MIZUHO

To Overcome the Constraints Facing Japanese Industry

Turning population decline into an opportunity to improve productivity

May, 2025

Industry Research Department
Mizuho Bank

Report worldview: To achieve transformation for the tomorrow of Japan's industry, we must overcome the constraints we face

	Japan's industry today **A manufacturing powerhouse, led by the automotive industry**	Japan's industry tomorrow **Captivating the world with a hybrid of products and experiences**
Manufacturing industry	**<High quality & high functionality product groups>** ■ Industries with a high level of competitiveness (products, machinery, components, materials) are concentrated in specific areas, consistently creating high quality & high functionality products ■ Leading the world with many resource-saving & energy-saving, low carbon products essential for SX/GX	**<Exerting presence in high added value fields>** ■ Continue to fend off competition from overseas companies in high functionality products, maintaining and increasing global share ■ For generic products, where Japanese companies tend to struggle with scale, achieve overall optimization through collaboration or integration with others
Non-manufacturing industry	**<Provision of high-level services>** ■ Providing world-class services in terms of quality, speed, hospitality, and accuracy, at affordable prices ■ However, some industries (companies) struggle with low productivity, as well as challenges in marketing, pricing, and earning power	**<Improving operational efficiency x high added value>** ■ Expecting revitalization of inbound tourism leveraging Japan's natural, cultural, and culinary resources, as well as expansion of healthcare and senior demand with the aging population ■ Advancing automation & labor-saving to enhance operational efficiency and increase added value by focusing human resources on tasks that only people can do

[Key constraints to overcome for transformation]

Scope of this report

<Labor shortages>

- Lost revenue opportunities in growth industries such as inbound tourism
- Maintaining essential services for daily life, such as healthcare, will become difficult
- Decline in the quality of products and services due to the discontinuation of traditional artisan skills

Comprehensive section (energy constraints)

<Energy constraints>

- Increasing power demand due to electrification and digitalization
- Greater pressure to reduce CO2 emissions
- Concerns over stable supply and soaring prices due to rising geopolitical risk

Supplementary discussion

<Resource constraints>

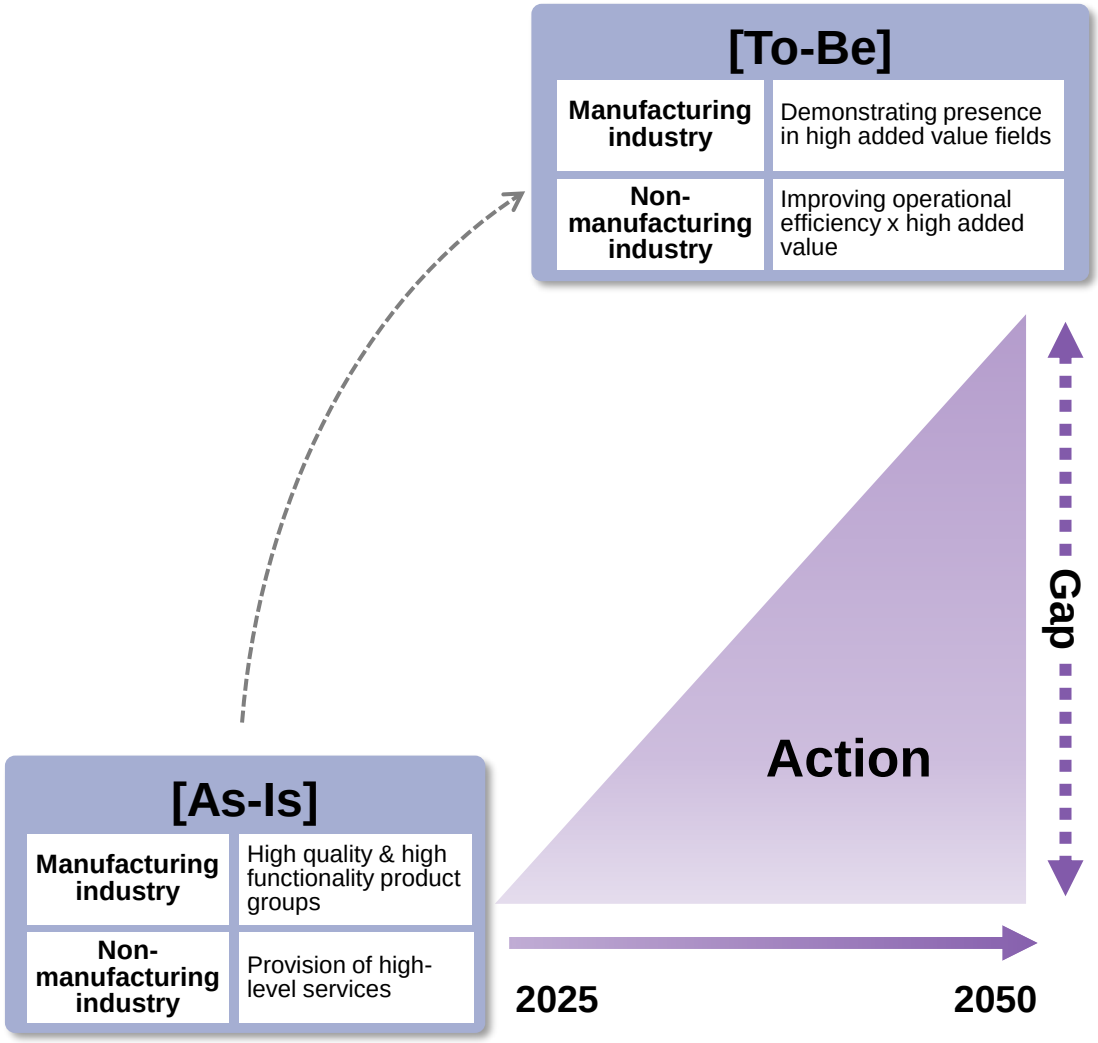
- Mineral resources: Important minerals for reserves, production, and refining are concentrated in specific countries, posing geopolitical risks

etc.

Through overcoming these constraints, Japan can challenge itself to the creation of new technologies, products, and services, capturing new business opportunities

Note: Japan's Industry Tomorrow assumes around the year 2050
Source: Compiled by Industry Research Department, Mizuho Bank, Ltd.

Report worldview: Transforming into an ideal state by commercializing products, technologies, and services that address social issues



- Manufacturing maintains and enhances its high status through continuously creating new value in advanced parts/materials and other high added value fields
- Non-manufacturing improves productivity by leveraging AI, robots, and more. Humans strengthen earning power of the industry by delivering emotional value

[Examples of products, technologies, and services created in the process of overcoming constraints]

Labor shortage

- AI (Industry-specific AI)
  - Developing AI tailored to the unique demands of each industry by scaling closed data using federated learning techniques
- Robots
  - Development of standard robots meeting the needs of specific industries
  - Introduction promoted in mainly non-manufacturing sectors by gathering user needs and component technologies
- Autonomous driving
  - Development & manufacturing: Vehicle development & manufacturing, autonomous driving systems
  - Systems: Dispatch systems, remote monitoring systems
  - Services: Remote monitoring, on-site response, maintenance, mobility experience services

Energy constraints

<Reduced energy consumption>
- Optoelectronic devices
  - Suppresses losses during data transmission
- Superconducting cables
  - No electrical resistance, enabling lossless conduction of large currents

→ Increasing electricity demand is a global challenge; if Japan takes the initiative in solving it, it will also help earn foreign currency

<Increasing energy supply>
- Direct hydrogen production
  - Generating hydrogen by electrolyzing water using solar power
- Solar power (perovskite cells)
  - Lighter, more flexible, and with the prospect of improved conversion efficiency over conventional products

→ Expect to provide solutions to countries with energy constraints similar to Japan, and generate income

Source: Compiled by Industry Research Department, Mizuho Bank, Ltd.

Summary ~ Comprehensive Edition: labor shortage

- Japan's working age population is on a continual decline due to the advancing declining birthrate and aging population. It is projected to further decrease toward 2040 and 2050. In this context, improving labor productivity per person is essential to achieve sustainable economic growth. In particular, boosting productivity in non-manufacturing industries, which account for about 80% of Japan's GDP and are labor-intensive, is a pressing issue. Should productivity improvements not progress, labor shortages may exceed 18 million people by 2050,
- While strengthening the labor force (such as women, seniors, and foreign workers) is anticipated as one solution to the labor shortage, it is also crucial to make active use of technologies that can substitute for or support humans, including AI, robots, and autonomous driving. If technology adoption progresses sufficiently, labor shortages in 2050 can be largely resolved.
- Such technology adoption presents a business opportunity for providers of labor shortage solutions, and for industries facing labor shortages such as nursing care and accommodation, it can help avoid lost sales. Furthermore, effectively utilizing labor freed up by addressing worker shortages creates opportunities for further sales growth. The market size created by resolving labor shortages is estimated to reach as much as 44 trillion yen.
- In a world where AI and robots are more widely adopted, tasks that ought to be assigned to AI or robots will be delegated to them, and humans will focus on tasks only humans can do. In particular, areas that provide emotional value (invisible value that appeals to consumer sensibilities) will remain as tasks only humans can do.
- As the labor force shrinks going forward and talent becomes increasingly scarce, especially in non-manufacturing, a premium will emerge for human-involved tasks, likely driving up service unit prices. For manufacturing, while promoting collaboration with other companies on generic products, there will be an increasing need to focus on advanced fields to achieve greater productivity. Enhancing per person added value in both non-manufacturing and manufacturing will feed directly into higher personnel costs per person and become the twin drivers of sustainable growth.
- By seizing on the labor shortage as a catalyst to achieve long-standing productivity improvements and focusing on areas of expected future growth, we anticipate Japan's continued development through 2050 and beyond.

Source: Compiled by Industry Research Department, Mizuho Bank, Ltd.

