries, etc.) ✓ Improvement of “UX” will be the most important factor to differentiate vehicles	✓ Decrease in number of trips and use case of POV ✓ Decrease in desire for ownership of vehicles (decrease in use case and increase in ownership cost) ✓ Polarization of values required of cars (cheap and convenient transportation, or entertainment focusing mobility experience) ✓ Alternatives via other transportation (inc. UAM, etc.) ✓ Change in consumer behavior (from goods to experience, from buying to subscriptions) ✓ Personalizing vehicles via Apps by OTA

Essential to build business models that respond to the drastic changes in "Making" "Selling" "Owning" and "Using" of vehicles

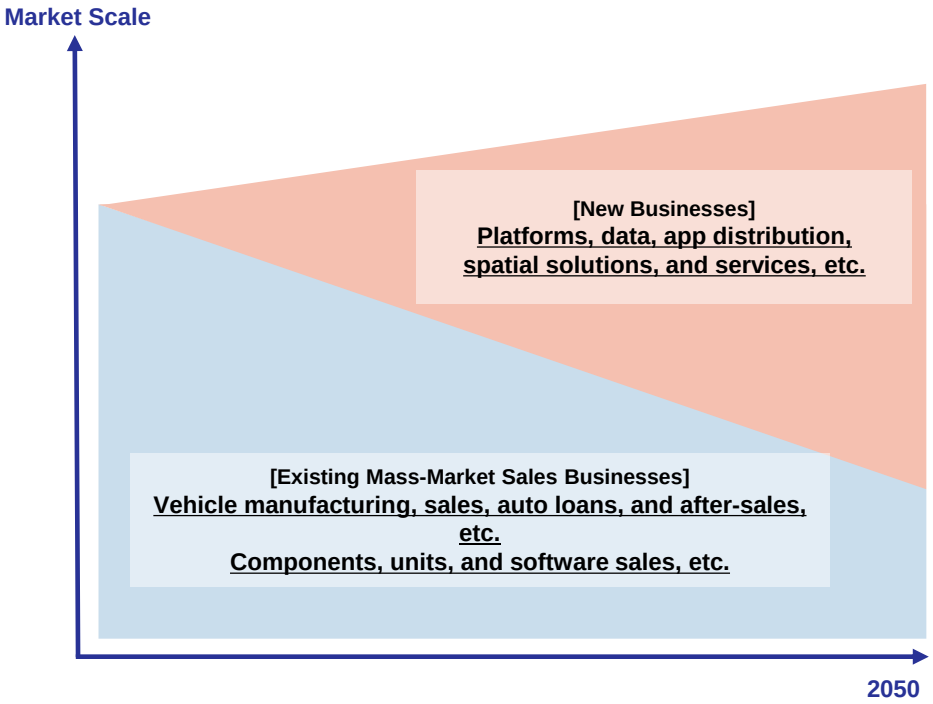
Making	Standardization of hardware, reduction in new development, and surplus production capacity ⇒Advance in the horizontal division of labor
Selling	Decrease in new vehicle sales, increase in vehicle sales prices, and deterioration in profitability of vehicles sales ⇒Transformation to service providers
Owning	Advance in shift to subscriptions, and car manufactures continue to own vehicles ⇒Keep customer touch point
Using	Short-distance daily trip, and non-daily mobility experience ⇒Using variable vehicles depending on purpose

Source: Compiled by Mizuho Bank Industry Research Department

[Automotive] Strategic Options for Japanese Automotive Industry toward 2050

- Vehicle production and sales are expected to shrink and the added value of goods is expected to decline, so it is essential to quickly pave the way for a transformation from the existing mass-market sales business.
- On the other hand, the existing "strengths in manufacturing" can be considered as a basis for creation of a new business model, and it will be required to create profit opportunities that do not rely on vehicle sales while optimizing existing businesses and assets that are becoming outdated.

Image of Automotive Market Scale for 2050



Strategic Options for Japanese Automotive Industry

1 Strengths of Existing Mass-Market Sales Business = Maximize Manufacturing Capabilities

Horizontal Deployment of Know-How (Intangible)	Commercialization of know-how, such as engineering, integration, and production technologies
Development of Vehicle Manufacturing, Platform, Contract Development	Creation of a mutually complementary relationship with new entrants, including IT companies

2 Consolidation and Reorganize in Commoditized and Shrinking Business Areas

Promote Standardization and Commoditization in Hardware	Promote separation of software and hardware, and increase usage ratio of standard products
Optimization of Production and Development Capability that will become Outdated	Consolidation across multiple OEMs and suppliers to reduce production capacity and shift human resources

3 Redefine Values Required of Vehicles, and Create New Brands

Break Away from Design and Development Concepts Centered around Hardware	Efforts for integrated development with services and designs that emphasize "spaces" and "experiences"
Explore and Expand Profit Opportunities that do not Rely on Vehicle Sales	Efforts to develop comprehensive solutions that position vehicles as one element

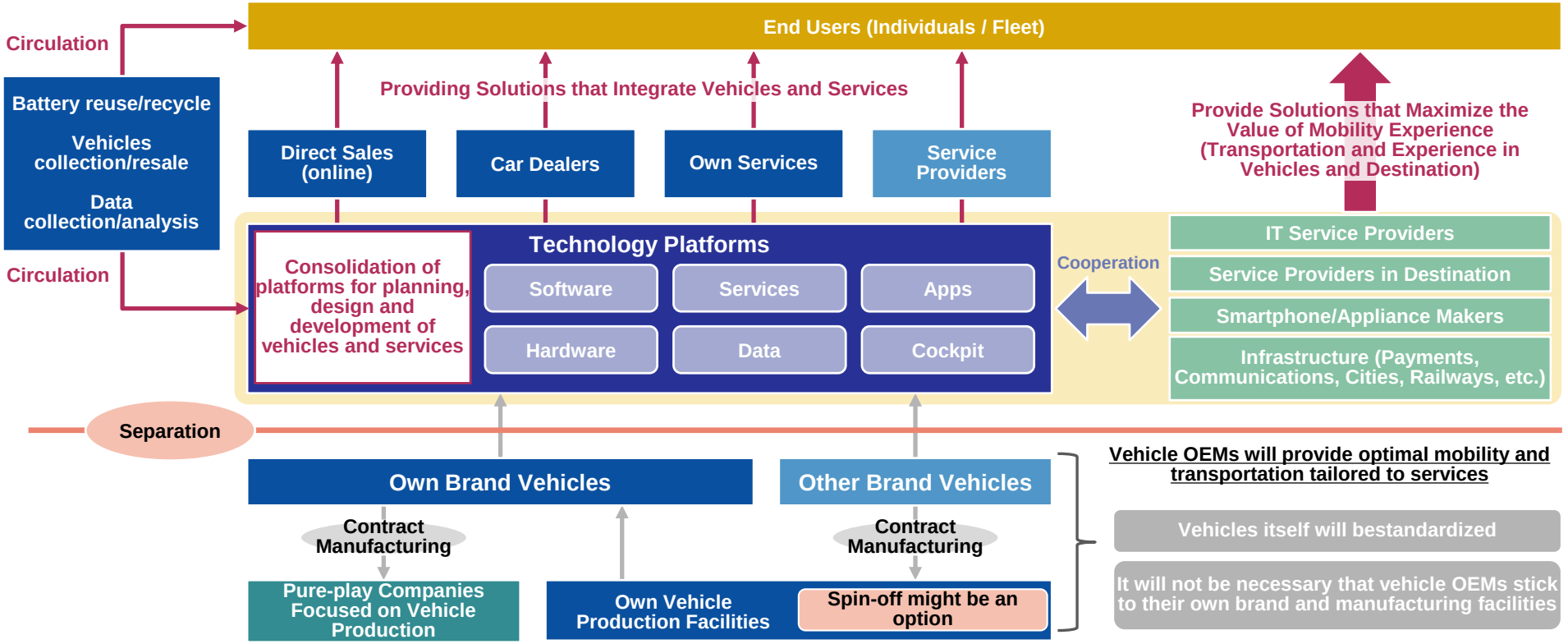
It will be essential to achieve transformation of business models leveraged by "strengths in manufacturing" and a soft landing for the existing mass-market sales business with a maximization of profits from the surviving businesses

Source: Compiled by Mizuho Bank Industry Research Department

[Automotive] Major Vehicle OEMs should aim for "Technology Platformers"

- By creating business models based on "technology platforms" that include hardware, major vehicle OEM may plan to expand their businesses apart from their own brand, and new vehicle manufacturing and sales.
  - — Ultimately, there are options to separate vehicle manufacturing facilities and make them independent as a standalone company, or outsource production to another existing companies.
- Vehicle OEMs can also consider providing comprehensive solutions that maximize the value of mobility experience through collaboration with platforms in different industries.

Concept of "Technology Platformers"

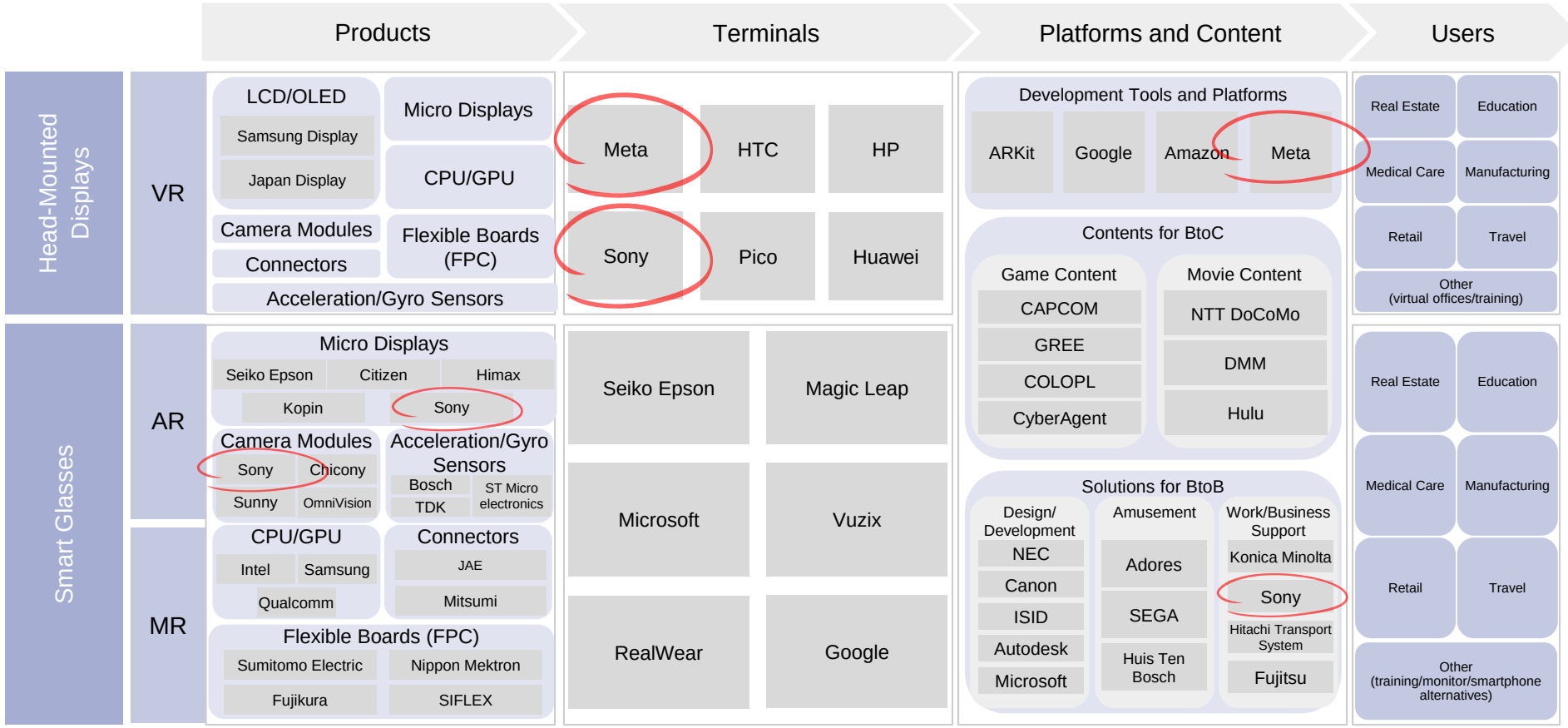


Source: Compiled by Mizuho Bank Industry Research Department

[Electronics] Product line-up Across Layers Provides an Advantage

- Diverse players exist at each layer that constitute infrastructure for the Metaverse
  - It may be important to have control all the way to the software level, similar to how Apple has achieved dominance in smartphones together with its platform.
  - Currently, Meta (formerly Facebook) and Sony have products across multiple layers.

Example: Player Map of xR Related Technologies



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

[Electronics] Joining Some of the Main Consortiums via Corporate Collaboration is Also a Strategy

- In the Metaverse, providers that supply services at each layer may change from the current ones for the physical world.
  - Through activities only by individual companies or at individual layers, there is the risk of being inferior to other companies.
- Movements for cooperation across companies have already begun, and joining some of the main consortiums by partnering with leading companies is also a strategy to consider.

Product Layer Structure in the Metaverse

Layer	Specific Example	Providers
Contents and Applications	Content such as videos	Production companies for movies, anime, games, etc.
	Sales of various goods and services	Retail (handling customers via avatars) Manufacturers (design only) Creators (digital assets)
	Communications	Metaverse PF Service providers (LINE, etc.)
Platforms	Services PF	Metaverse PF Existing PF/communications carriers
	Cloud	Amazon, Google, Microsoft, NTT Data
	DC	Equinix, NTT Communications
Networks	Fixed/mobile communications services	DoCoMo, KDDI, SB, NTT East/West
	NW infrastructure equipment	Ericsson, Nokia, NEC
Devices and Components	Smartphones, tablets, PCs, VR goggles, smart glasses, smart watches	In addition to existing smartphone/tablet providers, players will enter the market in response to device diversification
	Parts, sensors	Murata Manufacturing, Kyocera

Note: Areas highlighted in orange are areas where changes are expected before and after the Metaverse

Source: Compiled by Mizuho Bank Industry Research Department

Movement to Form Power Maps Between Companies has Already Begun

Microsoft x Qualcomm

Microsoft	Qualcomm
Provide a collaboration and communications platform on the Metaverse with the "Mesh" technology platform	Semiconductor development of glasses-type AR terminals compatible with Mesh

NVIDIA Ecosystem (Supporting Introduction in Japan)

NVIDIA

Provide "Omniverse" platform for collaboration in cyberspace and real-time simulations in the physical world

CTC	SCSK
HP	Lenovo
ISID	NTT PC

Groups supporting introduction in Japan (24 companies)

Guideline Formulation

KDDI | Future Design Shibuya | Tokyu | Mizuho R&T

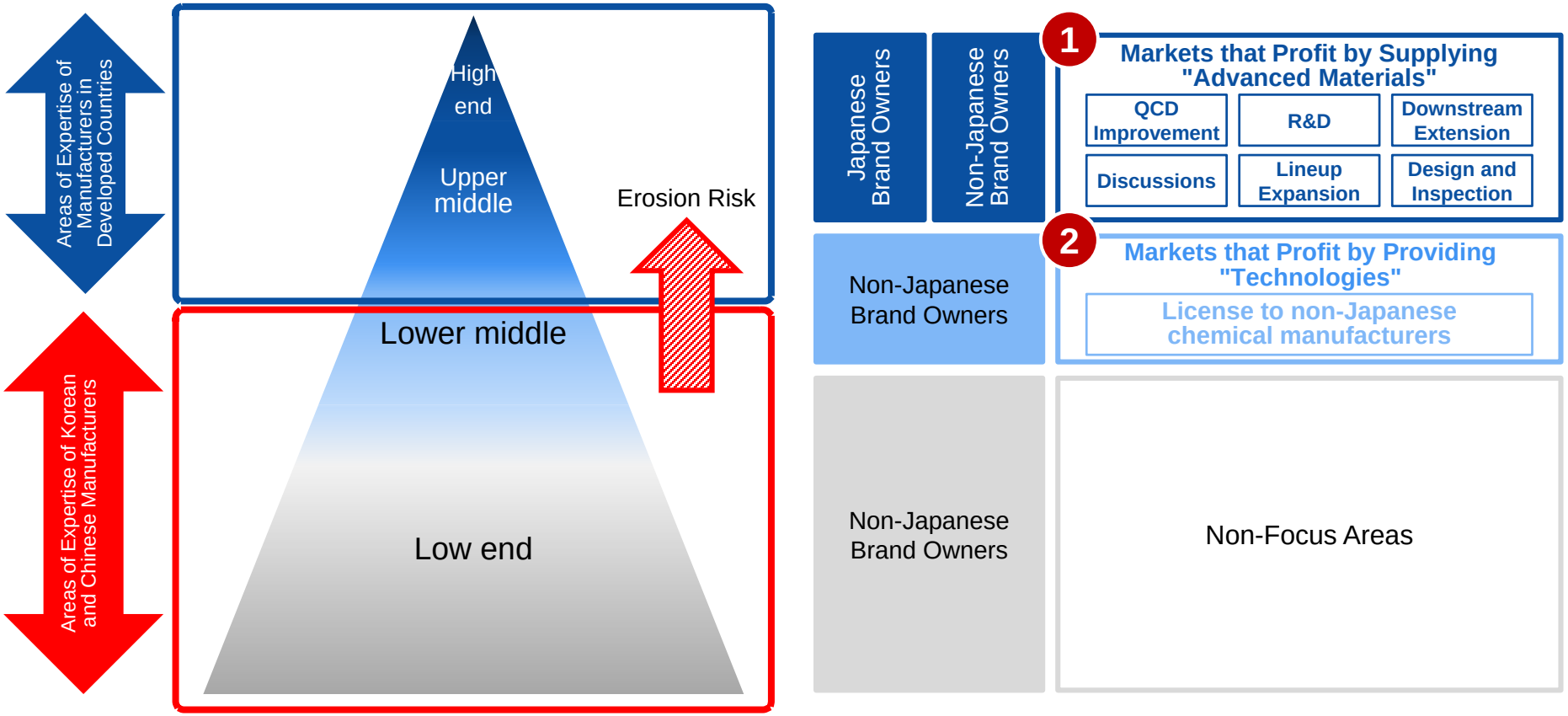
Formulate guidelines for everyone to utilize a city-linked Metaverse with peace of mind

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

[Chemicals] Functional Chemistry Can Also Shift to View of Collaborating with Middle-Range Non-Japanese Companies

- Amidst further catch-up from Korean and Chinese chemical manufacturers being expected, Japanese chemical manufacturers, as in the past, will continue supplying high-end markets with high-quality advanced materials, and at the same time will also have a strategy of acquiring growth markets by providing technologies for functional chemicals that have already begun to be generalized to some extent.

Areas Where Japanese Chemical Manufacturers Compete

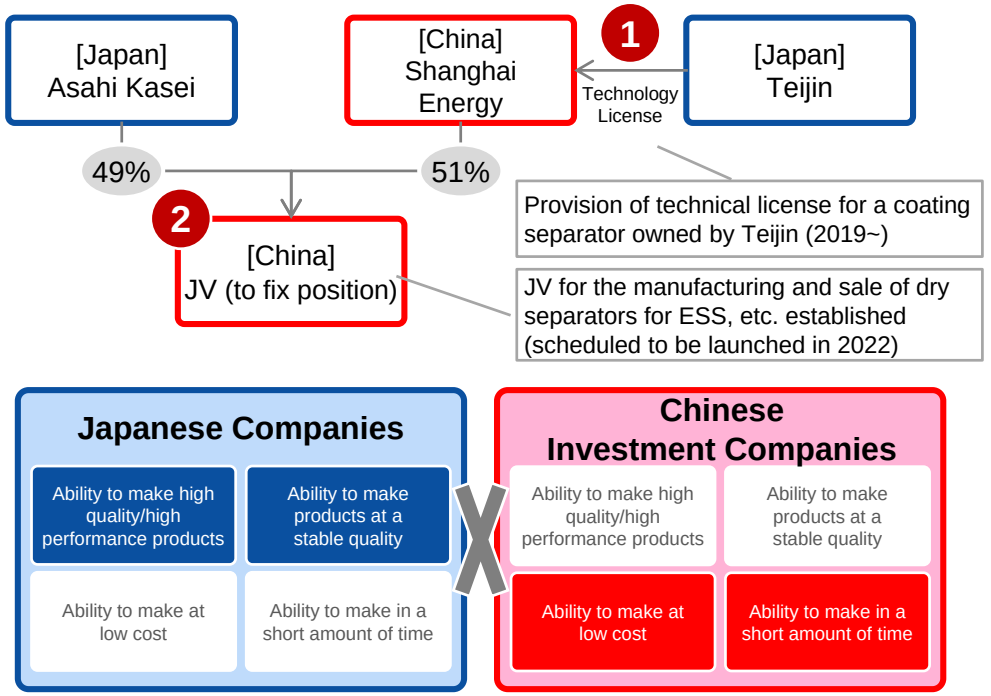


Source: Compiled by Mizuho Bank Industry Research Department

[Chemical] Efforts Required of Functional Chemistry ~Collaboration with Non-Japanese Companies

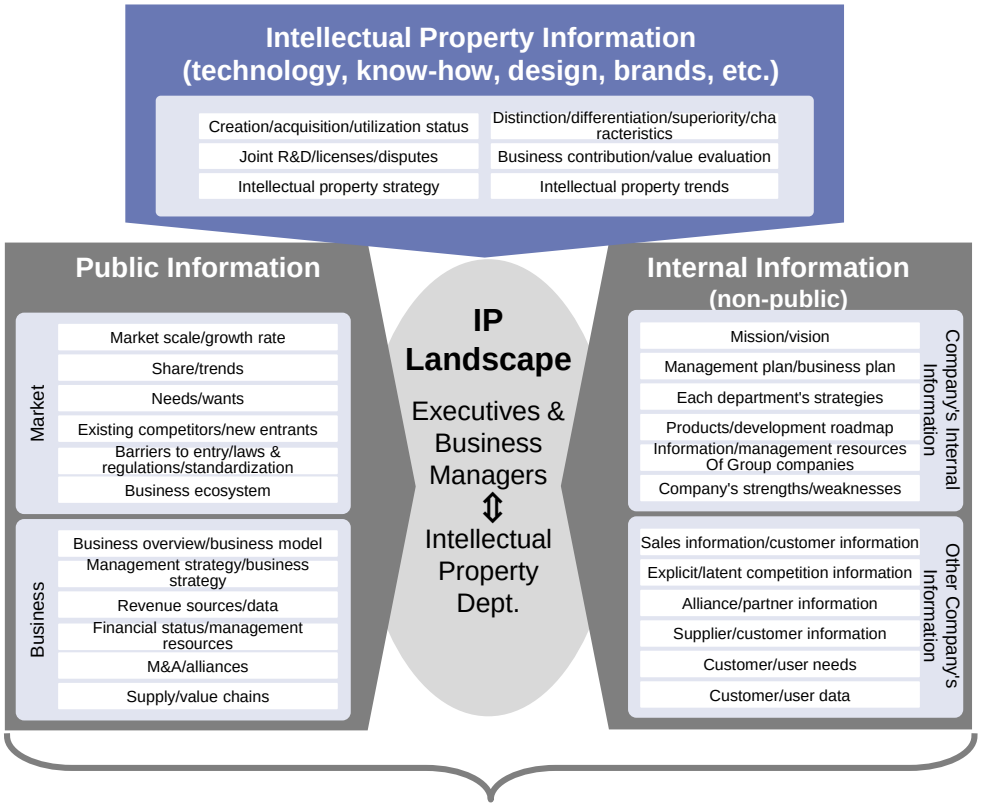
- With the rise of non-Japanese users, there is also the idea of strengthening via collaborations with non-Japanese companies.
- As for intellectual property, it will be necessary to separate areas that should be kept secret and areas that can be shared, and to then utilize them for planning and decision making in management strategy and business strategy.

Japanese/Chinese Manufacturer Collaboration in Separators



Note: Investments by Polypore International, a wholly owned subsidiary of Asahi Kasei. ESS = For position fixing
Source: Compiled by Mizuho Bank Industry Research Department based on Asahi Kasei and Teijin press releases

Using Intellectual Property as the Basis for Management and Business Strategies



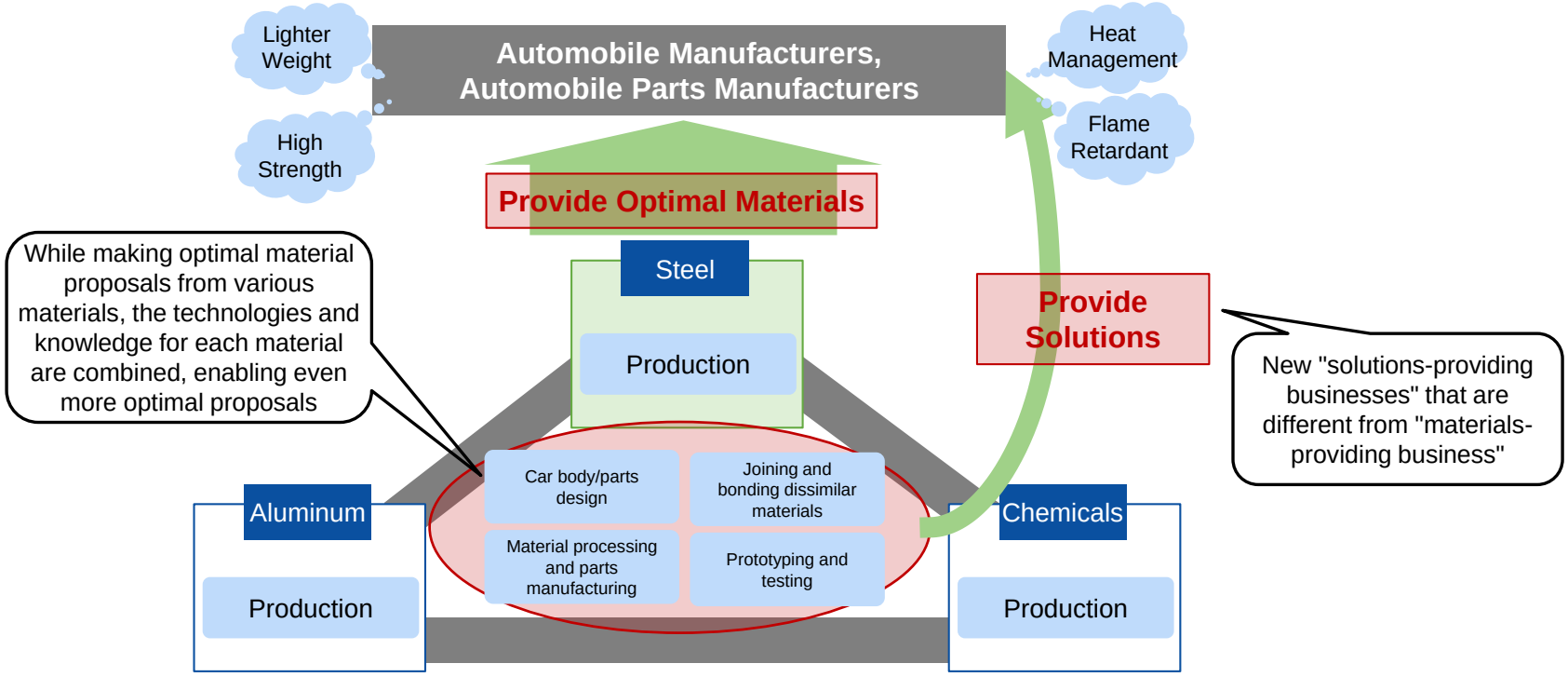
Planning and Decision Making in Management Strategy and Business Strategy

Source: Compiled by Mizuho Bank Industry Research Department based on Japan Patent Office materials

[Steel] Providing Downstream Solutions ~Shift to Professionals for Car Body Structural Materials

- In collaboration with other material companies, nurture "solutions-providing businesses" that are different from "materials-providing businesses" by not just providing materials, but by designing car bodies/parts assembly, joining/bonding dissimilar materials, and by a variety of downstream solutions such as processing for all materials.
  - While making optimal material proposals from various materials, as a solution monetize the knowledge, technologies, and knowhow cultivated as synergistic effects.

Transition to Solutions Company for Environmentally Friendly Automobiles



Note: indicates current business areas
Source: Compiled by Mizuho Bank Industry Research Department based on various materials

[Non-Ferrous Metals (Copper)] Copper is Indispensable for CN and Information Society. Japan has Strengths in Processing

- Because copper has high conductivity, it is used in many products such as electrical wires, appliances, electronics devices, electric vehicles, and renewable energy power generation equipment, and will be indispensable for realizing CN (carbon neutrality) and information society.
- In addition to increasing demand for copper due to CN trends, from the viewpoint of energy savings there is a sense that the required levels of miniaturization and high functionality (conductivity, thermal conductivity, etc.) for various products will increase even further. Japan has strengths in copper processing technologies and know-how that can steadily and carefully responded to user demands.

Non-Ferrous Metals Required for Carbon Neutrality

Field	System/Elemental Technology		Required Non-Ferrous Metals
Renewable Energy	Solar power generation	Solar panels	Copper, indium, gallium, selenium, silver
	Offshore wind power generation	High voltage seafloor cables	Copper, aluminum
		Turbines	Copper
Electric Vehicles	In-vehicle batteries	LIB	Copper, lithium, cobalt, nickel, manganese
		All solid-state batteries	Copper, lithium, nickel, manganese
	Motors	Windings	Copper
	Cables	Wire harnesses	Copper, aluminum
Low-Loss Energy Storage and Transmission	Superconductors	Superconducting power transmission cables	Copper, niobium, titanium, bismuth

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

Examples where Smaller/More Sophisticated Products are Required

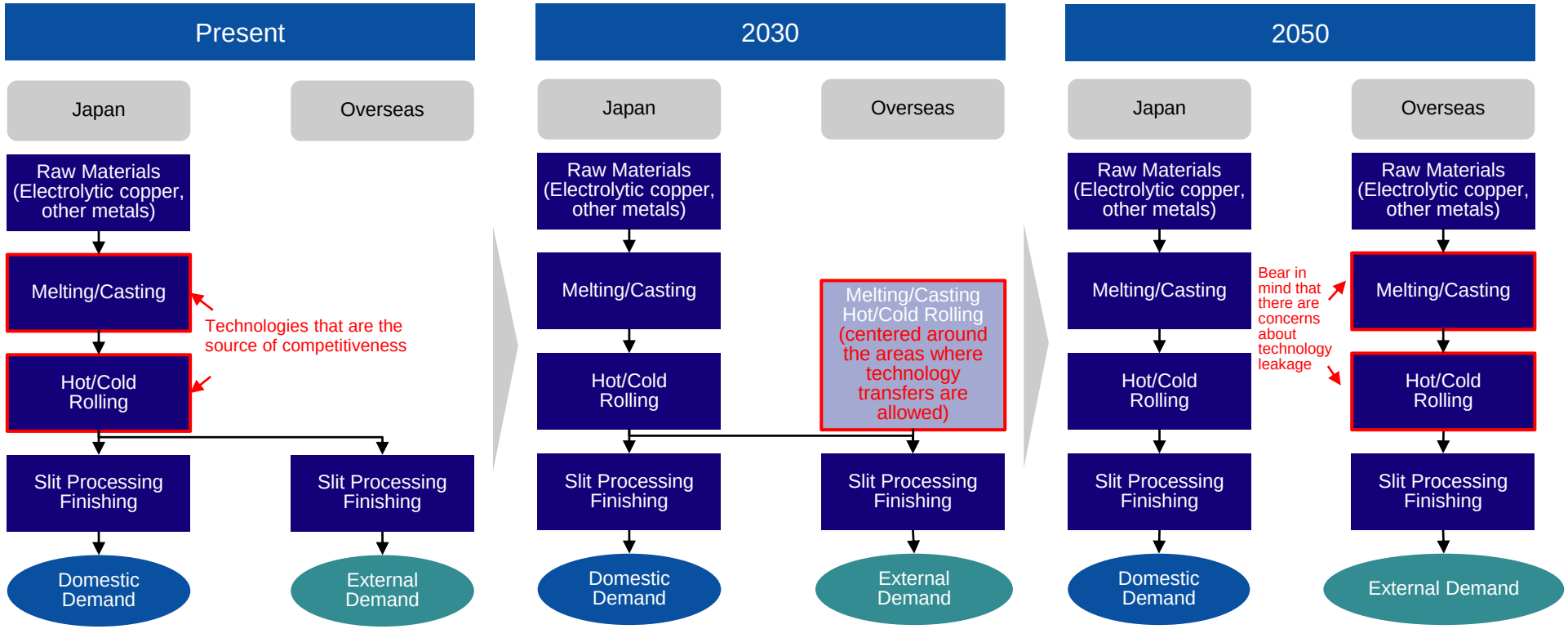
Electric Vehicles	• Because the number of in-vehicle circuits and windings will increase due to the shift to EVs, weight and size reductions for copper materials will be required from the viewpoint of increasing cruising range and space.
	• Because it will be required to increase the current in electronics parts, etc. for automobiles, high-performance materials that can provide high conductivity will be required.
Data Centers	• From the viewpoint of energy savings, copper and copper alloy products with high heat conductivity will be required for servers as a countermeasure for heat.
Electronic Devices such as Smartphones	• Because miniaturization and high functionality are being pursued by electronic devices such as smartphones, rolled copper products to handle this will be required.