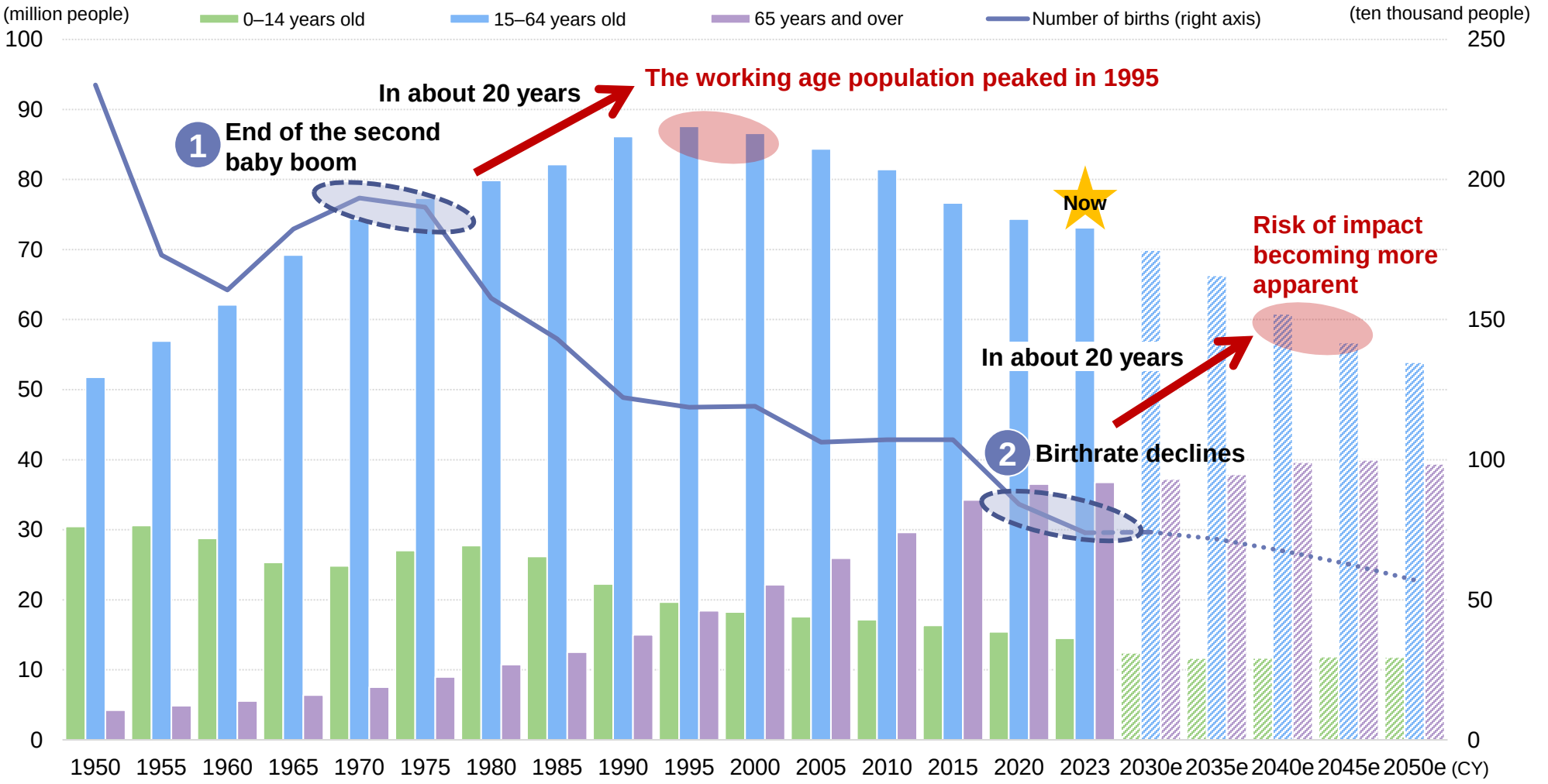
Structure of this Report (Table of Contents)

1. Introduction

Japan's population trend: Impact from current lower birthrate expected to emerge after 2040

- Assuming it takes about 20 years from birth until entry into society, the impact of the birthrate falling to around 700,000 since the COVID-19 pandemic is expected to emerge around 2040–2050

Japan's population by age group (1950–2050e)



Note: Birth estimates from 2030 onward are medium-variant projections from the National Institute of Population and Social Security Research
Source: United Nations, materials from the National Institute of Population and Social Security Research, compiled by Industry Research Department, Mizuho Bank, Ltd.

Japan tomorrow given population decline: Raising labor productivity is essential as labor inputs decrease

- Given the current birthrate, a further decline in the working age population in 2040–2050 is inevitable, and unless per person added value is increased, Japan's industries as a whole may stagnate

	2000 Japan yesterday	2025 Japan today	2050 Japan tomorrow
Population	• Total population: 130 million (of which, working age population: 90 million, 70% of the total) • Number of births: 1.19 million • Aging rate: 17%	• Total population: 120 million (of which, working age population: 70 million, 60% of the total) • Number of births: 720,000 • Aging rate: 29%	• Total population: 100 million (of which, working age population: 50 million, 50% of the total) • Number of births: 620,000 • Aging rate: 37% **Declining population & aging[2]**
Labor input	• Total: 121.9 billion hours • Manufacturing: 24.1 billion hours • Non-manufacturing: 97.9 billion hours	• Total: 113.7 billion hours (-7%) • Manufacturing: 19.7 billion hours (-18%) • Non-manufacturing: 94.0 billion hours (-4%)	**With a shrinking labor force and it being difficult to expect an increase in work hours per person, total labor input is declining**
Real GDP	• Total: 487 trillion yen • Manufacturing: 95 trillion yen • Non-manufacturing: 392 trillion yen	• Total: 559 trillion yen (+15%) • Manufacturing: 122 trillion yen (+28%) • Non-manufacturing: 437 trillion yen (+11%)	■ **As labor input decreases, achieving economic growth requires capital investment and improvement in TFP (Total Factor Productivity)** ■ **Among these, raising the labor productivity of non-manufacturing, which accounts for about 80% of Japan's GDP and is largely labor-intensive, is key to the nation's overall future**
Labor productivity	• Total: 3,995 yen / hour • Manufacturing: 3,942 yen / hour • Non-manufacturing: 4,004 yen / hour	• Total: 4,919 yen / hour (+23%) • Manufacturing: 6,182 yen / hour (+57%) • Non-manufacturing Industry: 4,654 yen/hour (+16%)	

Note 1: Japan's population for Today is actual results for 2024, labor input and real GDP are results for 2023. Labor input is a simple calculation: workforce x average hours worked per employee

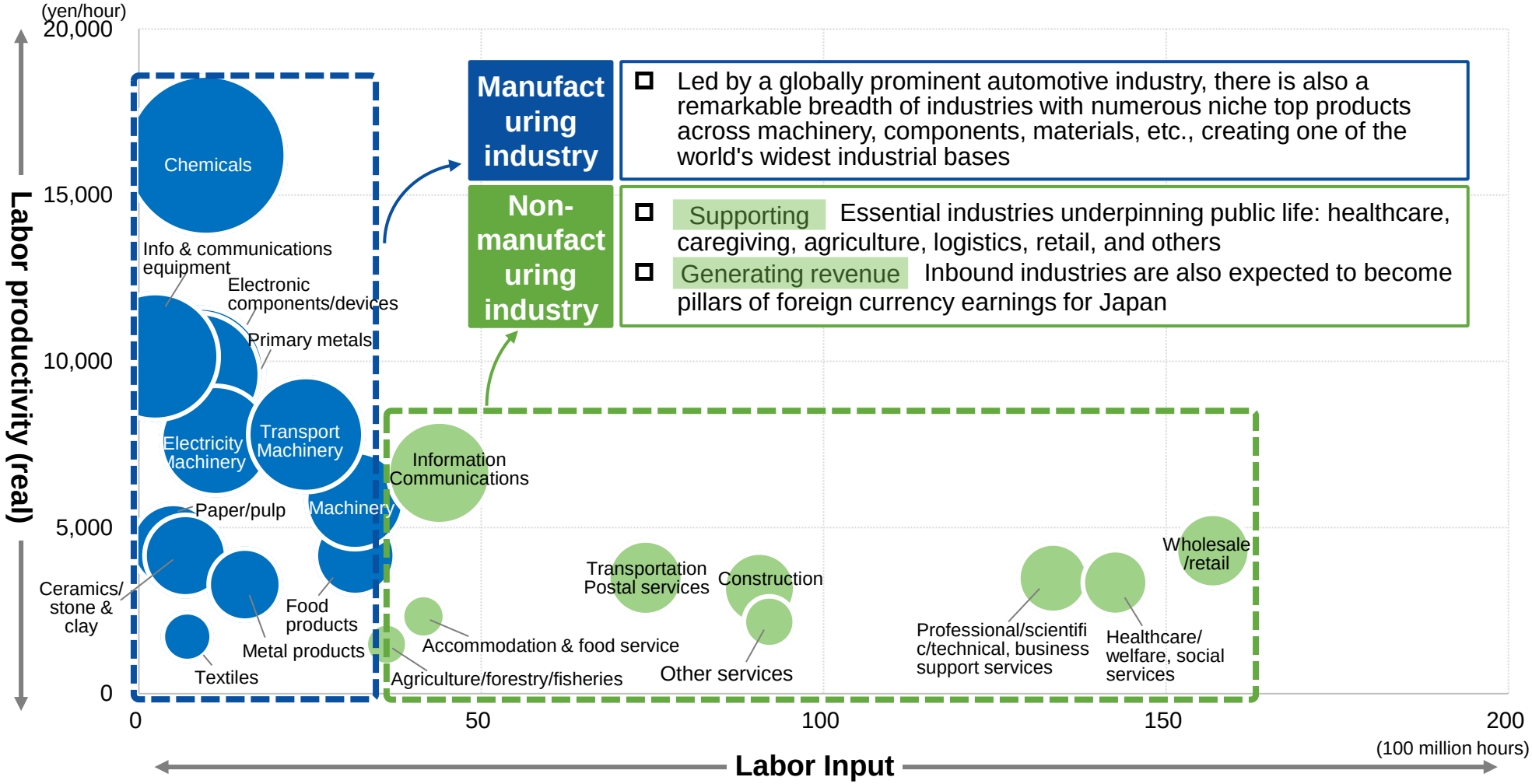
Note 2: Future population outlook based on medium-variant (for both deaths and births)

Source: Cabinet Office materials, National Institute of Population and Social Security Research, compiled by Industry Research Department, Mizuho Bank, Ltd.

Toward the Japan of tomorrow – By industry: Labor productivity and labor input

- While boosting labor productivity in non-manufacturing (focusing on numerous essential industries and growing inbound sectors) manufacturing must also aim higher

Labor productivity and labor input by industry (FY2023, blue = Manufacturing, green = Non-manufacturing) (Note)

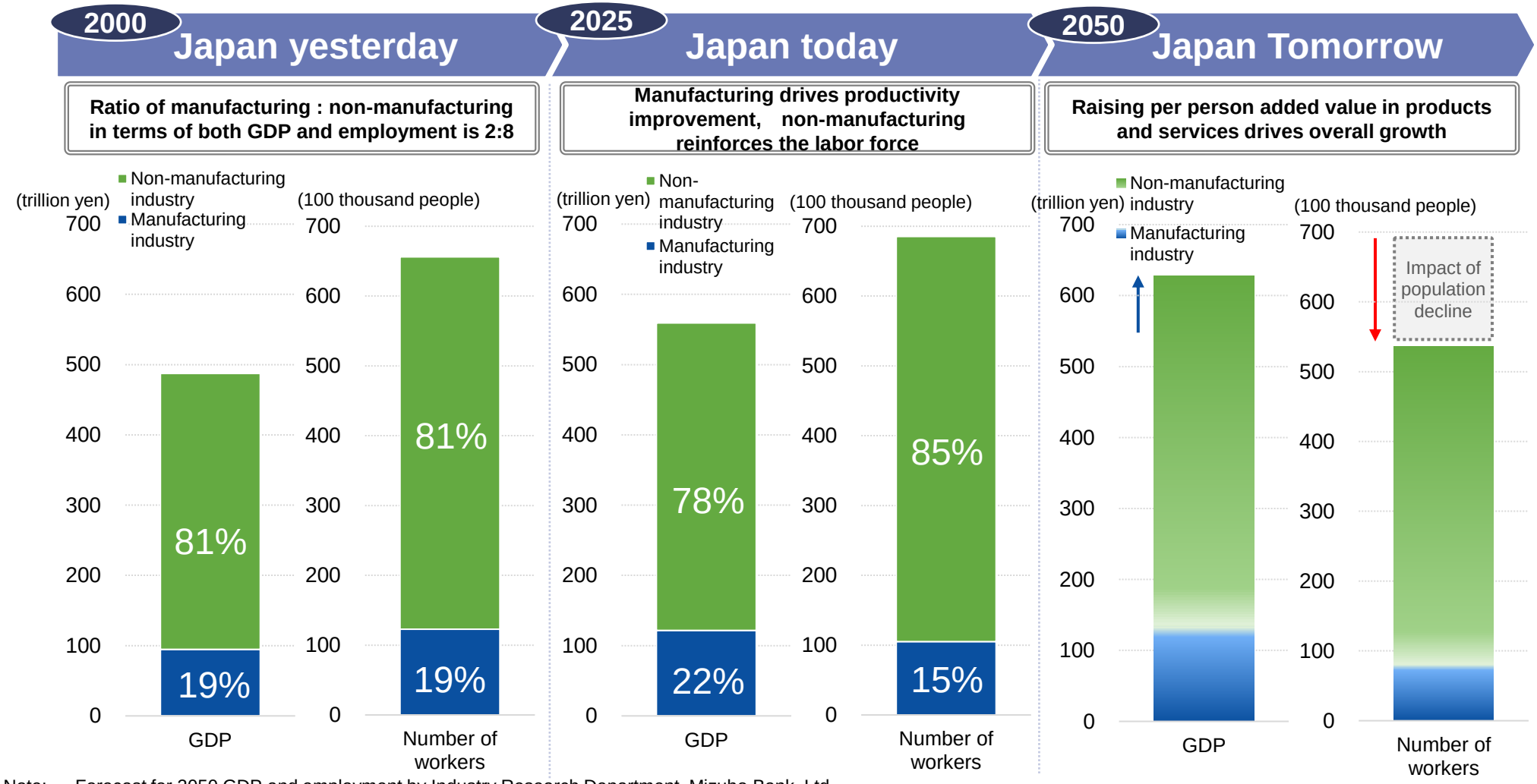


Note: Bubble size indicates per person added value
Source: Cabinet Office materials, compiled by Industry Research Department, Mizuho Bank, Ltd.