Source: Compiled by Mizuho Bank Industry Research Department

[Non-Ferrous Metals (Copper)] Shift to Systems for Production in Demand Areas to Meet Customer Demands

- Because copper processing quickly responds to strengthening supply chains and increasingly sophisticated demands from customers, there is the possibility that domestic production will shift to a system that produces only in demand areas, leaving only matching for domestic demand.
- When moving to overseas, it is necessary to bear in mind that there are concerns about technological leakage in the "melting/casting" and "rolling" processes, which are considered to be sources of competitiveness for Japanese companies.
  - Instead of relocating all processes at once, it is assumed that they will be relocated in stages, taking customer requirements and world affairs into consideration.

Shift for Processing in 2050 to a Local Production for Local Consumption Model

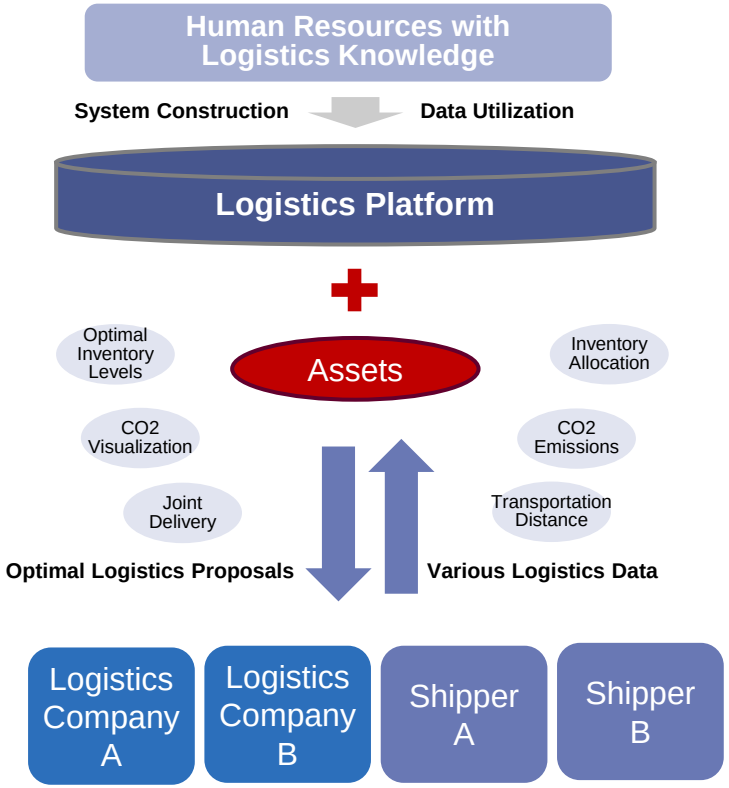


Source: Compiled by Mizuho Bank Industry Research Department based on various material

[Logistics (Land Transportation)] Propose Optimal Logistics that Utilize Logistics Information Platforms

- Due to the digitalization of transportation arrangements, it is assumed that the role of 3PL/forwarders will shift to the proposal of optimal logistics that utilize logistics IT platforms + assets.
- Added value will be through employing human resources with specialized logistics knowledge, and by building and operating a platform that optimizes logistics overall.
  - Building platforms according to the characteristics of each shipper's industry seems effective.

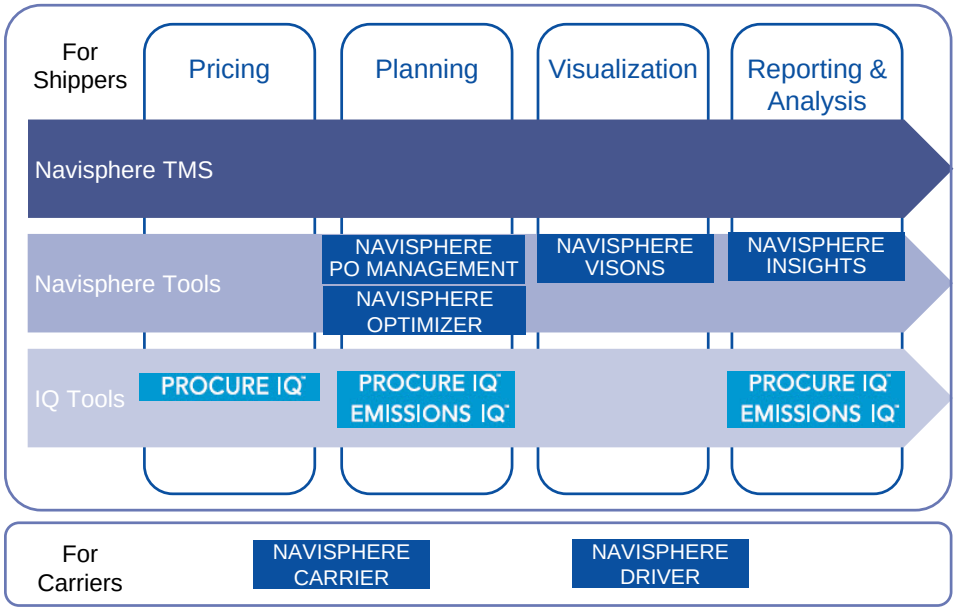
Future Image for 3PL / Forwarders (Mizuho Hypothesis)



Source: Compiled by Mizuho Bank Industry Research Department

(Reference) C.H. Robinson Platform

- Approx. 200,000 shippers and carriers are connected via the "Navisphere" global platform
- Provides optimal logistics solutions via the expertise of more than 1,000 data scientists, engineers, and developers

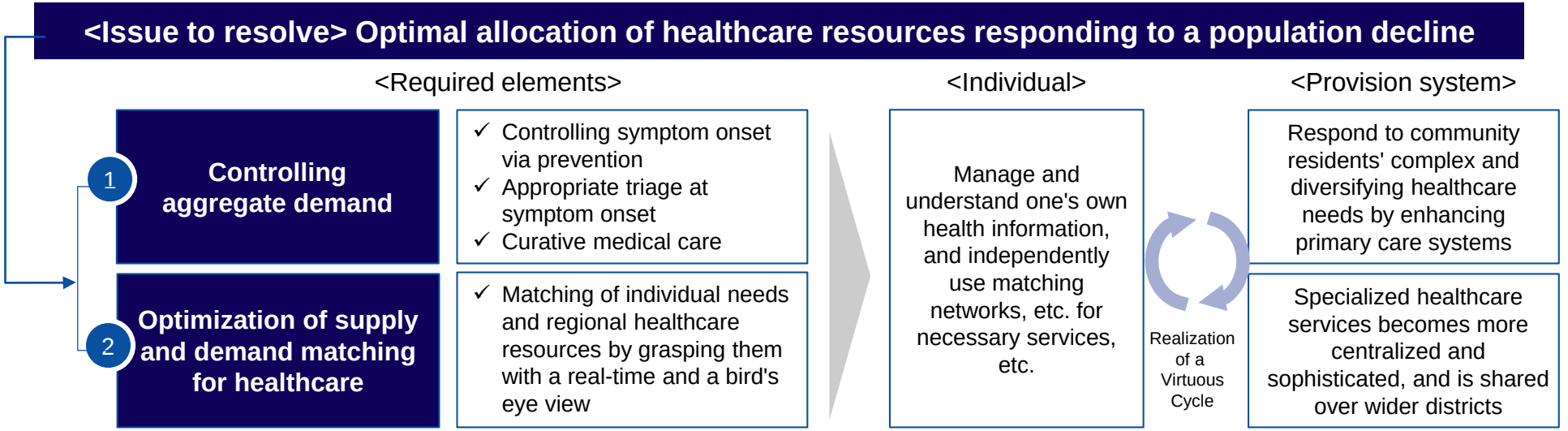


Source: Compiled by Mizuho Bank Industry Research Department based on IR materials

[Healthcare] Demand-oriented healthcare system simultaneously realizes control of aggregate demand and optimization of supply and demand matching

- In the demand-oriented healthcare system converted by 2050, (1) Controlling total demand and (2) Optimization of supply and demand matching for healthcare services will have been realized.
  - (1) can be achieved by controlling the onset of symptom via prevention, by appropriate triage at symptom onset [Note], and curative medical care
  - (2) can be achieved by implementing matching functions of individual needs and regional healthcare resources (supplies) by grasping them with a real-time and a bird's eye view.
  - Healthcare system in 2050 will focus on responding to diversifying needs that include backgrounds for daily life such as patients' employment status and household/family status. The system will build and strengthen a primary care system in which members of various occupations collaborate and provide support as a team. In order to realize a flexible use of limited resources, advanced and specialized healthcare services will be centralized and shared with collaborations in wider districts by utilizing online and other tools.
- As a result, the quantity and quality of healthcare services will be adjusted to achieve optimal allocation. Healthcare institutions will be consolidated and broaden their medical districts, and there will be a virtuous cycle in which quality and safety are improved, the business foundation is strengthened, and sustainability is enhanced.

Virtuous cycle of supply and demand that is realized by demand-oriented systems



Note: The original meaning is to determine treatment priority according to the urgency and severity of an injury or illness in the event of a disaster, etc. Here, it shows the distribution of response policy, such as whether or not an individual needs to see a medical consultant depending on their necessary medical services.

Source: Compiled by Mizuho Bank Industry Research Department

[Healthcare] Improved healthcare literacy, participation by people, more open information, and verification of cost-effectiveness

■ Increasing public literacy and a sense of involvement for the healthcare systems through visualization and openness will lead to the monitoring and supervision of the healthcare system for optimal resource allocation, and will realize a transition to a sustainable demand-oriented system.

	Purpose	Visualization / Openness	Efforts required of government
Start of national discussions	• For the people to have an accurate awareness of the current state of the healthcare system	• Current status of and future forecasts for benefits and burdens • Current status of and future forecasts for healthcare resources • Institutional issues of the healthcare system	• Measures to improve public literacy for the national healthcare system －Mechanisms for education/nudges Note1 • Revise and publicize future forecasts for social security
Development of data platform	• People have free access to their own health status • Eliminates asymmetry in healthcare information • Coordination between medical care and long-term nursing care • Foundation for innovations	[Individuals] • Lifelong healthcare information (PHR Note2) [Medical Institutions] • Sharing of medical treatment details/prescription information, etc. from medical institutions (EHR Note3)	• Development of public data platform and its utilization by individuals and healthcare facilities, and rulemaking, etc. for private sector usage －Setting for advanced medical models (specialty zones)
Verification of healthcare cost-effectiveness	• People have ability to choose health care services for which they have an understanding of the costs • Optimal allocation of financial resources (prioritization of compensation for medical care and long-term nursing care that leads to definite results)	• Logical explanations for insurance coverage • Disclosure of cost-effectiveness verification results for new and existing technologies • More open discussion of people's QOL and the costs of healthcare technologies	• Creation of a mechanism to streamline cost-effectiveness verification via utilization of data platform such as EHR. －Verification/governance by third-party institutions

Realization of demand-oriented healthcare system by 2050

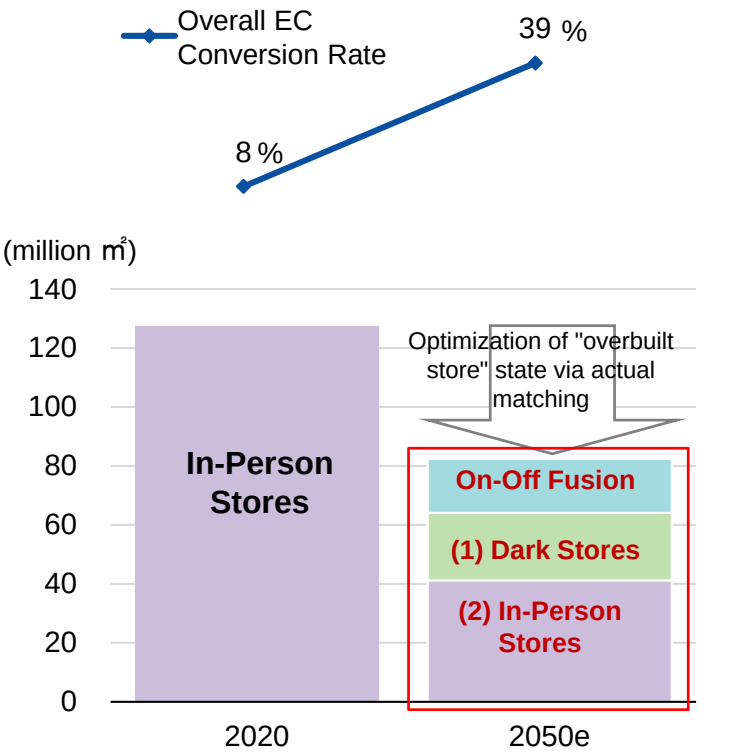
Note: 1. An approach that encourages people to take desirable actions based on the knowledge of behavioral science
2. PHR: A mechanism that enables individuals to view and utilize their own healthcare information through PCs and smartphones
3. EHR: A mechanism that allows patients and nationwide medical institutions, etc. to verify healthcare information

Source: Compiled by Mizuho Bank Industry Research Department

[Consumer Services (Retail/Restaurants)] With Progress in EC Conversion, Stores Change to Dark Stores and In-Person Stores

- Retail stores in 2050 will be divided into (1) "Dark stores (delivery bases for products sold online)" that respond to the progress in EC conversion, and (2) "In-Person Stores (enjoying unexpected discoveries and the comfort of certain values)" that provide experiential value to customers.