Toward the Japan of tomorrow: Outlook for real GDP and number of workers

- Unlike the manufacturing sector, which has raised productivity in the past, non-manufacturing has increased added value mainly by increasing employment. However, boosting per person added value has now become essential

Future outlook for real GDP and number of workers



Note: Forecast for 2050 GDP and employment by Industry Research Department, Mizuho Bank, Ltd.
Source: Cabinet Office materials, compiled by Industry Research Department, Mizuho Bank, Ltd.

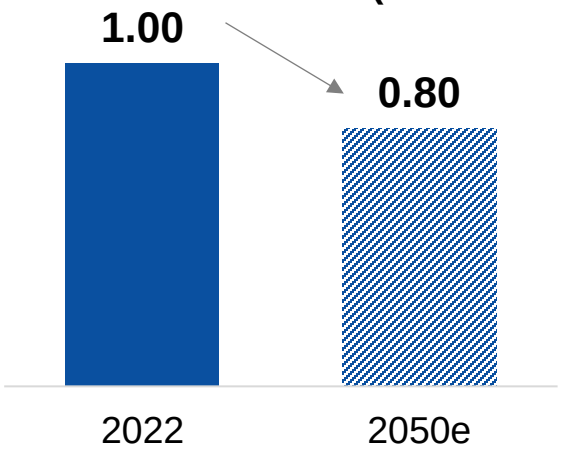
Toward the Japan of tomorrow : Desired and undesired futures for manufacturing & non-manufacturing

- For both manufacturing and non-manufacturing, employment is projected to drop by about 20%. In this environment, manufacturing must accelerate a shift from commodity to high-function segments, while non-manufacturing must drive automation and labor-saving, focusing people on tasks only humans can do

On desired and undesired futures

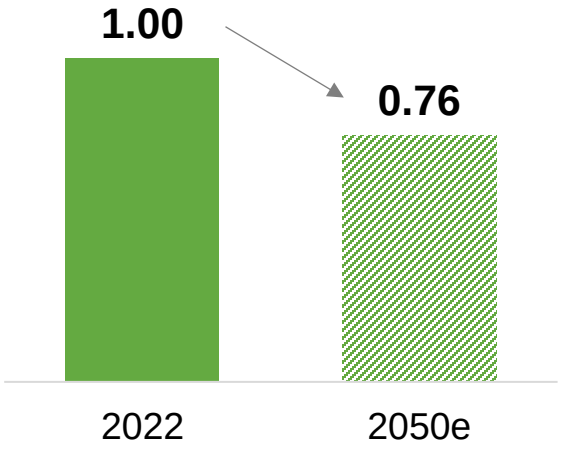
Manufacturing industry

<Number of workers (2022 = 1.00)>



Desired future	☐ Contracting commodity segments and expanding high-function segments to raise per person added value ☐ Expanding the business domain from selling products to selling experiences, creating new value ☐ Continuing to plant the seeds for the next generation and producing world-leading technology and products
Undesired future	☐ Increased on-site burden leads to declines in both product quality and quantity, stunting per person value-added growth ☐ Catch-up by overseas, especially Chinese, manufacturers erodes or weakens manufacturing's competitive edge

Non-manufacturing industry



Desired future	☐ Drive automation & labor-saving, allowing people to focus on work that should be done by humans, boosting per person added value ☐ Inbound industries: capture expanding demand as inbound visitor numbers grow, missing no opportunities ☐ Essential industries: ensure service sustainability
Undesired future	☐ If technology adoption stalls, workplace burdens rise and both service quality and quantity decrease, resulting in stagnant per person added value ☐ Inbound tourism: lost business opportunities due to inability to meet demand because of human resource constraints ☐ Essential industries: burden on workplaces exceeds limits, making supply difficult in certain regions or job types

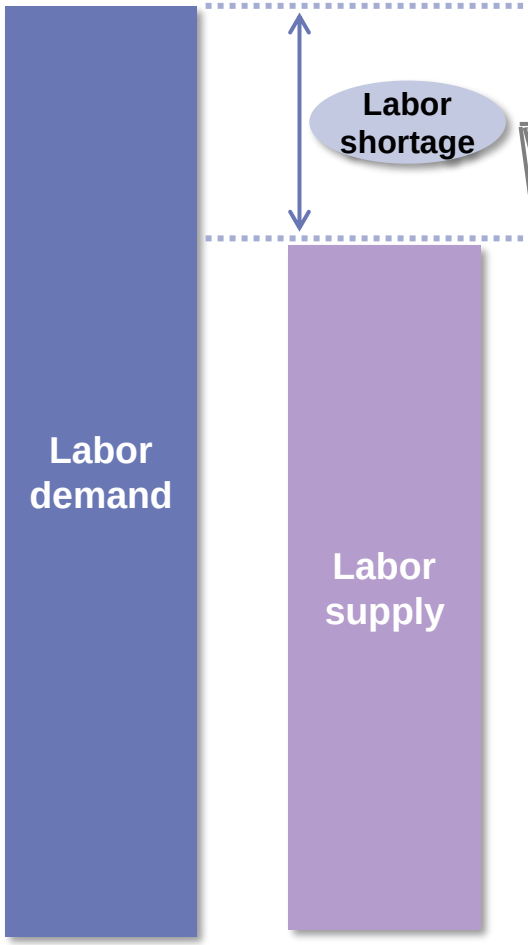
Note: Worker numbers for 2050 are forecasts by Industry Research Department, Mizuho Bank, Ltd.
Source: Compiled by Industry Research Department, Mizuho Bank, Ltd.

2. Current State and Outlook of Labor shortage

Labor shortage means a gap between labor demand and supply

- A labor shortage is the gap between labor demand and labor supply. It causes negative impacts for employees, customers, and companies themselves

Examples and negative effects of labor shortage



<Impacts of labor shortage>

On employees

[Worsening work environment]

- To provide existing products/services, current employees must handle more work than usual, causing long work hours, overtime, and overwork
- Loss of potential gains such as not being able to take paid leave or difficulty taking it
- The above leads to higher turnover, reinforcing a negative spiral where labor shortage gets even worse

On customers

[Limitations on the quantity of production and service]

- Lack of staff causes work delays and stoppages in production or service delivery
- Impacts existing business by reducing factory operating rates, shortening store hours, etc., and in some cases, delays or cancellation of new openings, businesses, or projects

On customers

[Decline in the quality of production and service]

- Deteriorating work conditions lead to more mistakes and slower production, creating negative impacts
- Lack of experienced staff makes it harder to maintain traditional quality standards
- Responding to customers becomes slower or inadequate, hurting customer satisfaction

On companies themselves

[Wage increase pressures]

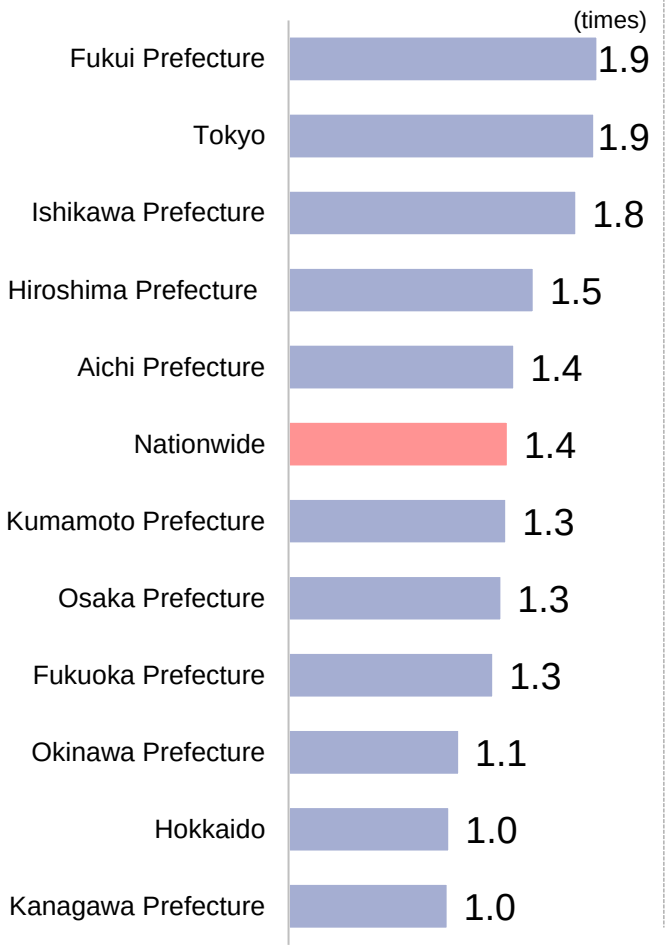
- To lower turnover, companies must raise wages, and with more intense hiring competition, need to offer higher wages to attract talent
- Companies unable to pass higher labor costs onto prices, or that cannot raise wages, are expected to face even more severe staff shortages

Source: Compiled by Industry Research Department, Mizuho Bank, Ltd.