Outlook for E-Commerce Conversion Rate (Top) and Store/Commercial Floor Area (Bottom)

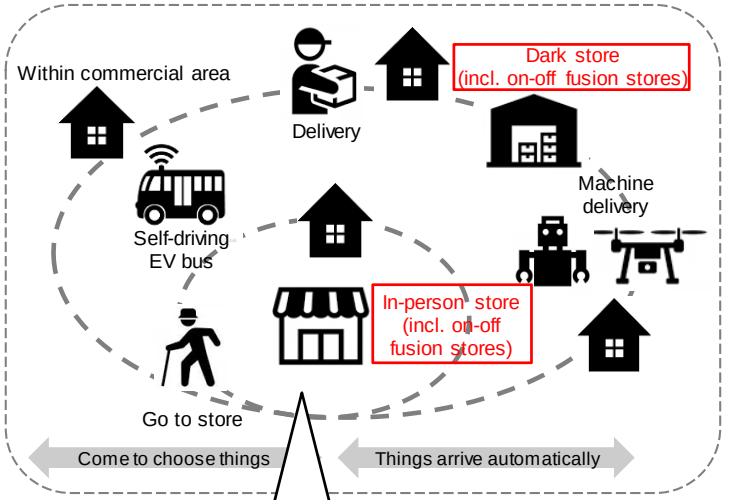


- Convert legacy assets compatible with digitalization
- Store format shifts to customer contact point that is digitally compatible

(Reference) Distribution in 2050, a Prerequisite for Store Format

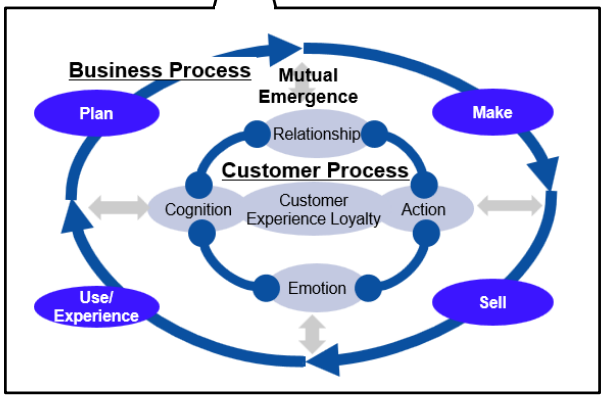
(1) Distribution as Inclusive Infrastructure

- Becomes frictionless by refining conventional functions
- Distribution as infrastructure that includes the provision of food and daily necessities



(2) Distribution that Co-Creates Value

- Co-creation of experiential value that gives rise to surprise and joy for businesses and customers
- From more corporate-led to consumer-led
- To a relationship that co-produces valuable things in the process of interacting with customers

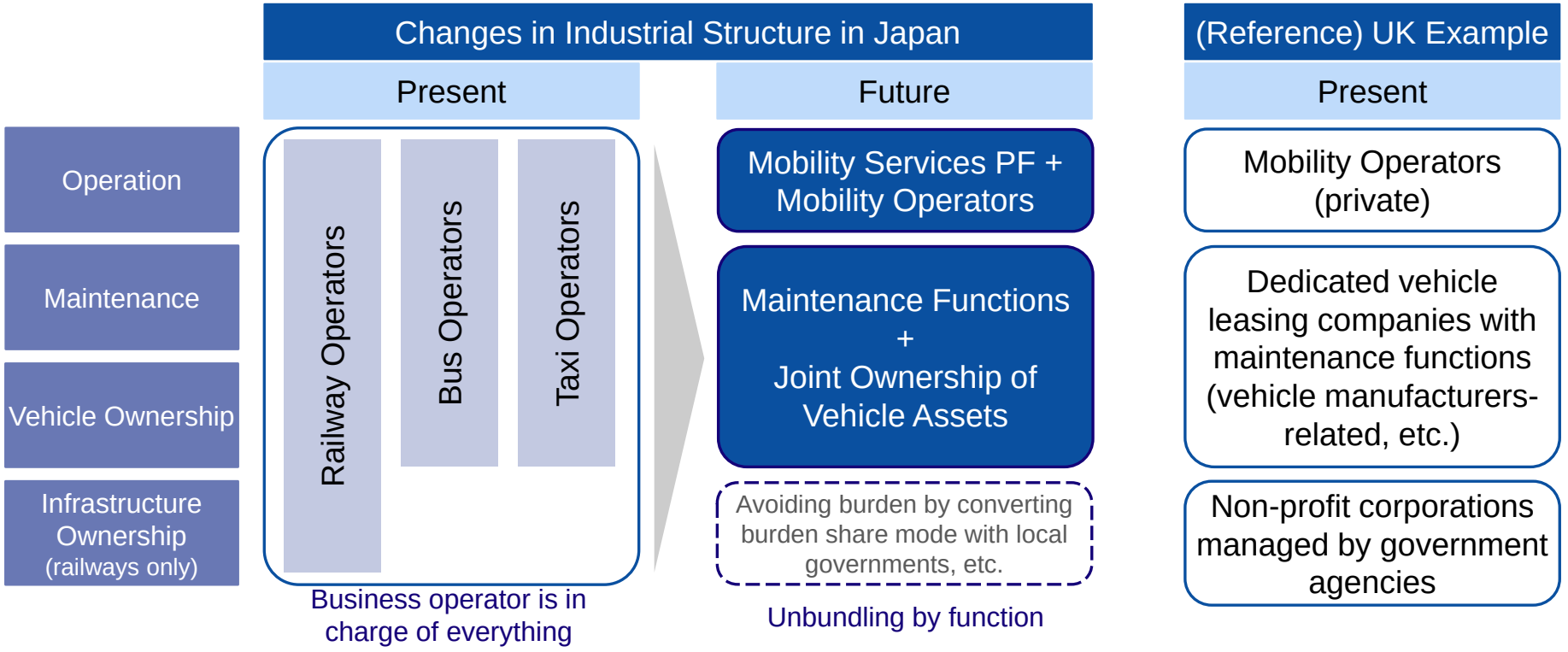


Source: Compiled by Mizuho Bank Industry Research Department based on Economic Census and FY2021 Economic Conditions Survey

[Mobility Services] The Way Assets are Held Changes According to Integration and Collaboration for Services

- If the integration of services and operations within the mobility layer progresses, then there will be changes in the way assets are held, including for mobility.
- In the future, there will be further unbundling of the functions of operations (which each business is responsible for) and infrastructure holdings, and it will be necessary to enhance the specialization each function.

Industrial Structure for Mobility Services in 2050



Source: Compiled by Mizuho Bank Industry Research Department

[Mobility Services] Increase Sustainability by Integrating Services and Reviewing Asset Holdings

- To realize the ideal form, mobility service providers will be required to (1) Build a mobility PF via service integration, and (2) Review the way they hold assets to be in line with changes in industrial structures.
  - The efforts in (1) will lead to flexible adaptation for supply and demand according to mobility demand, and the creation of mobility demand.
  - Through the efforts in (2), it will be possible to reduce procurement costs, including for mobility, and to improve efficiency, etc. for maintenance.
- It is speculated that it will be possible to provide sustainable mobility services through such efforts.

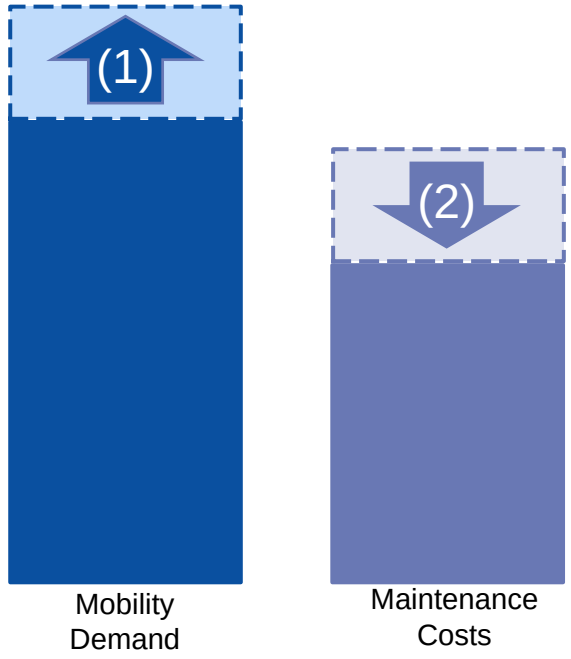
Balance Impact of Mobility Services by Realizing the Ideal Form

Mobility Demand

- In addition to a declining population, structural changes from the COVID-19 shock will accelerate the speed of the decline in mobility demand
- Mobility purposes are diversification and decentralization

(1) Significance of Building a Mobility PF

- Construction of a flexible mobility network that includes next-generation mobility
- Creation of mobility demand via coordination with destination layer



Maintenance Costs

- Expected increase in initial running costs in order to accommodate carbon neutrality
- External take-out costs will be incurred from data linkages

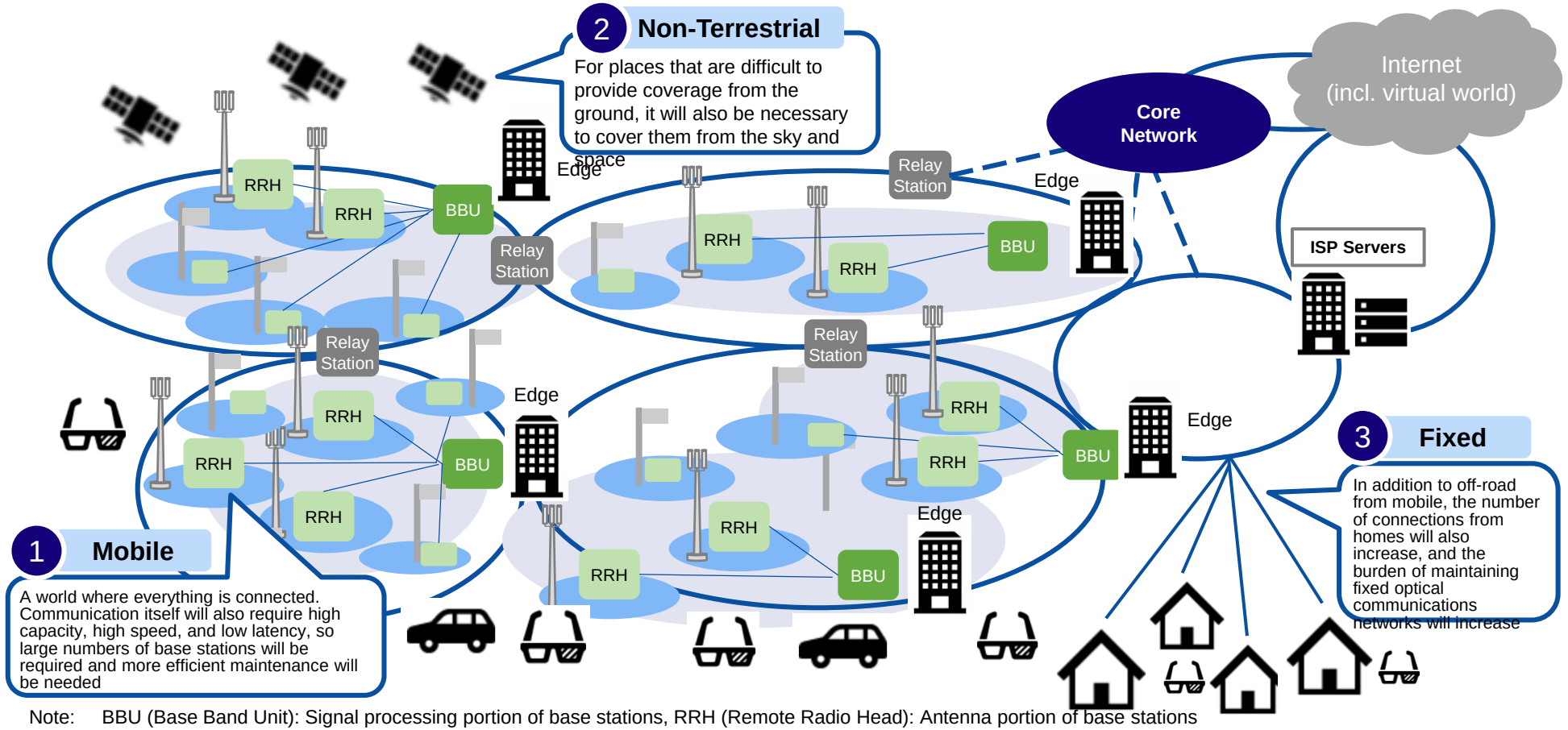
(2) Commonization of Asset Holdings

- Reduction in procurement costs via the use of bargaining power
- Increased efficiency via commonization of maintenance functions

Source: Compiled by Mizuho Bank Industry Research Department

[Communications] 2050: Ultra-High Quality Communications Infrastructure Required, and Collaborative Areas for Each Company

- In a world where the real and virtual worlds coexist, communications infrastructure becomes an more important lifeline (on the other hand, it will be difficult to raise prices).
- For 6G and 7G in mobile communications, even more fine-grained base stations will be developed based on radio wave characteristics ((1)), and, in addition, in order to provide high-quality networks everywhere, it will be necessary to also provide coverage for non-terrestrial areas ((2)), and there will be an enormous investment burden and maintenance/renewal costs.
- Furthermore, in addition to increased demand for fixed communications in homes ((3)), the inflow of traffic from mobile will also increase, which will increase the burden of maintaining fixed networks accordingly.



Note: BBU (Base Band Unit): Signal processing portion of base stations, RRH (Remote Radio Head): Antenna portion of base stations
Source: Compiled by Mizuho Bank Industry Research Department

[Communications] Promotion of Increased Efficiency, Including Spinning Off Infrastructure, and Strengthening of Apps, Content, and PF

- For communications infrastructure, together with various efforts to improve efficiency in preparation for the future, there will be an acceleration of efforts to provide coverage from the sky and space, which also have many technical and institutional issues.
- With regards to apps, content, and PF, which are becoming increasingly important, there will also be large amounts of investment, so it will be necessary to identify cooperation areas/competition areas and to work strategically.

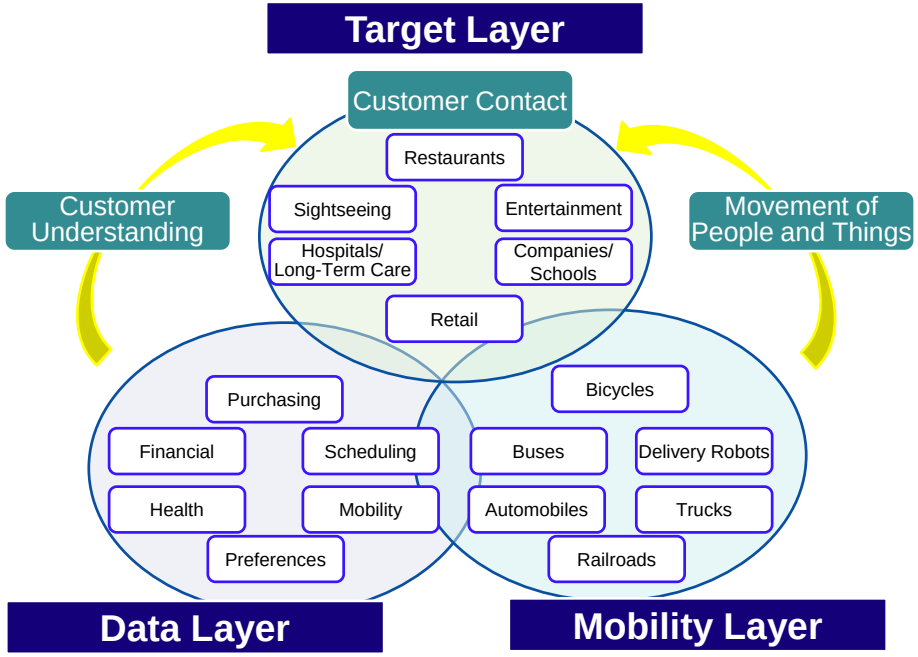
	Efforts
Communications Infrastructure (terrestrial)	■ For future infrastructure integration, as in preceding examples from overseas, each company will first separate their infrastructure division and their services division, and will then establish a flexible system while promoting increased efficiency for the infrastructure division ■ Efforts that contribute to network efficiency (ORAN, vRAN, RAN sharing) will be accelerated
Communications Infrastructure (aerial/space)	■ In addition to providing coverage from space with low-earth orbit satellites, efforts to provide coverage will be strengthened from the skies near the ground, such as via HAPS, and efforts to promote the realization of a world wherein people can be connect anywhere with low latency will be promoted.
Other Communications Technologies	■ In order to realize the world of 2050, there will not just be efforts on the communications infrastructure side, but also on the device side for communications technology (technologies to convey the sense of touch and smell, etc.), which aim to bring about more realistic communications. ■ Efforts will be strengthened in collaboration with vendors on information processing technologies and energy-saving technologies in preparation for increases in communications traffic and electricity.
Content, Apps, Service PF	■ Telecommunications carriers have already begun to work on service PFs. ■ In the future, it will be necessary to strengthen content and applications more than in the past, so it will be necessary to strategically identify cooperation areas and competition areas.

Note: ORAN (Open Radio Access Network): RAN (Radio Access Network) with separated functions built on the basis of open interface specifications
vRAN (virtual RAN): A RAN that uses virtualization technologies
HAPS (High Altitude Platform Station): A communications base station that is permanently stationed at an altitude of approx. 20 kilometers, which corresponds to the stratosphere
Source: Compiled by Mizuho Bank Industry Research Department

[Consumer Services (Retail/Restaurants)] Collaboration with Various Platforms

- Although competitions with platforms is expected, cooperation at each layer is important under a multi-layered platform.
- Collaboration requires the participation of diverse consumption service operators in the ecosystem in order to increase consumer choices.

Possibility of Collaboration with Multi-Layered Platforms



Possibility of Collaboration

- ○ Multi-layered platforms have direct contact with local residents, and, based on customer understanding from the acquired data, combine various transportation modes to and logistics.
- ○ Will involve local customer contact points as the target layer for mobility and will create a virtuous cycle by understanding needs, attracting and sending customers, and providing maximum opportunities.

Source: Compiled by Mizuho Bank Industry Research Department

[IT] Form the IT Service Industry Should Aim for in the Metaverse Era

- As the act of providing various goods and services shifts to virtual platforms, there will be a further acceleration in the change to the value-added structure of the existing information service industry.
  - The increase in commercial transactions in the Metaverse will expand IT and digital investment for business transformations and for strengthening customer engagement.
  - Assuming activities on the platforms, enterprise features that are provided by platforms will be more widespread than before.
- On the other hand, there is also the possibility that a new IT market will be formed due to the development of the Metaverse.

Appearance and Spread of the Metaverse

Responding to changes in IT and digital investment on the user side by further accelerating digital shifts in economic activities

Approaches to the new IT market created by the formation of Metaverse platforms

by Metaverse

- User activities shift to digital (Metaverse)
- IT/digital investments also premised on use of Metaverse PF
  - Further increase in IT/digital investment to increase value
  - Accelerate alternatives to existing IT via platforms

Convert to a partner that promotes corporate transformation together

Next Page

of Metaverse

- Develop and provide a variety of infrastructure and technologies for building Metaverse platforms

Convert to a partner that provides technologies

- Develop and provide applications and content platforms built on Metaverse platforms

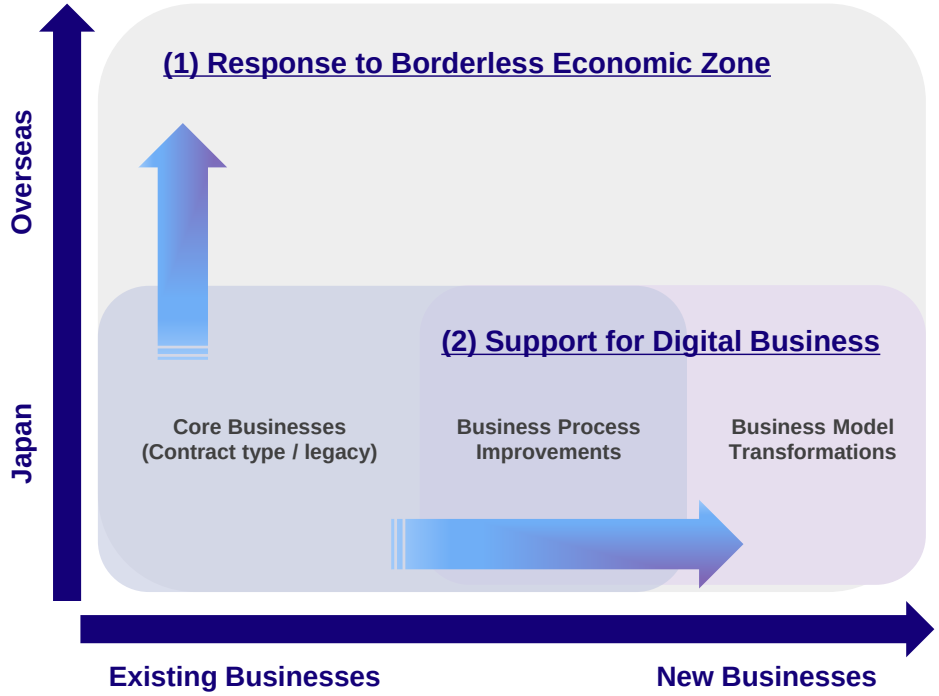
Be the platform provider

Source: Compiled by Mizuho Bank Industry Research Department

[IT] <by Metaverse> Acquisition of Related Companies to Secure Insufficient Capabilities

- Together with responding to the expansion of IT and digital investment by user companies to increase value, it will also be necessary to shift capabilities in anticipation of a decline over the medium to long-term in the software contract development market.
- Specifically, along with medium to long-term structural reforms by transitioning the skills of domestic IT human resources, it is presumed that it will be critical to promote M&A of related companies in order to expand to upstream processes such as consulting, and to acquire advanced technologies such as AI/IoT and security, and to acquire horizontal/vertical software technologies.

Issues and Response Directions for IT Service Providers



	Response Direction	Issues and Points
(1) Shift to Borderless	**Acquire Base of Overseas Customers and Overseas Human Resources via Acquisition of Overseas Companies** ■ Acquire a customer base in growing regions such as Europe, the US, and China ■ Create a globally standard organizational culture and systems for utilizing overseas human resources	■ Identify Formation of New Economic Zones — How new economic zones be formed and developed — Economic zone market size, growth potential, competitors, etc. ■ Feasibility of acquisitions in list of competition from large, well-capitalized global players
(2) Digital Business	**Strengthen Capabilities via Acquisition of Digital-Related Companies** ■ DX-related — Consulting, managed services, migrations, etc. ■ Development model (Agile, model base) ■ Digital technologies (AI, IoT, security)	■ Scaling methods using technology, business model, and know-how, etc. of target companies. ■ Soaring valuations for digital companies — Capability enhancement through partial investment or joint venture (JV) in Japan, etc. is also an option

Source: Compiled by Mizuho Bank Industry Research Department

(Reference) Common Issues Related to Interacting with Platforms / Platformers

- In constructing business models for 2050, a common issue will be how to interact with the expanding areas of platforms and platformers, and one or both of the following strategies should be considered.
  - (1) Identify areas that can be separated from platformers, and build and establish a platform as a leader.
  - (2) In markets already occupied by platformers, expand the areas where one's company can provide the strengths by utilizing the platformers' functions and network.

Direction of Strategy Efforts for Japanese Company Platforms ((1) and/or (2))

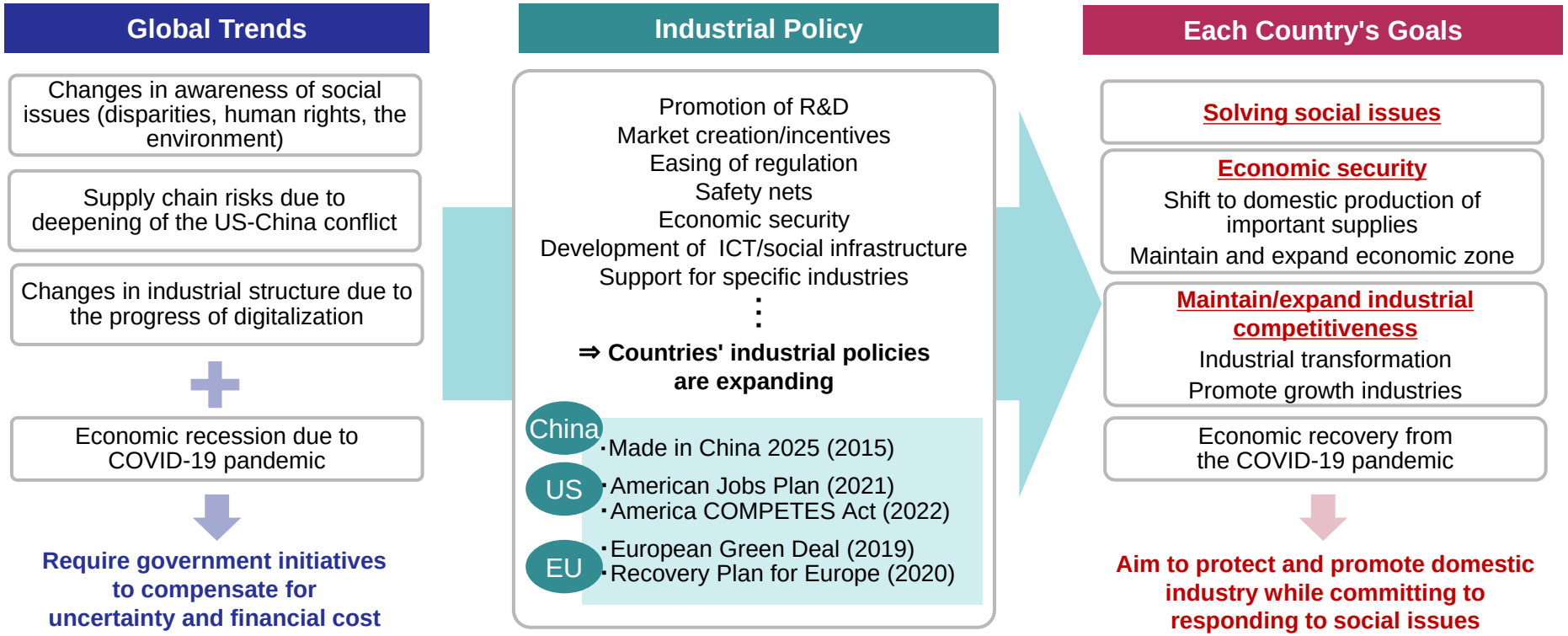
Strategy Direction		Type	Points for Efforts
1 Establish Platforms in Niche Areas	**Identify areas that can be separated** from platformers, and **construct and establish a platform** as a leader	• Service integration • Specific industry • Specific customer base • Specific area	• Redefine **company's own strengths and provided value** • **Model design** that maximizes stakeholder interests • On premise of openness, lack of resources will be supplemented by **making partners** within the industry and between other industries • After establishing a platform in a specific area, consider **expanding to other areas where synergies can be expected** • **Compliance with laws and regulations** (←room for policy support)
2 Deepen Collaboration with Platformers	**Utilize platformers' functions and network**, and expand the areas where one's company can provide the strengths	• Complement/co-create platform • Deploy services on platform	• Redefine **company's own strengths and provided value** • Based on an **understanding of the platform providers' business model**, promote the benefits of collaboration with the platformers • Product development premised on **connecting with the platform** • Demonstrate presence within the platform by **refining core competencies**

Source: Compiled by Mizuho Bank Industry Research Department

Amidst the COVID-19 pandemic, the Role that Governments Play is Reaffirmed, and Countries are Strengthening Industrial Policy

- In addition to megatrends such as the environment, digital, and US-China conflict, the role played by governments amidst the COVID-19 pandemic has been reaffirmed and governments are strengthening their industrial policies.
  - While committing to deal with diversifying social issues such as disparities, human rights, and the environment, governments will be required to maintain and expand their own country's economic security and industrial competitiveness in a more divided world.

Background of Governments Strengthening Industrial Policy



Note: Years in parenthesis are the years when the policies were announced by the governments
Source: Compiled by Mizuho Bank Industry Research Department

Policies Expected for Japanese Industries and Companies to Move Towards Ideal Forms

- Some countries are strengthening industrial policies, which are supporting corporate activities.
- While there are many structural issues that are unique to Japan, it will be difficult to realize ideal forms for Japanese industries and companies only by entrusting them to the optimization of individual companies based on market principles, so government support through industrial policy is essential.

Example of Industrial Policies Expected from the Japanese Government

Disseminating ideal form for the country and fostering a common understanding with companies and individuals		• Disseminate the ideal form for the country, deepen discussions that involve companies and individuals, and foster a common understanding **[Common]** • Improve national literacy about the healthcare system **[Healthcare]**
Promoting technologies and R&D that will be sources of competitiveness and innovation for all industries		• Deep tech support (support for world-leading technologies to overcome the "valley of death") **[Common]** • Subsidies for large R&D costs required for maintaining competitiveness and innovation **[Common]** • Discover innovation seeds through startup support and industry-academia-government collaborations **[Common]**
Creating systems to support companies that are working to realize ideal forms	Providing market creation Incentives	• Develop the green steel market and stimulate demand **[Steel]** • Create mechanisms for giving environmental added value to recycled materials **[Non-Ferrous Metals (Copper)]**
	Easing regulations Elimination of bottlenecks	• Flexible operation of antitrust laws during times of industry reorganization **[Steel][Non-Ferrous Metals (Copper)]** • Support for facilitating the reorganization of industries with high GHG emissions **[Oil and Gas][Chemicals]**
	Safety net	• Create mechanisms to promote structural reforms, including for small and medium-sized enterprises, such as incentives for business expansion and M&A, and support for acquiring the skills of managers and employees **[Common]**
Developing social infrastructure that will be a foundation for all industries	Economic security (stable procurement and supply of energy and resources)	• Support for both gradual reduction of fossil fuel power sources and stable supply, and for the sustainable utilization of nuclear power **[Electric Power]** • Design systems to properly distribute stable supply maintenance costs throughout society **[Oil and Gas][Steel]** • Support decarbonization of the entire food supply chain **[Food]**
	Develop ICT/social infrastructure	• Promote digitalization and data utilization in society as a whole **[Common]** • More open information for demand-type systems, and create a cost-effectiveness verification system **[Healthcare]**

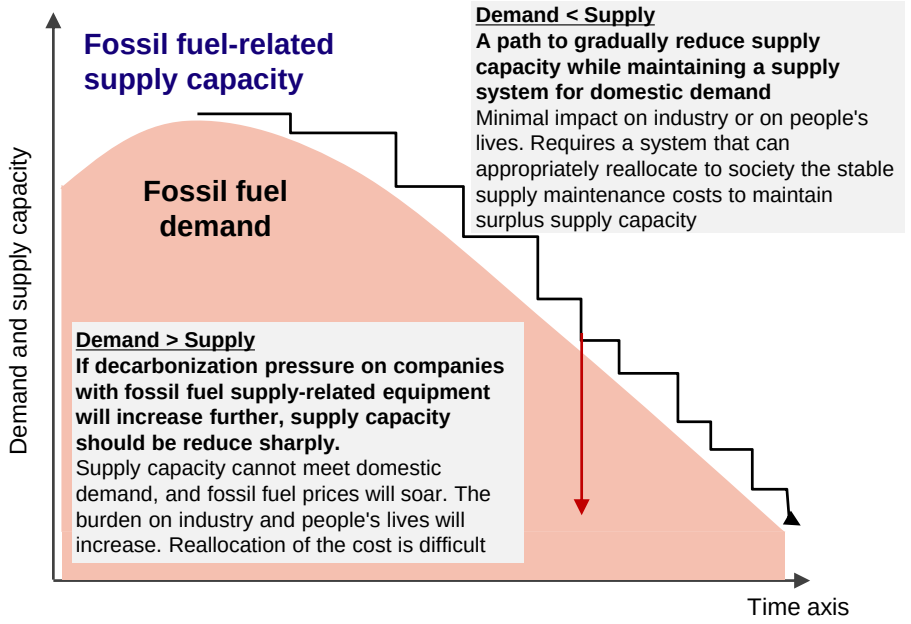
A common public-private understanding of ideal forms and policy that supports the realization of ideal forms will bring about solutions to social issues and the inclusive growth of an country, companies and individuals

Source: Compiled by Mizuho Bank Industry Research Department

How to optimize the existing assets size for fossil fuels

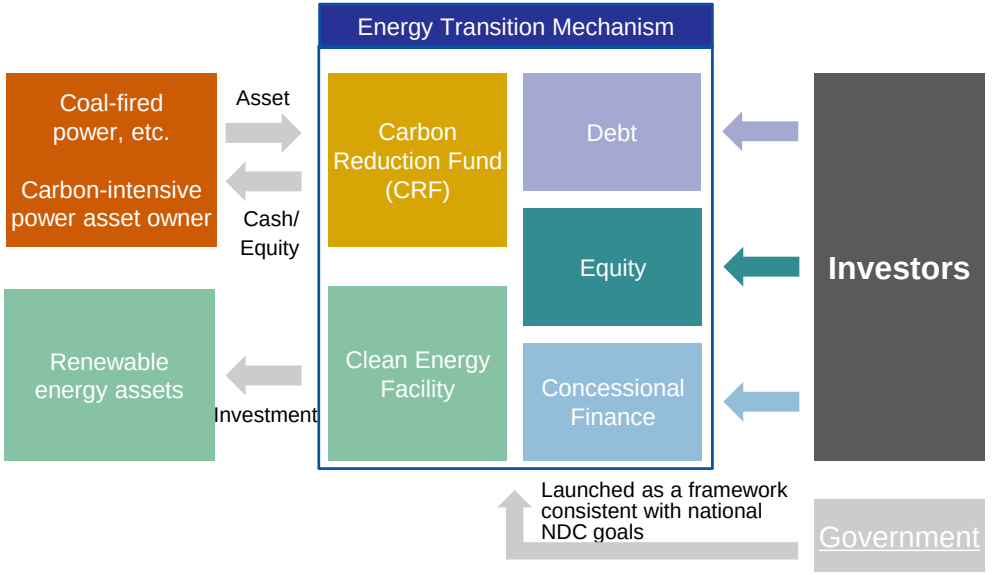
- Converting infrastructure for a decarbonized society need considerable time. However, companies are confront with the pressures to shorten the transition periods.
  - Although companies are considering optimal transition plans, there are concern of further increases of decarbonization pressure from financial markets and shareholders.
- To avoid the unintended shortage of the fossil fuels supply infrastructure, government can take further efficient support.
  - ADB Energy Transition Mechanism is an effort to support an appropriate energy transition for Asia region.