Main causes of labor shortage: Regional, job-type, and seasonality gaps

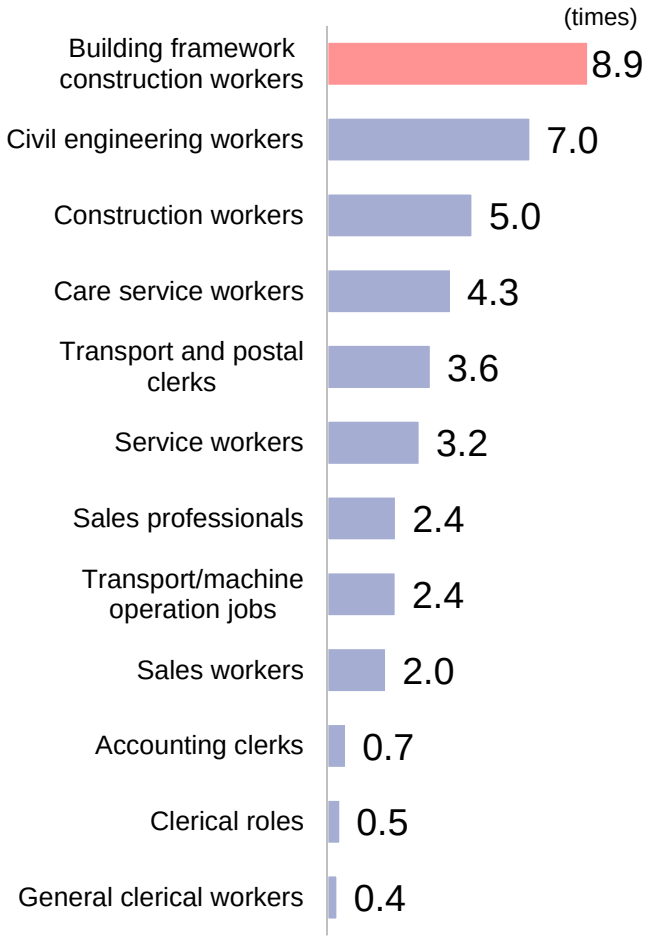
1 Regional gap (effective job openings/applicant rate)

- Some regions have sufficiently many job seekers but even more job openings (Tokyo), while others have low numbers of job seekers (rural areas)



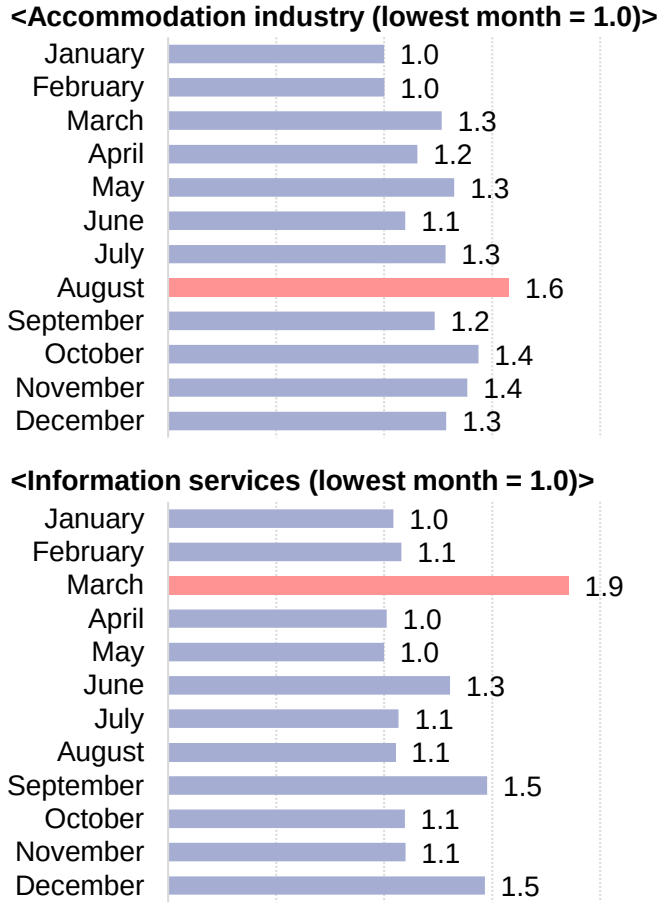
2 Job-type gap (effective job openings/applicant rate)

- Labor shortages are especially acute in construction, caregiving, and logistics
- Ratios differ greatly depending on working conditions and employment terms



3 Seasonality gap (sales)

- Seasonal fluctuations by industry (e.g., summer vacation, year-end/New Year's, fiscal year-end) cause greater staff shortages in peak periods

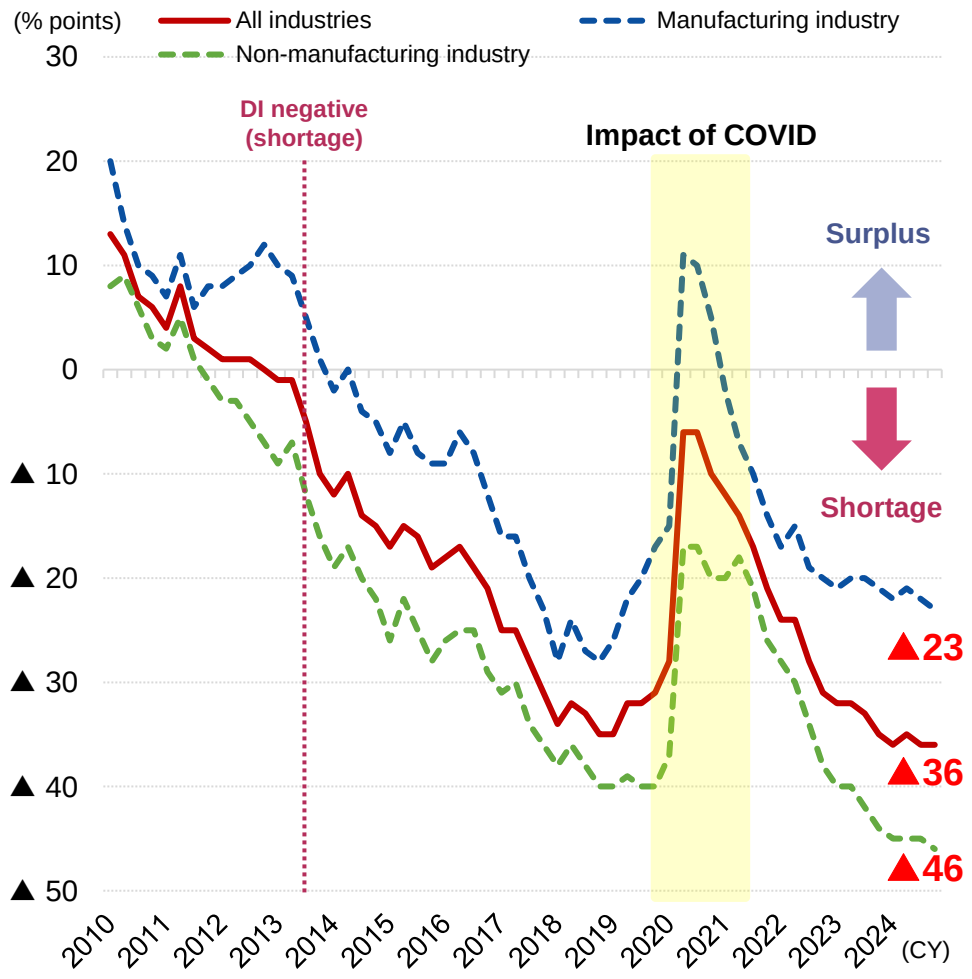


Note: Effective job opening/applicant rates as of December 2024; sales are the 2023/2024 actual average
Source: Ministry of Health, Labour and Welfare; Ministry of Internal Affairs and Communications, compiled by Industry Research Department, Mizuho Bank, Ltd.

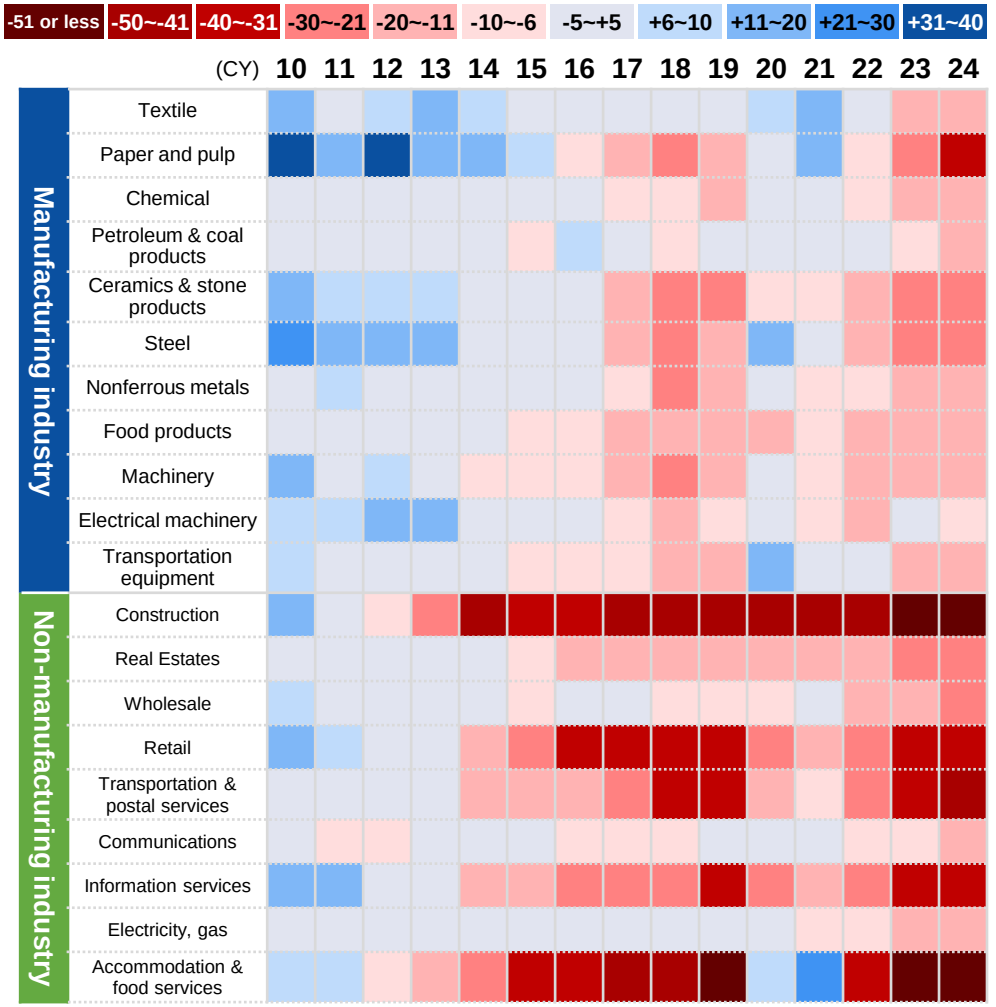
Current state of labor shortage: Labor shortage has intensified after the pandemic

■ From around 2014, employment DI (excess – shortage) turned negative. Although the pandemic caused short-term staff surpluses, currently the sense of shortage is strong especially in construction and hospitality/food services in non-manufacturing sectors

Transition of employment DI (2010–2024)



Transition of employment DI by industry (2010–2024) (Note)

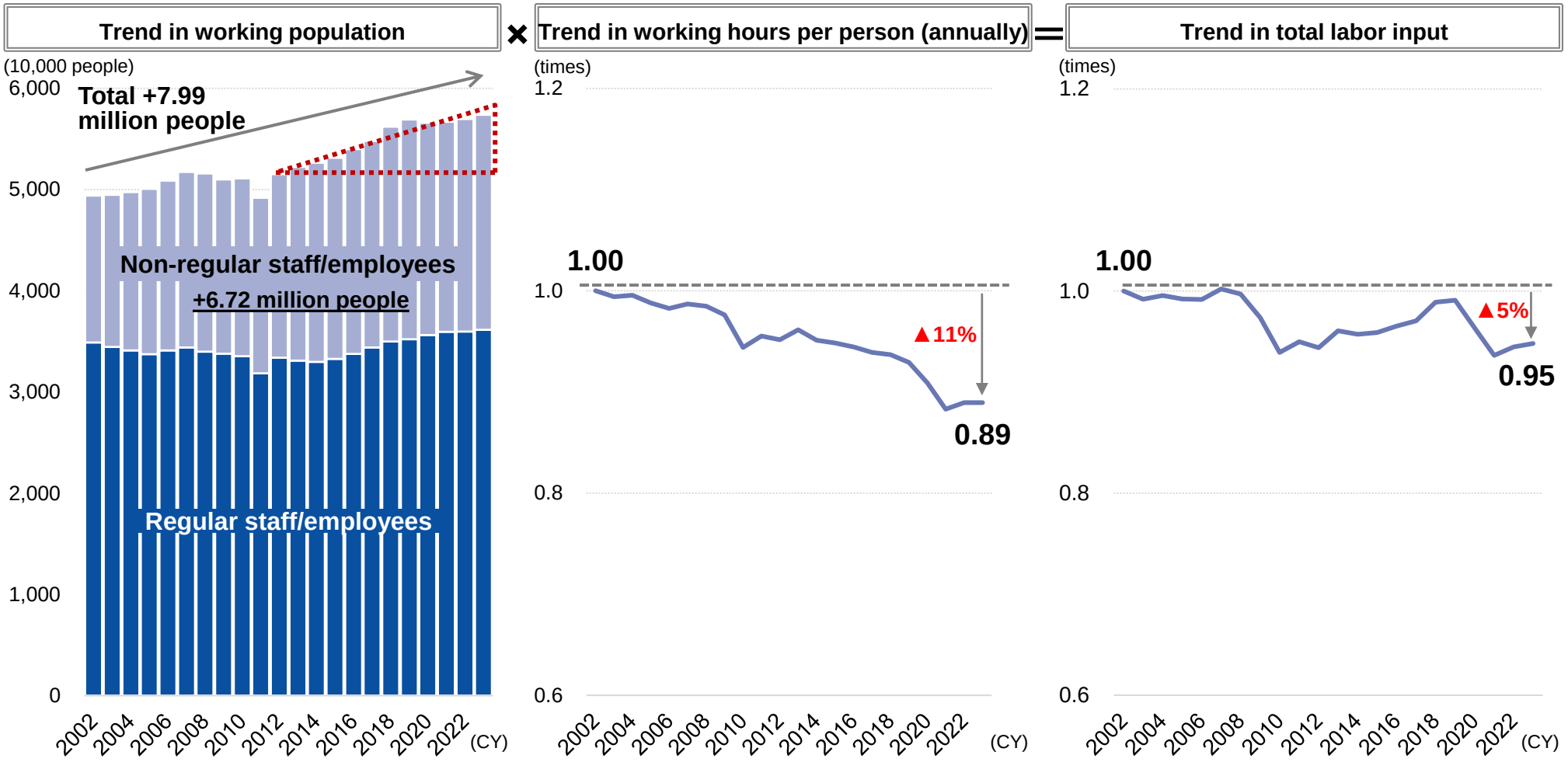


Note: Each year's average for March, June, September, and December
Source: Both charts: Bank of Japan Tankan survey, compiled by Industry Research Department, Mizuho Bank, Ltd.

Current state of labor shortage: Declining labor input even as staff increases

- Over the past 20 years, the increase in employees (mainly non-regular) has added about 8 million more workers However, average annual working hours per person have dropped over 10% due to workstyle reforms and the rising share of non-regular workers (who work shorter hours), reducing total labor input by 5%

Trends in labor input (2002–2023)



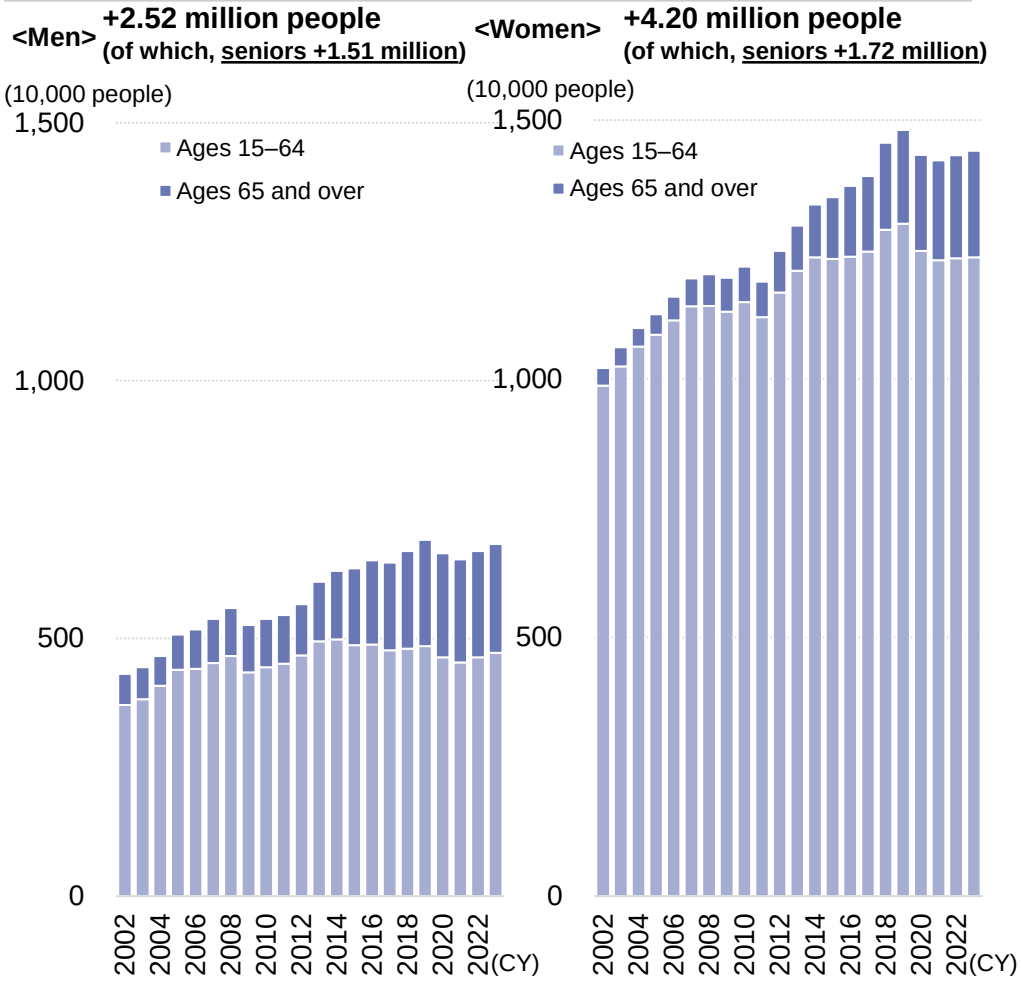
Note: 2011 results exclude Iwate, Miyagi, and Fukushima. Excludes company officers. Annual per-person hours for regular employees are used for this metric

Source: Both charts used Ministry of Internal Affairs and Communications Labour Force Survey, Ministry of Health, Labour and Welfare Monthly Labour Survey, compiled by Industry Research Department, Mizuho Bank, Ltd.

Current state of labor shortage: Trends in non-regular employees: increase in employment among women and seniors

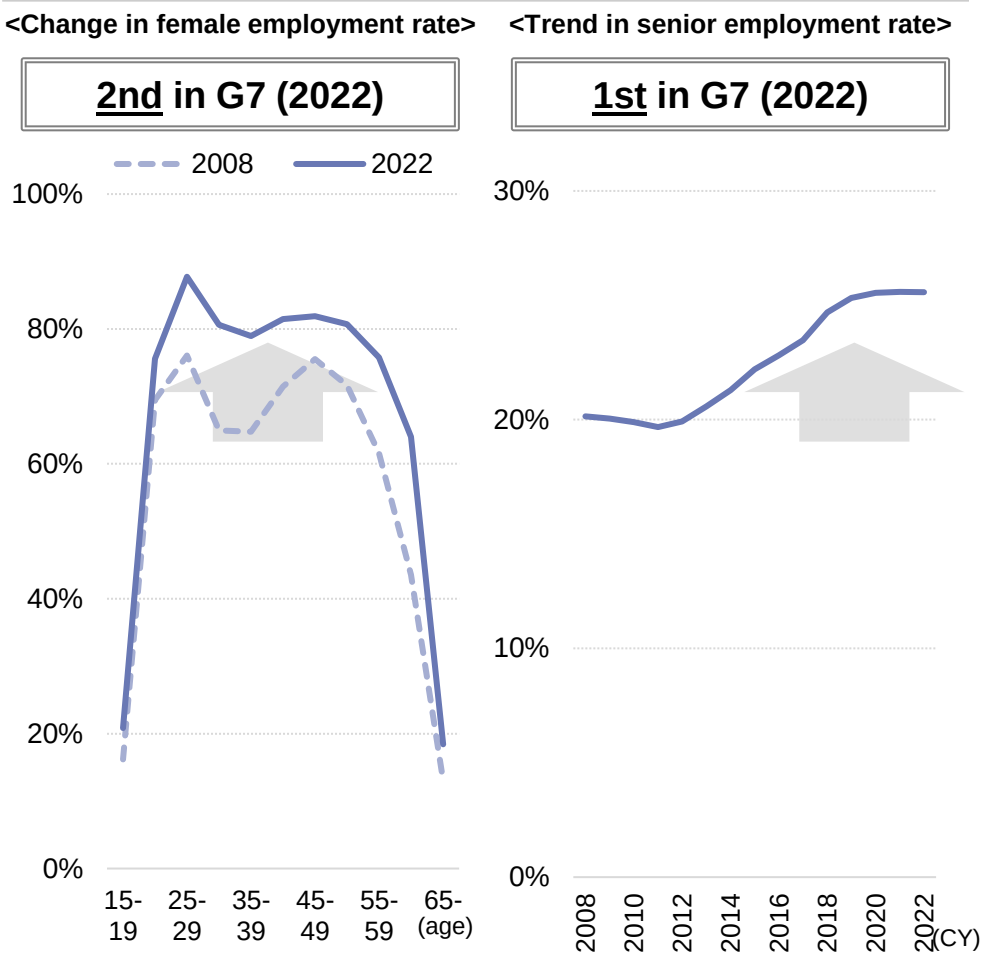
■ Among both men and women, the number of non-regular employees, including seniors, has risen. As a result, labor force participation rates among women and seniors have reached high levels even by global standards

Trends in non-regular employee numbers (2002–2023)



Note: 2011 results exclude Iwate, Miyagi, and Fukushima. Excludes company officers
Source: Ministry of Internal Affairs and Communications Labour Force Survey, compiled by Industry Research Department, Mizuho Bank, Ltd.