Decreased Fossil Fuel Demand and Supply Capacity



Source: Compiled by Mizuho Bank Industry Research Department

ADB Energy Transition Mechanism



Source: Compiled by Mizuho Bank Industry Research Department based on the "Expert Panel on Climate Change (2nd Meeting)" materials by the Cabinet Secretariat

Europe Supports an Inclusive and Just Carbon-Neutral Transition

- In Europe, there is advocacy for a transition to a carbon neutral economy and society where no one is left behind, and progress in policy support that includes large-scale fiscal mobilization to facilitate the decarbonization and low-carbonization of industries with high GHG emissions.
  - The Just Transition Fund, created in the EU in July 2021, aims to support people, economies, and the environment in areas that will be severely socio-economically affected during the transition, the fund's size is equivalent to 17.5 billion euros.
  - Germany, which has higher GHG emissions than other EU countries, is actively supporting industries with high emissions.

Examples of Policy Support for European Industries, etc. with High GHG Emissions

EU	Overall	• Just Transition Fund • Innovation fund that is funded by EU-ETS • Horizon program for research support (2021 - 2027: Horizon Europe) • Recovery Plan for Europe
	Steel	• Contributes up to 700 million euros to the "Clean Steel Partnership" for the transition to low carbon steel
Germany	Overall	• Contributed 9 billion euros to the technological development of hydrogen utilization (national hydrogen strategy)
	Coal	• Contributed 40 billion euros as compensation to coal areas due to the total abolition of coal-fired power (Act on Structural Change in Coal Mining Areas) • As decommissioning-related costs including mine closures, a fixed amount is granted to major power generation companies that handle lignite (Act on the Phase-out of Coal)
	Nuclear Power	• 2.4 billion euros of compensation for nuclear power plant operations companies that are affected by the elimination of nuclear power (revised Atomic Energy Act)

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

[EU] JTF：Just Transition Fund

Scale	• **17.5 billion euros** - 7.5 billion euros from the 2021-2017 EU multi-year financial framework, and 10 billion euros from the reconstruction fund
Allocation to Member States	• **Allocated according to industrial emissions** in areas with concentrated GHG, etc. - Higher allocation countries: (1) Poland, (2) Germany, (3) Romania • If the fund is increased by the end of 2024, then will be allocated according to GHG reduction rate • Upper limit of 50% of allotment if CN goal is not adopted
Supported Activities	• SME support, investment in entrepreneurship • Investment for **renewable energy and increasing energy efficiency** • Investment for **decontamination of brown fields, etc. and for land restoration** • Investment for **digitalization** • **Support for worker re-education and job-hunting**, etc.
Non-Supported Activities	• Decommissioning/new construction of nuclear power plants • Manufacture, processing, and sale of tobacco products • Fossil fuel production, processing, transportation, storage, and combustion, etc.

Source: Compiled by Mizuho Bank Industry Research Department based on the "Regulation Establishing the Just Transition Fund" by the EU

Expected Role of Industrial Finance in order for Japanese Industry and Companies to Move Towards Ideal Forms

- The role of financial institutions is to provide added value from both financial and non-financial perspectives, as represented by transition finance.
- Industrial finance is required to fulfill its role as a value co-creation partner that together creates the ideal forms for Japanese companies.

Expected Role of Industrial Finance

Ideal Forms for Japanese Industries and Companies, and Examples of Problems that Cannot be Solved by Companies Alone		Expected Role of Industrial Finance as a Value Co-Creation Partner (examples)	
Achievement of carbon neutrality and stable supply of energy and resources	・Large investment and expenses (transition costs, emissions compensation) ・Responding to changes in values chains and industrial structure	Rebuilding Value Chains	・Supporting the realization of companies' transition strategies by utilizing sustainable finance, etc. and providing the necessary funds in consideration of industry characteristics and timelines ・Support for acquiring the certifications necessary for overseas sales
Early investment in and development of advanced technologies	・Insufficient R&D funds ・Technology development through industry-academic collaboration ・Fostering startups	Support for Converting Business Models	・Sharing of cultivated know-how ・Accompanying conversion to new businesses
Transforming to new business models	・Lack of upfront investment funds, human resources and know-how ・Fostering awareness of social issues and reforming institutions	Joint Development of Products and Services	・Industry-academia collaboration support that utilizes extensive networks, and collaboration support through business matching between companies ・Providing necessary funds for industry reorganization and overseas expansion
Industry integration/reorganization	・Insufficient funds ・Persuading stakeholders	Risk Sharing as Partners	・Supplying the financing required for the above efforts
Promoting/reviewing overseas expansions	・Insufficient know-how such as business customs ・Insufficient in terms of financing/know-how for M&A and listing	Recommendations and Efforts for Social Change	・Collaboration from a financial perspective, proposals for public goods, and bridging public-private partnerships to solve social issues

Industrial finance is required to play a role as a value co-creation partner that together creates the ideal forms for Japanese industries and companies

Source: Compiled by Mizuho Bank Industry Research Department

Value Co-Creation through Risk Sharing and Management Support During the Transition Period

- In the transition to a sustainable society, technological development and the emergence of startups are expected, but funding for such areas is highly uncertain.
- It is expected that industrial finance will co-create social value by appropriately evaluating risks via industry knowledge, by supporting funds procurement using various methods, and by supporting management through personnel dispatch and governance support.

Types of Sustainable Finance

Restricted Funds Usage	**Green Finance**	・"Businesses that contribute to the environment" are the use for these funds (Ex.: Renewable energy, hydrogen, adaptation businesses, etc.)
	Sustainable Finance	・Both "Businesses that contribute to the environment" and "Businesses that contribute to society" are the use for these funds
	Social Finance	・"Businesses that contribute to society" are the use for these funds (Ex.: Medical care, long-term care, disaster prevention, education, regional revitalization, etc.)
Unrestricted Funds Usage	**Sustainability Linked Finance**	・Sets goals (SPTs) for sustainability strategies. Have incentives (changing interest rates, etc.) depending on whether or not the goals are achieved.
Additional Elements	**Transition Finance**	・Finance that trusts a company's decarbonization transition strategy ・Possible to send out the company's strategy for a third-party evaluation ・Feature is that it can be applied to gradual reduction efforts in industries where short-term decarbonization is difficult, such as steel, gas, and chemicals
	Impact Finance	・Finance intended to have a positive impact on the environment, society, and economy while ensuring appropriate risks and returns ・Features are that it clearly intends impacts and conducts measures on the impact

Value Co-Creation Through Finance to Transition Areas

Risks of Investing in Transition Areas

・Forms and technologies are still developing, so there is a high degree of uncertainty
・Sufficient financial analysis is difficult for companies in founding stage

Role of Industrial Finance

・Supports funds procurement via appropriate methods after conducting risk assessments that utilize industry knowledge
・Accompanies transitions over a long period of time through dispatching personnel, providing information, and supporting governance

- **Financial support: Handle various procurement sources and funds usages**
- **Supplying human resources: Dispatch management human resources and engineers**
- **Industry knowledge: Business strategy planning and investment decisions**
- **Governance: Support for strengthening corporate governance**

Co-creating social value through risk sharing and management support during the transition period

Note: SPT (Sustainability Performance Targets): Goals for sustainability strategies that are set by sustainability linked finance with no restrictions on funds usage
Source: Compiled by Mizuho Bank Industry Research Department

Conclusion

Considering Japanese Industry in 2050
- Promising Fields and their Contribution to Japan's Development

- Working towards the ideal forms will lead to the development of Japanese industries and companies, and then to individual growth and national development

Ideal Forms for Industries and Companies

Promising Fields

(1) Realizing the stable procurement and supply of energy and resources, and the decarbonization of society as a whole

- Clean energy
- Carbon-free hydrogen
- Synthetic fuels and synthetic methane
- Adjustments for power supply/demand
- CCUS solutions
- Solutions for low carbon production
- Comprehensive energy provisioning
- Overseas expansion of solutions
- Recycling
- Sustainable food

(2) Capturing domestic and overseas demand by providing value for decarbonization products while utilizing technological capabilities

- Planning and designing vehicles and services
- Application development
- Providing production technologies and mass production capabilities
- Comprehensive provision of materials
- Providing cutting-edge materials
- Optimal solutions for vehicle body materials

(3) Utilizing technology to continue increasing productivity and providing services that are close to daily life

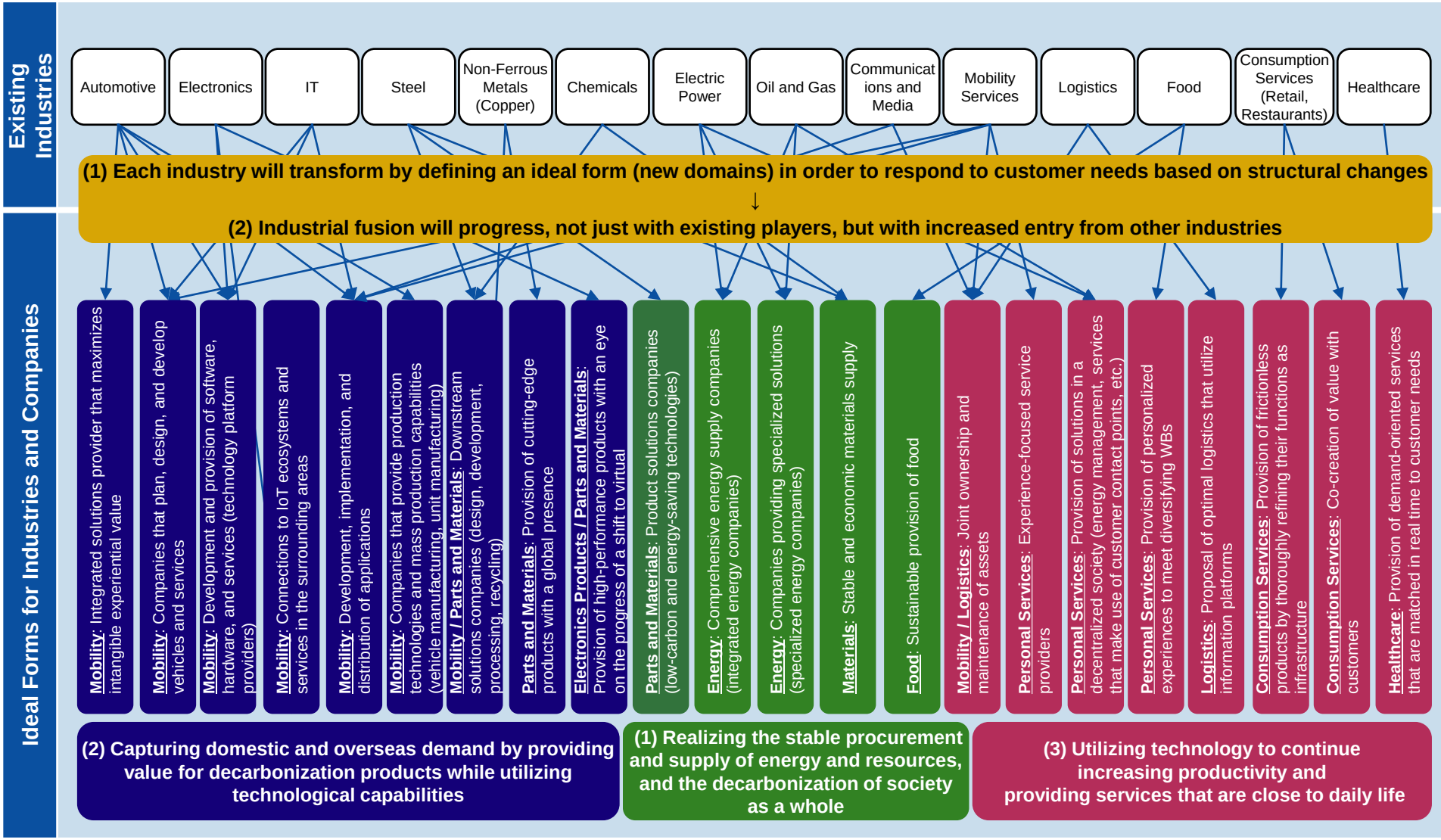
- Joint ownership and maintenance of assets
- Personalized services
- Providing value of experience
- Provide optimized logistics
- Matching services
- Regional services for daily life
- PF for services and contents
- Providing next-generation communications NW

Leads to the Development of Industries and Companies, then to Individual Growth and National Development

Increase Earning Power (Economic Growth Rate)	Improve Self-Sufficiency Rate (Current Account Balance)	Realize a Sustainable Society (Public Finances, Productivity)	Realize Well-Being (Affluence, Health, Coexistence)
➢ Investment in technology and human resources ➢ Shift to high value-added industries ➢ Raise potential growth rate and expand domestic investment ➢ Business expansion by expanding overseas investment	➢ Investment in next-generation infrastructure ➢ Manufacture of clean energy ➢ Strengthen resource recycling ➢ Export technologies and services ➢ Bring back overseas investment income	➢ Improve efficiency via supply optimization by matching supply and demand ➢ Dispel anxiety about the future and expand consumption and investment	➢ Provide products and services that meet individuals' needs

Source: Compiled by Mizuho Bank Industry Research Department

Considering Japanese Industry in 2050
- Progress in Industrial Fusion While Realizing Ideal Forms

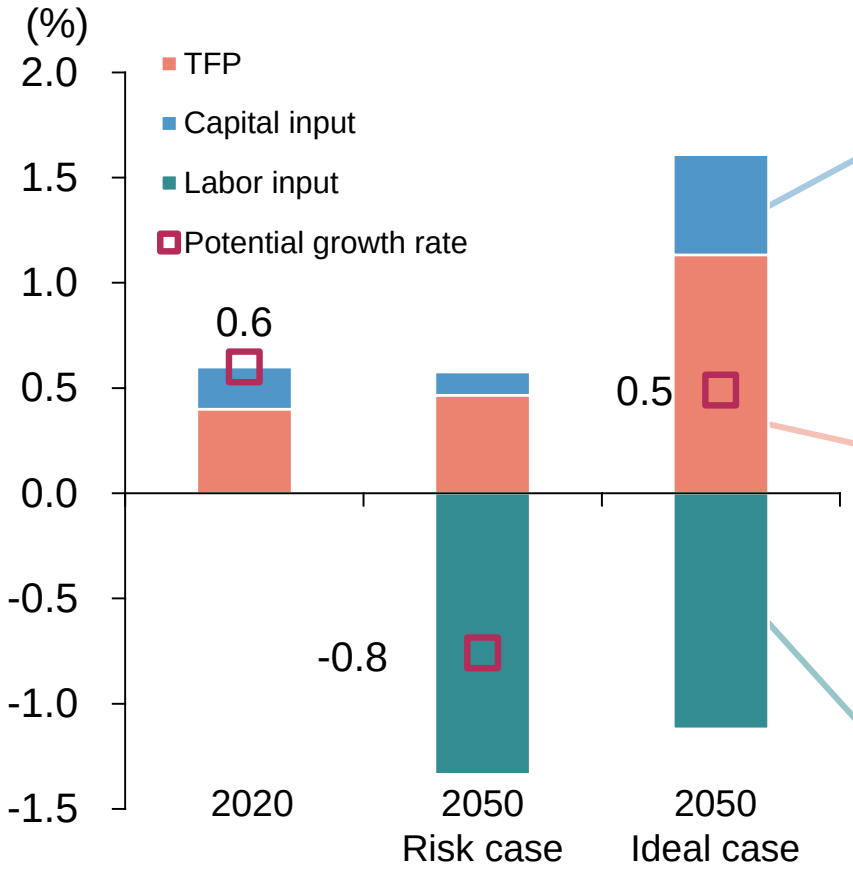


Source: Compiled by Mizuho Bank Industry Research Department

(Reference) Achieving Positive Growth Through 2050 via Efforts Towards Ideal Forms

- The decline in labor input will accelerate toward 2050, but, in the future, in the ideal forms Japanese economy will achieve positive growth by increasing capital inputs and productivity (TFP) and by further improving labor quality and resolving mismatch between labor supply and demand.

Potential Growth Rate and Factors



- Information-related investments [Automotive, Electronics, IT, Healthcare]
- Investments in labor savings and robots [Mobility Services, Logistics, Consumption Services (Retail, Restaurants)]
- Investments in decarbonization [Automotive, Materials, Electric Power, Oil and Gas]

- Accumulation and utilization of intangible assets such as information assets and intellectual property [Automotive, Materials, Mobility Services, Logistics, Consumption Services, Communications and Media, Healthcare]
- Improvements in management and organizational efficiency (e.g. business restructuring, promoting corporate cooperation, etc.) [Materials, Consumption Services]

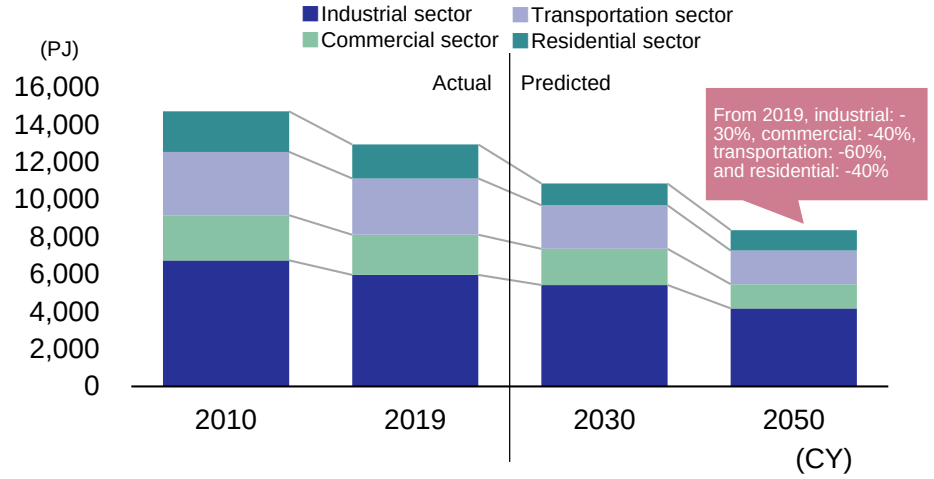
- Investments in human capital [All Industries]
- Increased labor force participation rate for women and the elderly
- Resolving mismatch between labor supply and demand (e.g. smooth labor transfer from low-productivity industries to high-productivity industries)

Source: Compiled by Mizuho Bank Industry Research Department based on “National Accounts of Japan” by the Cabinet Office, the “JIP Database” by the Research Institute of Economy, Trade & Industry

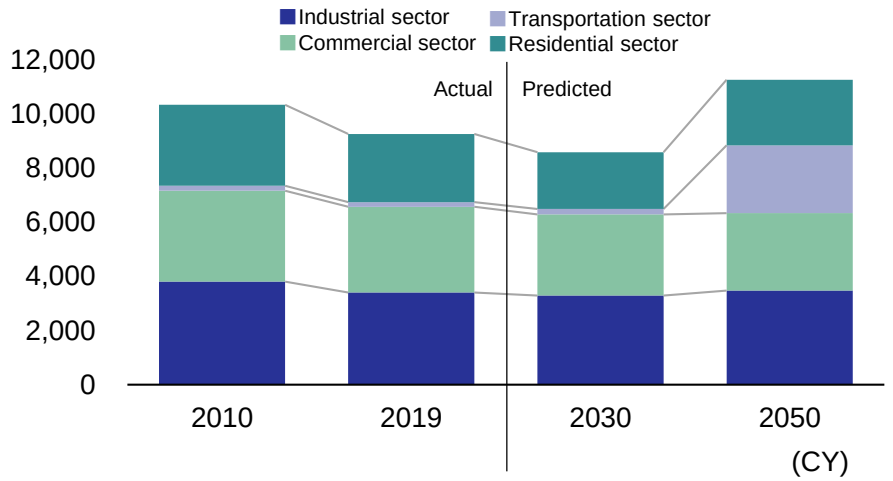
Appendix.
Supply and Demand Outlook of Major Products by 2050

While Energy Saving is Developing, Electrification is Progressing and Electricity Demand is Expanding. Oil and Gas Demand is Declining

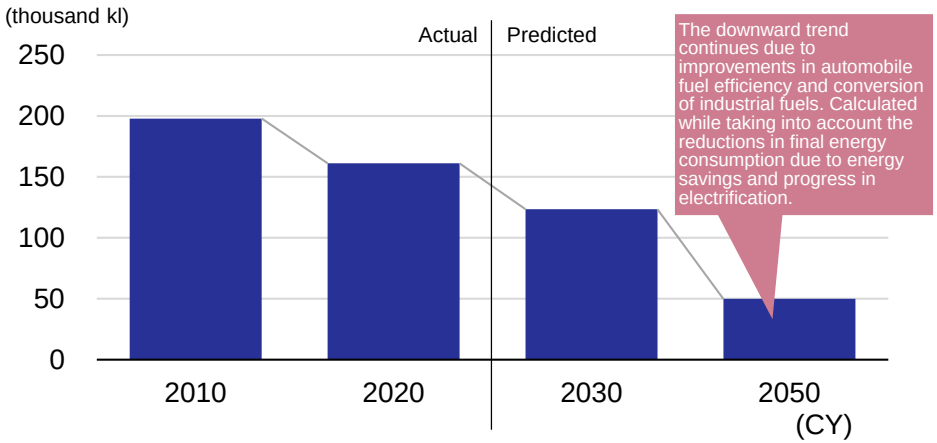
Final Energy Consumption (by Sector)



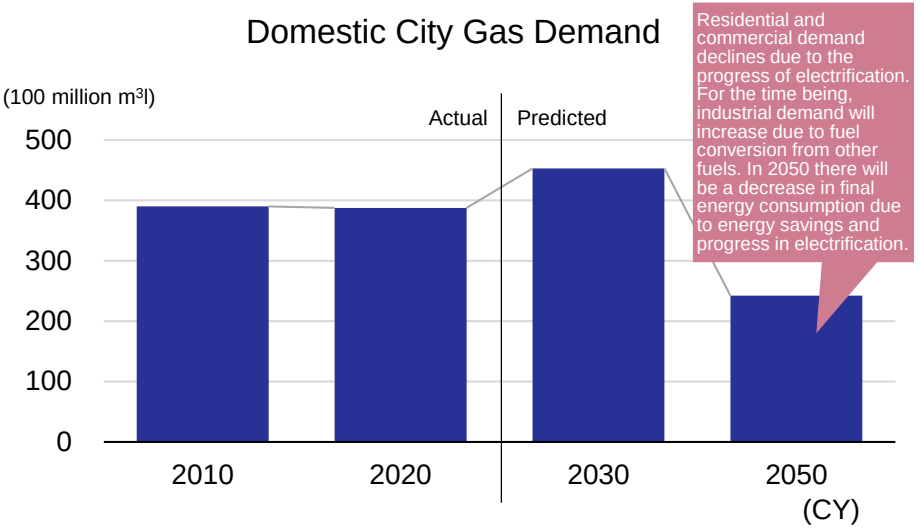
Electricity Demand (by Sector)



Domestic Petroleum Product Demand



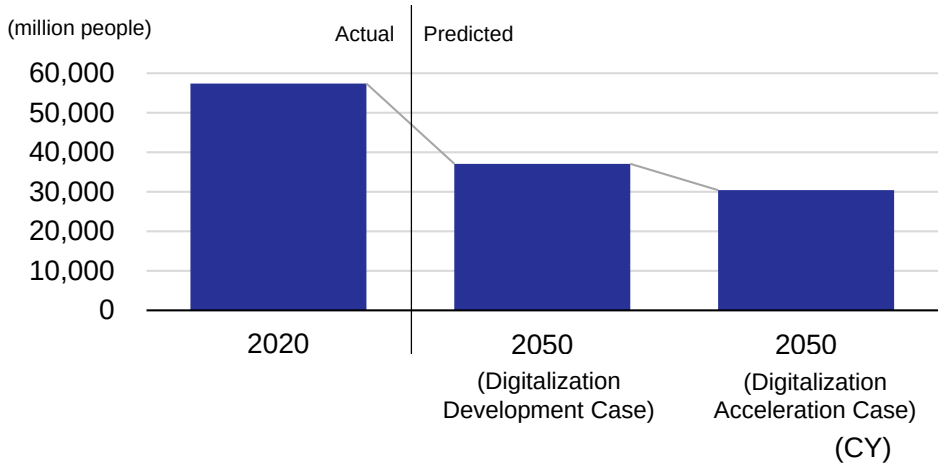
Domestic City Gas Demand



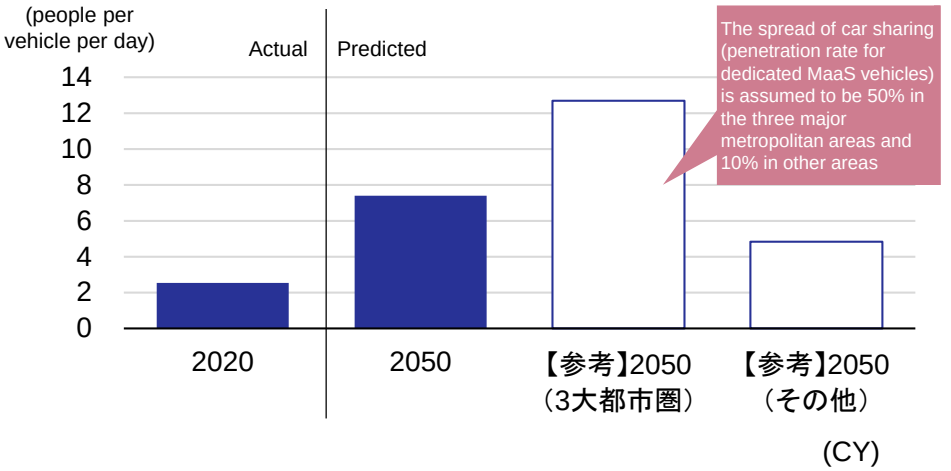
Source: Compiled by Mizuho Bank Industry Research Department based on Agency for Natural Resources and Energy materials and National Institute for Environmental Studies materials

The Number of Owned Passenger Vehicles May Decrease Due to Decrease in People's Mobility Demand and the Development of MaaS

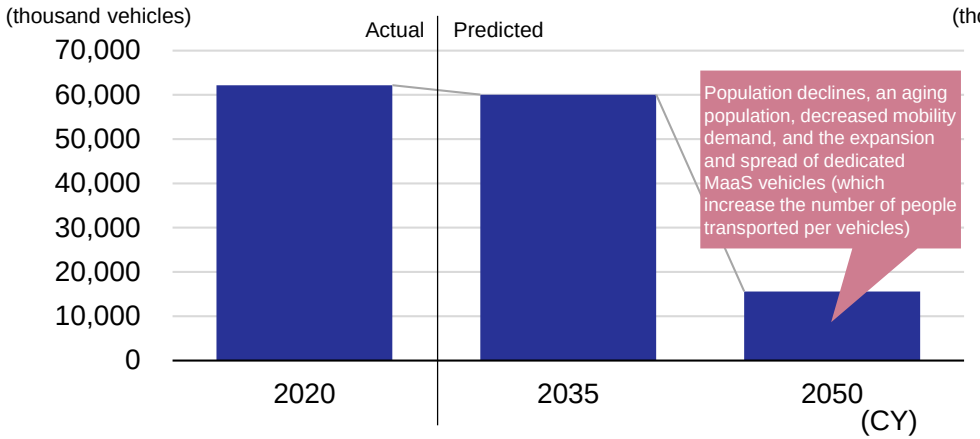
Domestic Passenger Transport Volume by Passenger Vehicle



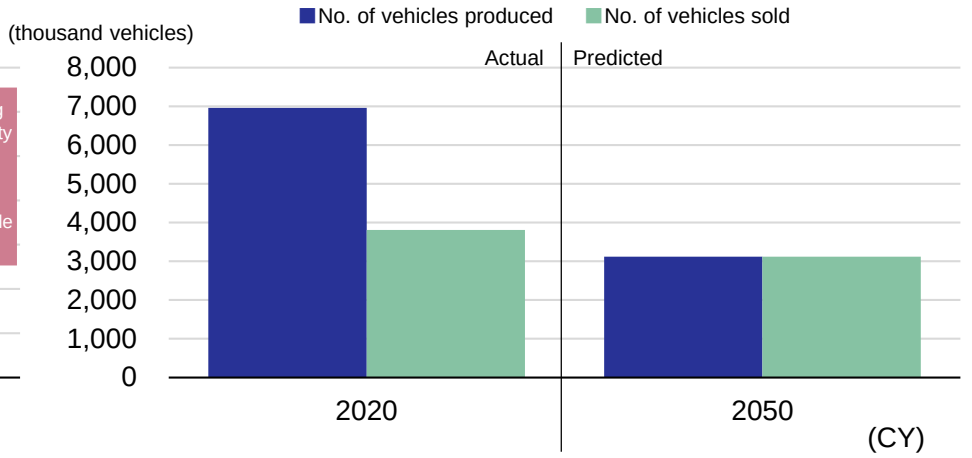
Number of People Transported per Passenger Vehicle per day



Number of Owned Passenger Vehicles



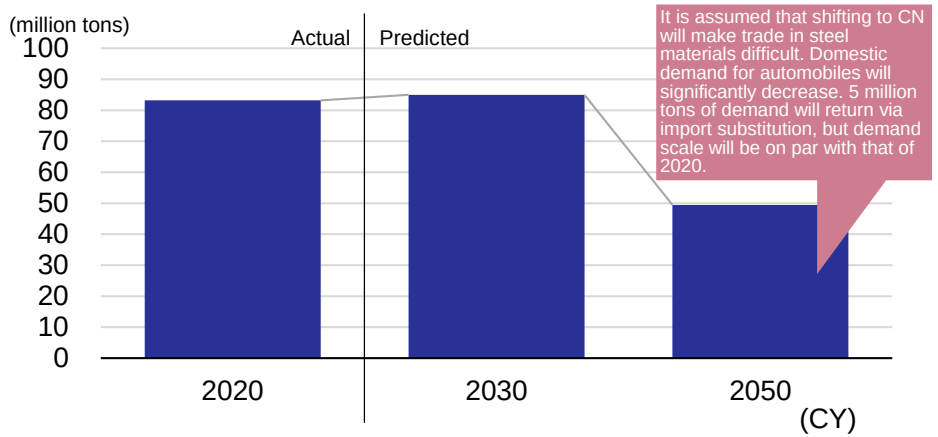
Number of Passenger Vehicles Produced and Sold