Trends in the employment rates for women and seniors (men & women)



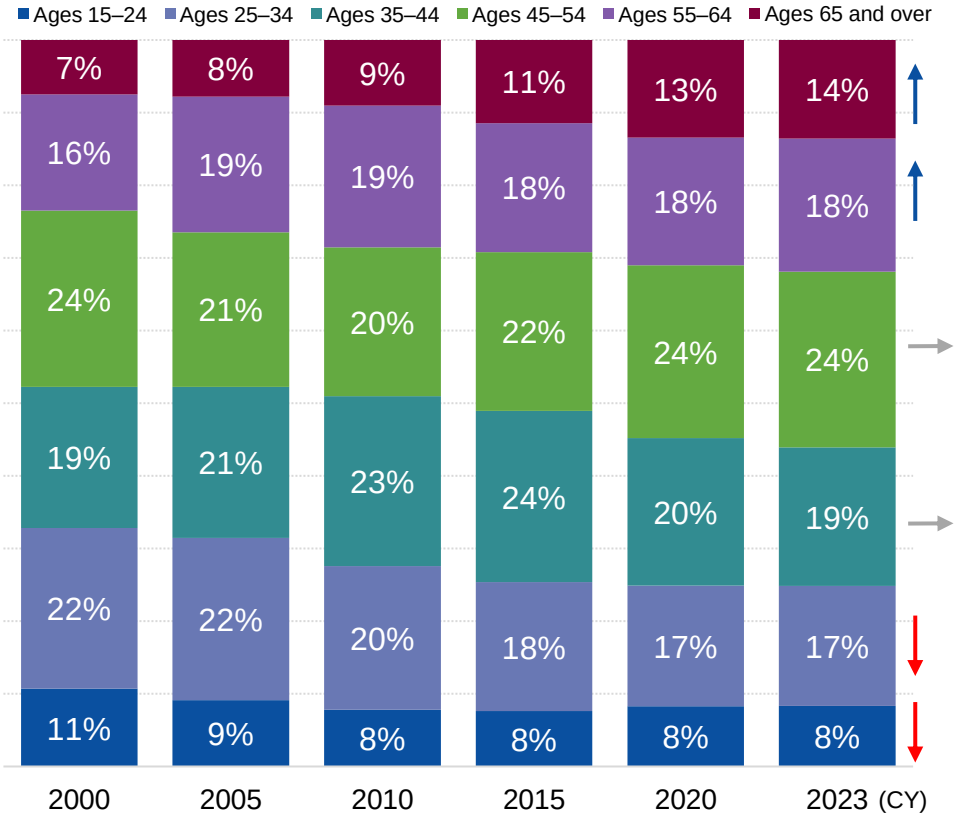
Note: G7 employment rate for women calculated as employed women aged 15–64 ÷ female population aged 15–64
Source: Ministry of Internal Affairs and Communications materials, OECD statistics, compiled by Industry Research Department, Mizuho Bank, Ltd

Current state of labor shortage: While there are industry gaps, aging is progressing gradually

■ With falling birthrates and more seniors joining the workforce, Japan's industries as a whole are steadily aging. Especially in agriculture and certain service sectors, the participation of the elderly is essential to operations

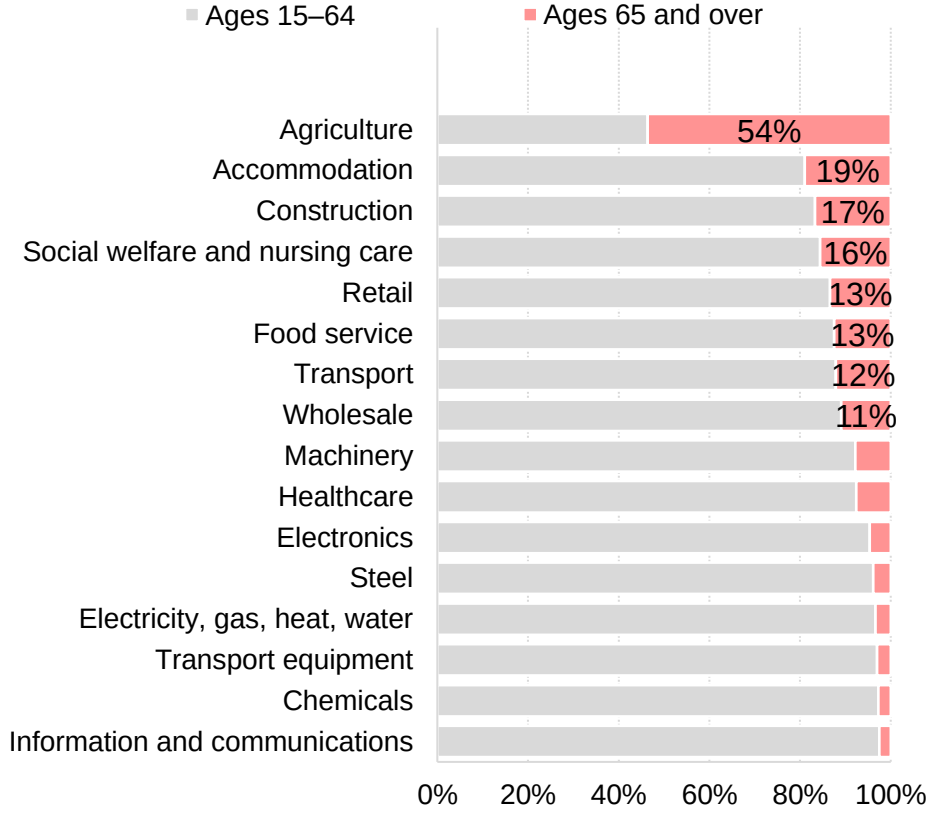
Change in workforce composition by age group (2000–2023)

- In 2000, 1/3 of workers were aged 15–34; by 2023 that share has dropped to 1/4 (-8%)
- In the same period, senior workforce participation doubled from 7% to 14%



Aging rate by industry (2023)

- The aging rate in agriculture stands out, with seniors making up over half the workforce
- Similarly, in accommodation, construction, and care sectors which involve physical labor, nearly 20% are seniors (seen both as a receiver for senior employment and as supported by elderly labor)



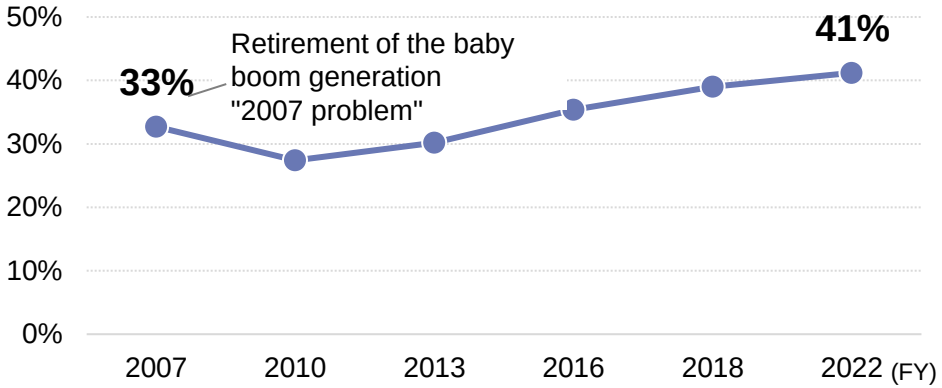
Source: Both charts: Ministry of Internal Affairs and Communications materials, compiled by Industry Research Department, Mizuho Bank, Ltd.

Current state of labor shortage: Transfer of skills an emerging issue due to aging workforce

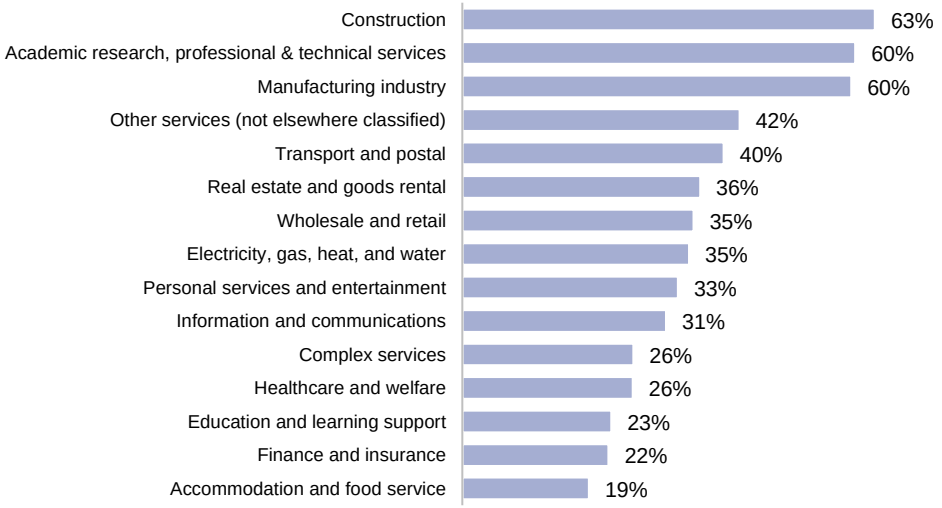
- More than 40% of companies report issues with skill transfer; reaching 60% in construction and manufacturing. Resolving these requires addressing not only the people problem of hiring/retirement, but also the structural issue of making skills visible, standardized, or systematic

Companies reporting problems with skill transfer

<Percentage of business establishments reporting problems with skill transfer>



<Percentage of respondents reporting problems with skill transfer by industry (FY2022)>



Source: Ministry of Health, Labour and Welfare materials, compiled by Industry Research Department, Mizuho Bank, Ltd.

Causes and risks associated with skill transfer (examples)

Causes	Turnover/new hires	High turnover or low hiring among young workers makes it hard to secure talent for the next generation
	Visualization/ standardization	Skills in minute details of work are hard to convey verbally or through manuals, so are difficult to teach
	Systems	Lack of frameworks or programs for technical training means few opportunities for systematic study
Risks	Quality	Unable to maintain traditional product/service quality, lowering customer satisfaction
	Cost	More rework, trouble-shooting, etc. increases costs
	Trouble	Incidents can't be anticipated or addressed promptly

<Reference: Difference between skill and technology>

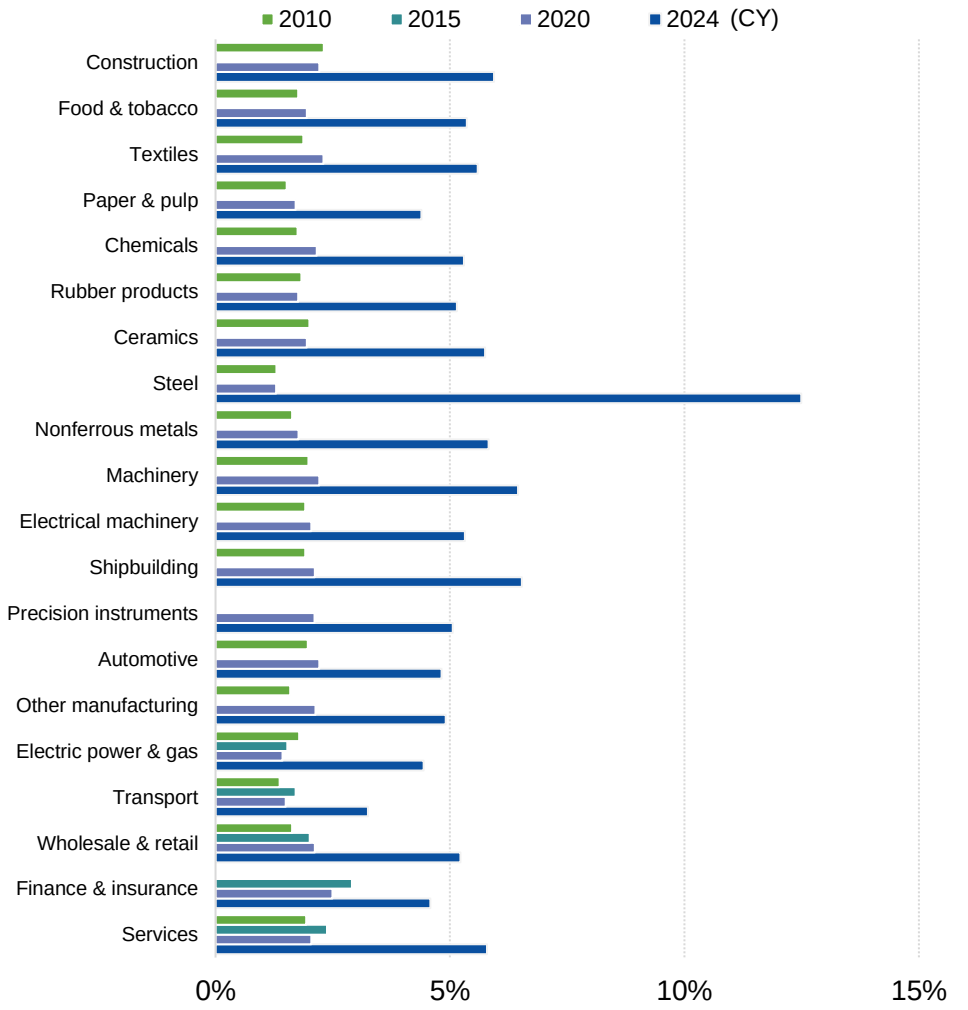
Skill Personalized	Ability acquired through experience or training	• Relies on individual capability, so proficiency varies • Since it is possessed by individuals, it is hard to directly observe or standardize
Technology Not personalized	Scientific theory or principle	• Standardized, so repeatable results are possible • Often embodied in machinery, devices, software, etc.