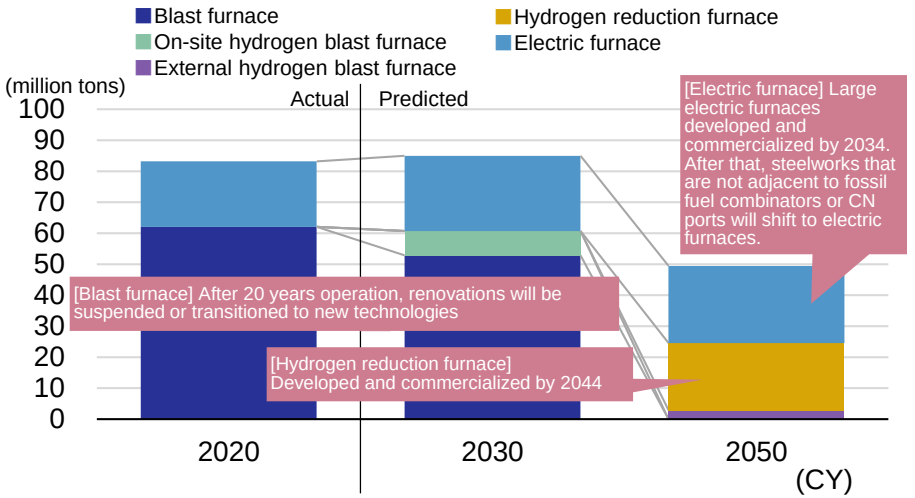
Source: Compiled by Mizuho Bank Industry Research Department based on the “Survey on Motor Vehicle Transport” by the Ministry of Land, Infrastructure, Transport and Tourism, the “National Urban Transport Characteristics Survey” by the Ministry of Land, Infrastructure, Transport and Tourism, the Automobile Inspection & Registration Information Association, and the Japan Automobile Manufacturers Association

Production Volume in Materials Industry is Expected to Approach Domestic Demand

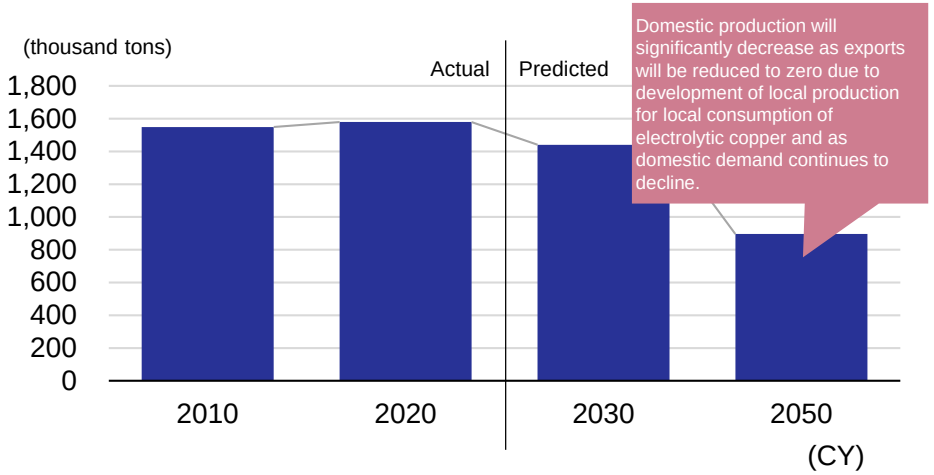
Domestic Crude Steel Production



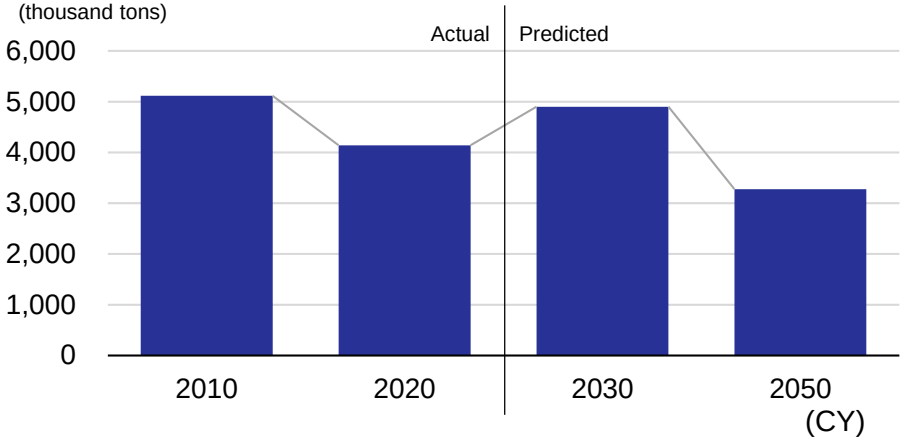
Domestic Crude Steel Production



Domestic Electrolytic Copper Production



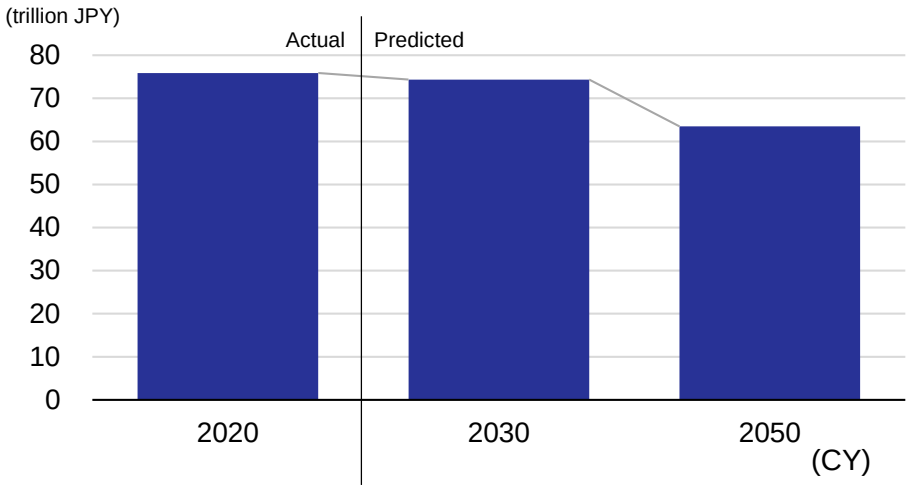
Domestic Ethylene Equivalent Production



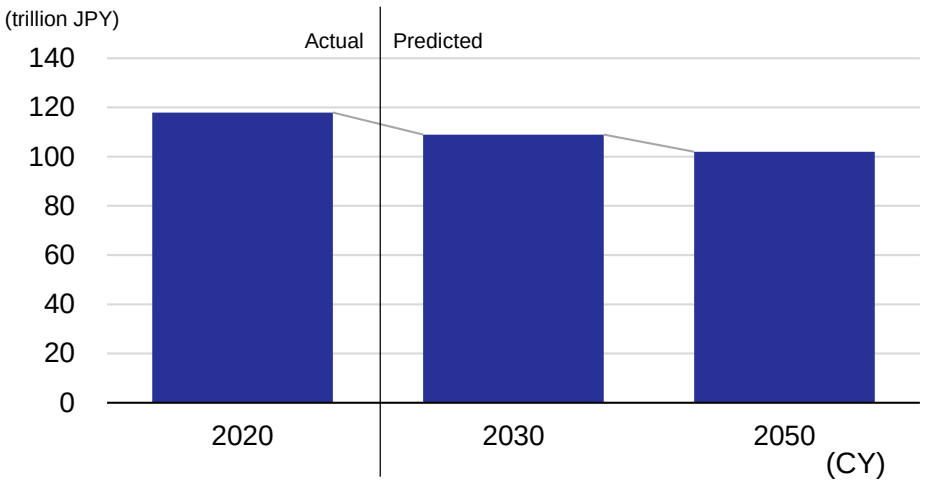
Source: Compiled by Mizuho Bank Industry Research Department based on The Japan Iron And Steel Federation, the Ministry of Economy, Trade and Industry, and The Heavy & Chemical Industries News Agency.

Demand for Food and Retail is Declining due to the Population Declines. Digitalization will Change Store Formats

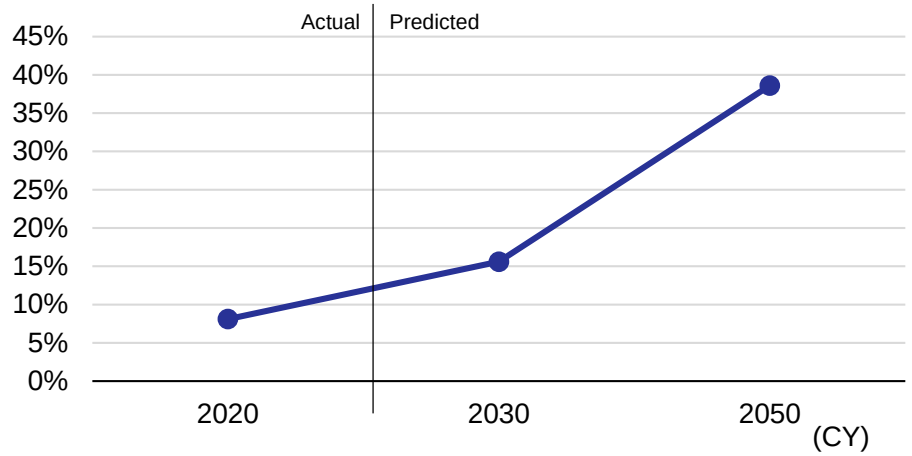
Food Expenditures



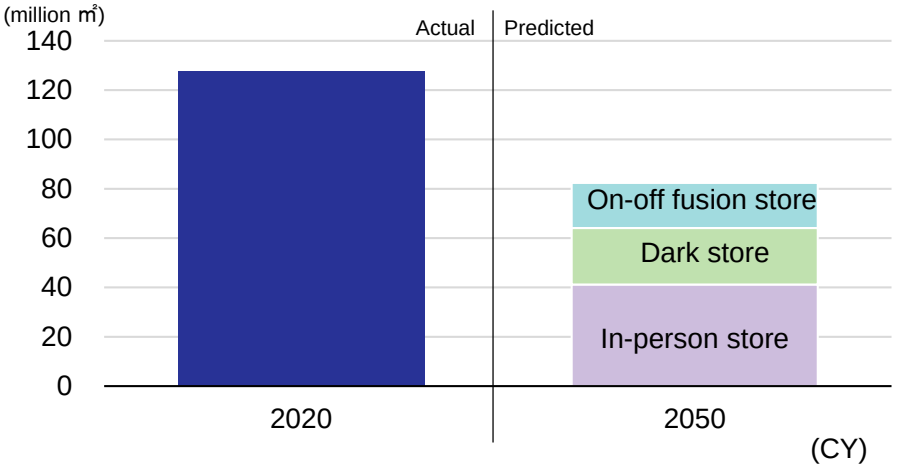
Retail Sales



EC Conversion Rate



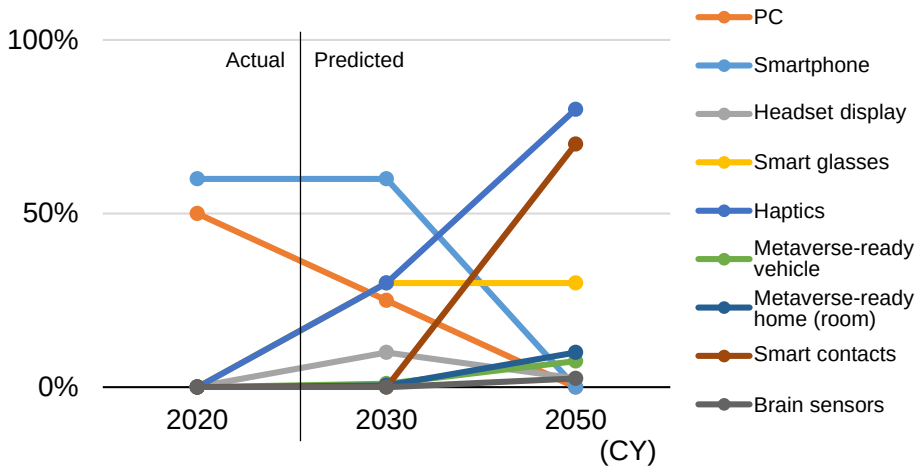
Store/Commercial Floor Area



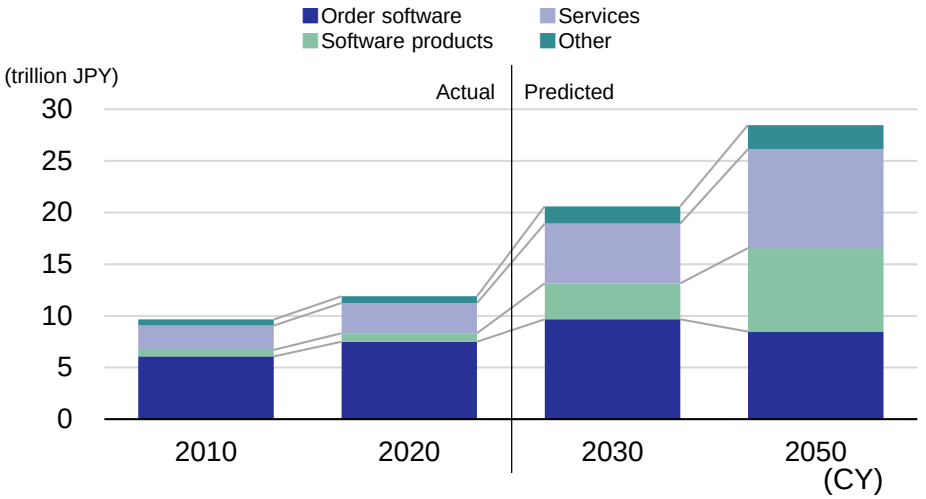
Source: Compiled by Mizuho Bank Industry Research Department based on the Foundation of Food Safety and Security, the Ministry of Internal Affairs and Communications, and the Ministry of Economy, Trade and Industry

As the Metaverse Develops, Related Terminals and Media will also Change. IT Services will Expand

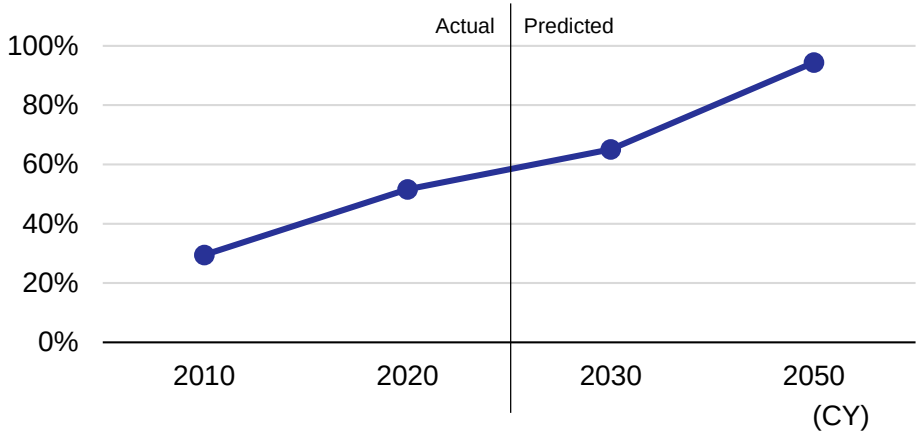
Penetration Rate for Metaverse-Related Terminals (Installation Base)



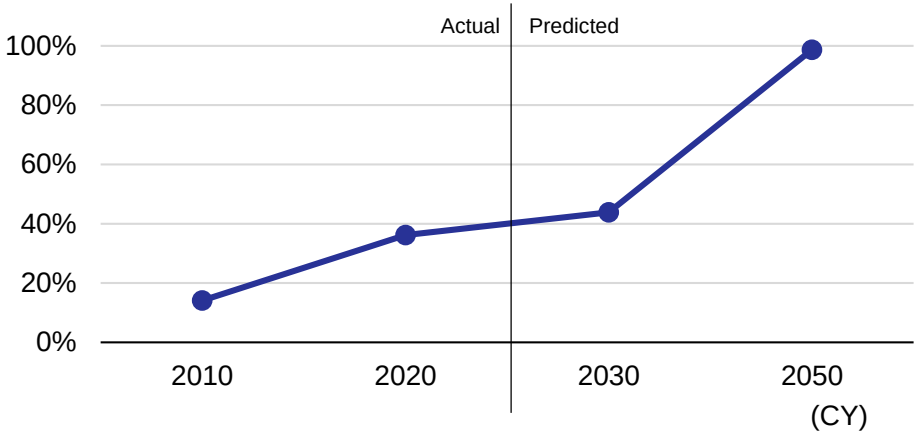
Domestic Information Service Sales



Internet Media Ratio



Internet Advertising Ratio



Source: Compiled by Mizuho Bank Industry Research Department based on the Ministry of Economy, Trade and Industry, Hakuhodo DY media partners Institute of Media Environment, and Dentsu

Link to survey

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