Source: Public information, compiled by Industry Research Department, Mizuho Bank, Ltd.

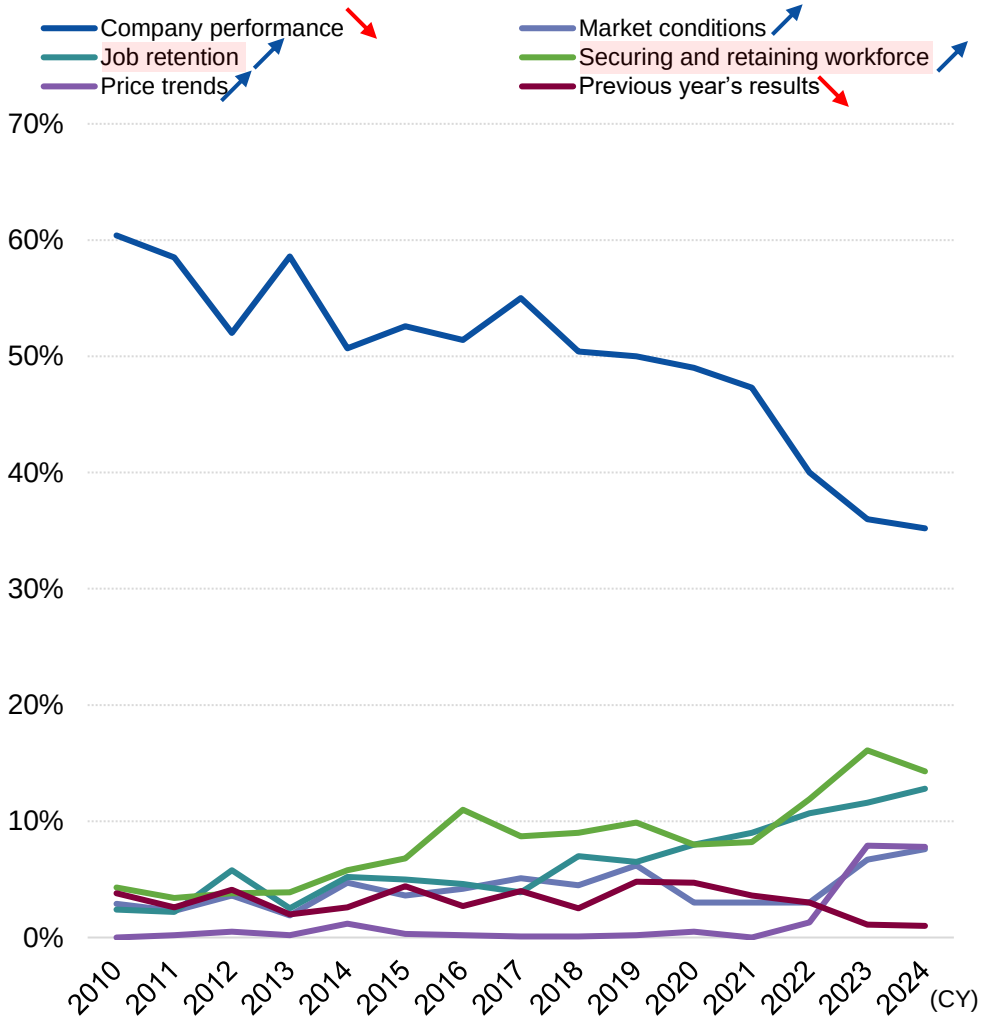
Current state of labor shortage: Need for wage hikes to retain and recruit workers

- Traditionally, companies adjusted wages based on their own business performance, but intensifying competition for talent means that companies now need to raise wages regardless of their performance

Private sector major companies' spring wage hike rate



Trends in the percentage of companies prioritizing each factor when revising wages



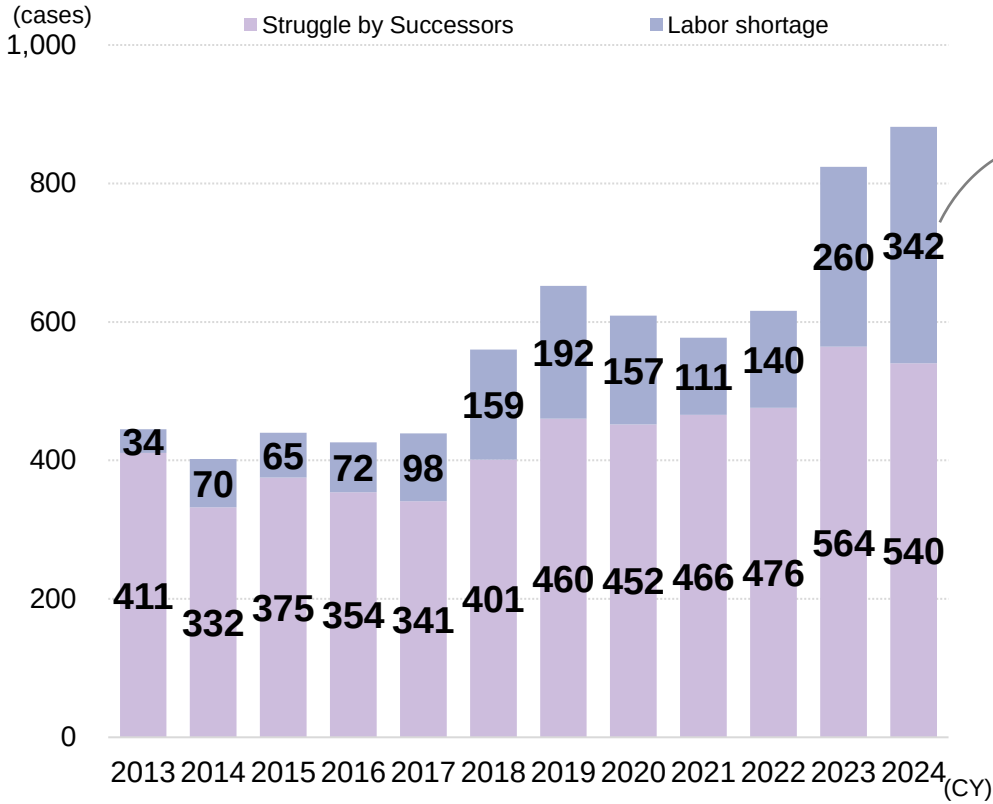
Source: Both charts from Ministry of Health, Labour and Welfare materials, compiled by Industry Research Department, Mizuho Bank, Ltd.

Current state of labor shortage: Business closures due to successor shortage, insufficient employees

■ With progressing aging, successor shortage bankruptcies due to a lack of heirs, and bankruptcies due to employee resignations or hiring difficulties, are increasing, mainly among small and medium enterprises

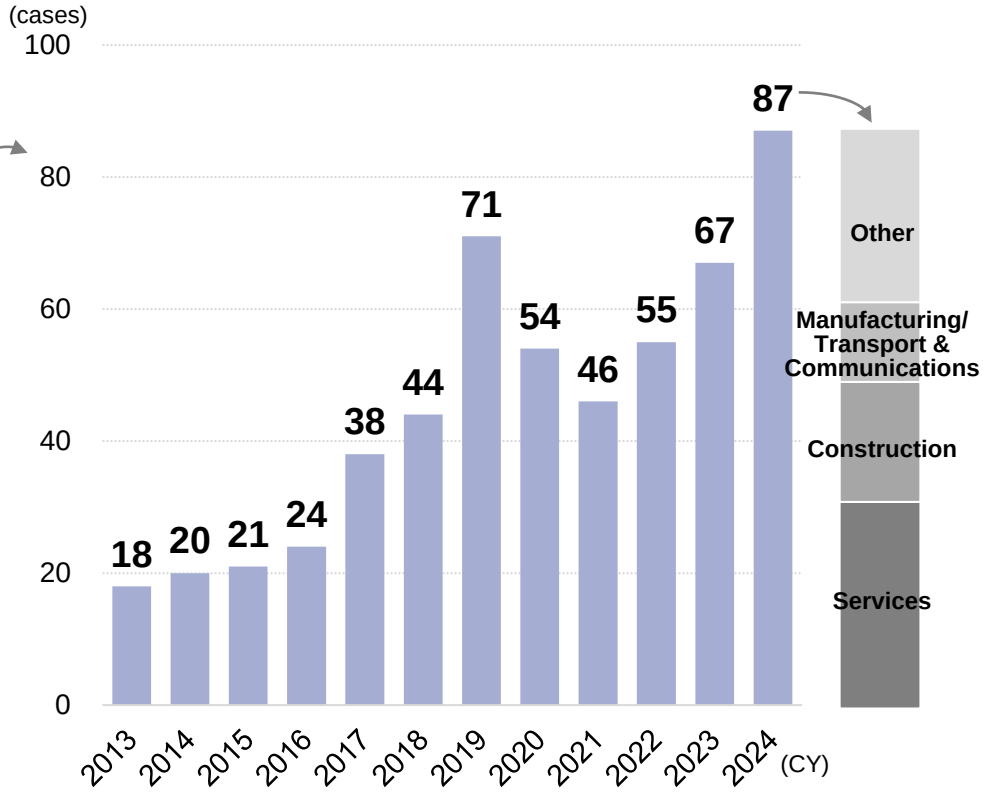
Trends in bankruptcies due to successor and labor shortages

- Over 500 bankruptcies per year due to lack of successors, and the number is rising
- Bankruptcies due to resignations, hiring difficulties, or soaring labor costs have surged, hitting a record 342 cases in 2024



Trends in bankruptcies due to employee resignation

- About 30% of labor shortage bankruptcies are due to employee resignations (over half in services or construction)
- To retain employees, it is essential to match competitor wage hikes, and improving earning power is a prerequisite for this

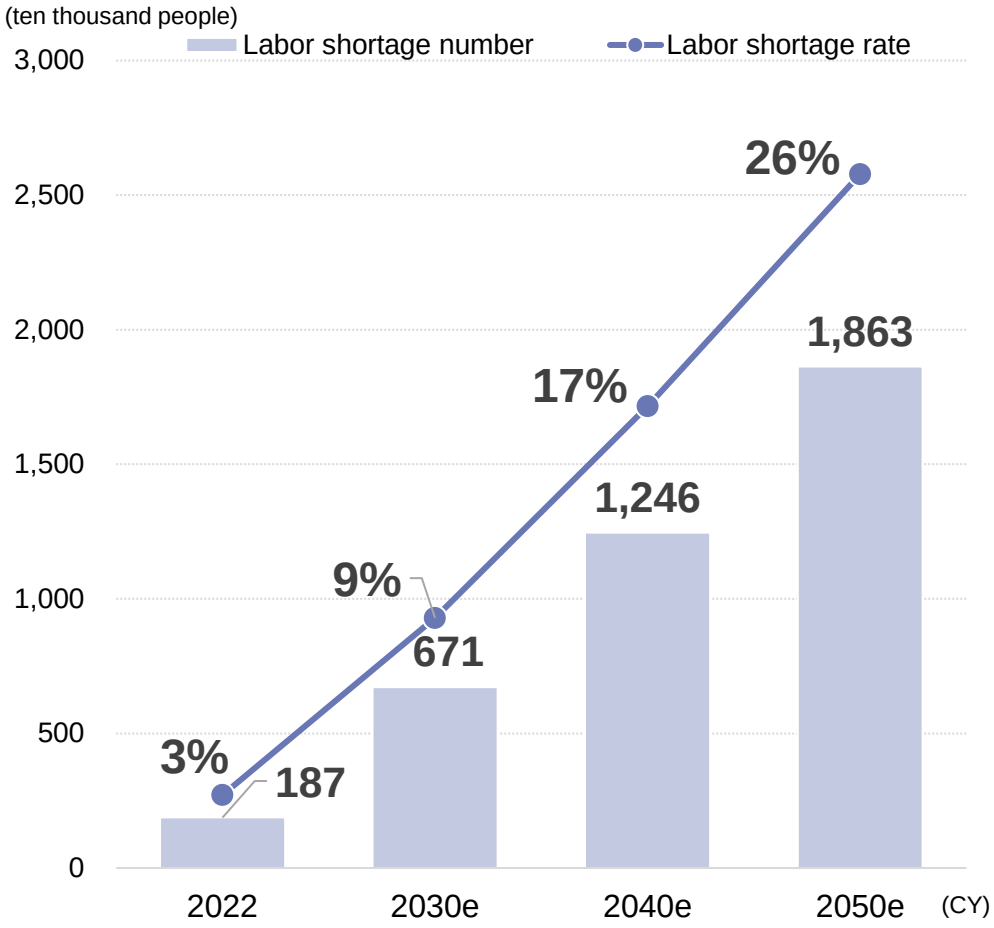


Source: Both charts: Teikoku Databank's national bankruptcy statistics, compiled by Industry Research Department, Mizuho Bank, Ltd.

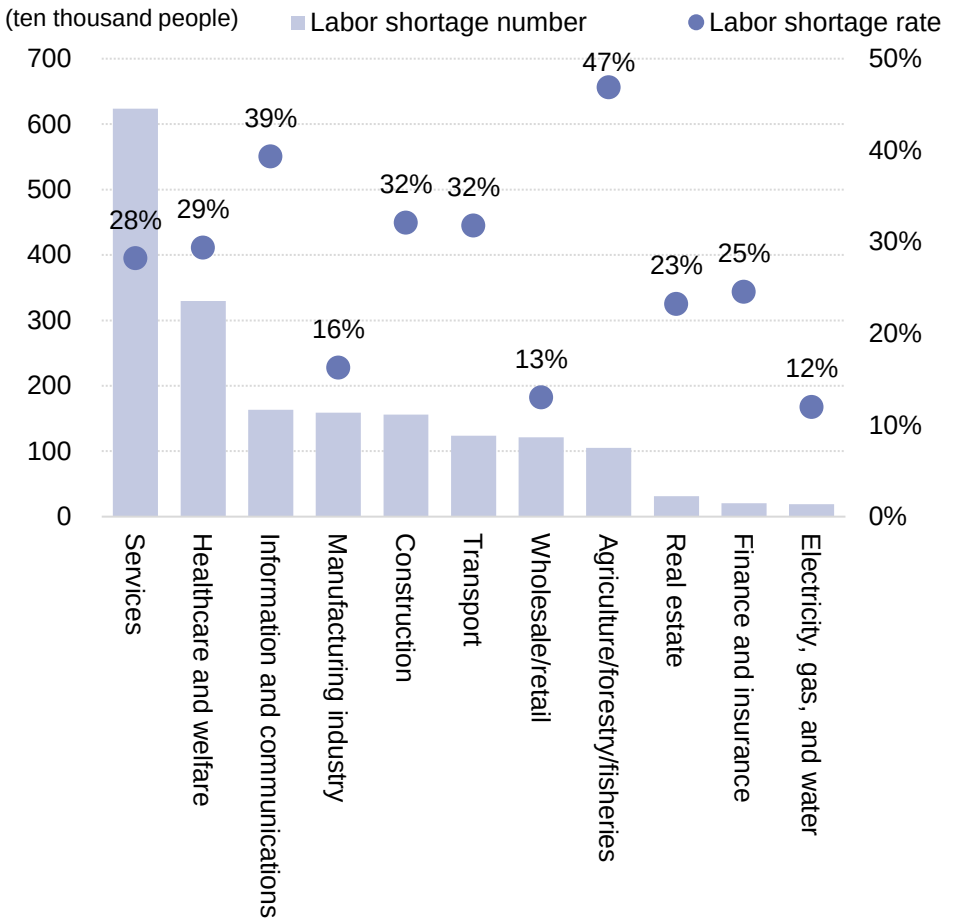
Looking ahead: 18 million shortfall in labor possible by 2050

- Based on future demographics and industry growth rates, Japan's overall labor shortage is forecast to reach 12.46 million (17%) in 2040 and 18.63 million (26%) in 2050

Projected trends in number/rate of labor shortage



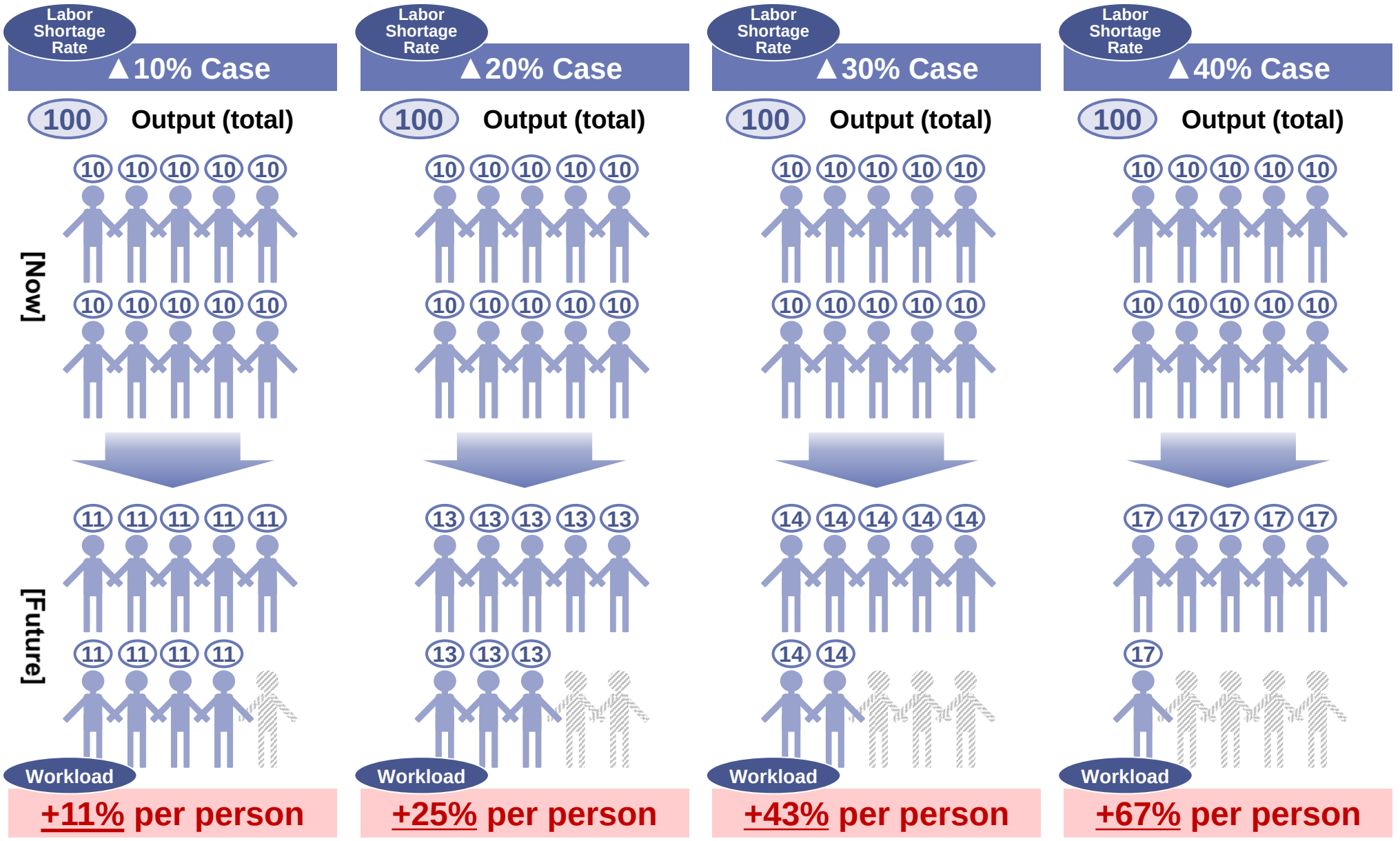
Projected labor shortage numbers/rates by industry (2050)



Note: Labor shortage in 2022 = number of unfilled jobs; shortage rate = unfilled jobs ÷ (employed + unfilled). From 2030, Industry Research Department, Mizuho Bank, Ltd. forecasts shortage as labor demand minus supply. Labor supply is calculated by multiplying the projected population for each age group by the labor force participation rate, based on the National Institute of Population and Social Security Research's "Population Projection for Japan (2023)" (medium-variant for births and deaths), and summing the results Labor force rates for each age group based on current performance Labor demand is calculated by estimating figures for each industry based on an assumed annual GDP growth rate of 0.5% through 2050, and then summing these values

Source: Both charts produced from National Institute of Population and Social Security Research materials, etc., compiled by Industry Research Department, Mizuho Bank, Ltd.

Looking ahead: How much additional burden per person? (Assuming unchanged output and productivity)



Source: Compiled by Industry Research Department, Mizuho Bank, Ltd.

Looking ahead: Impact on each sector (1): product/service volume

[Labor shortage rate]	Around 2030	Around 2040	Around 2050
▲10% Although there is some added burden, it remains manageable	**Healthcare, welfare, other services (food, accommodation, etc.)** □ Some excessive services are changed or halted □ If active wage hikes do not occur, turnover may gradually rise, mainly at small and medium firms	**Manufacturing industry** □ As on left	**Wholesale/retail** □ As on left
▲20% Some operations exceed the limit of providing traditional product/services	— □ No affected industries	**Construction, transport, healthcare, welfare, other services (ditto)** □ Construction and transport: longer construction/delivery periods, lower service quality □ In the accommodation industry as well, the inability to accommodate all tourists will accelerate moves to restrict operations	**Manufacturing industry** □ Even large companies see more delayed deadlines and higher costs □ Supply chain impacts become more apparent; need to review organizational setups
▲30% Operational disruptions mean it is difficult to supply same services/products as now	— □ No affected industries	— □ No affected industries	**Construction, transport, information/communications, healthcare, welfare, other services (ditto)** □ In some regions or areas of work, certain services may become difficult to provide. In nursing care (where service interruptions have especially large impacts) this could become a serious social issue
▲40% Crises on-site create doubts about industry sustainability	**Agriculture/forestry/fisheries** □ Sharp decline in yield, lower crop quality, more abandoned farmland □ May cause further deterioration in food self-sufficiency and expanded trade deficits	**Agriculture/forestry/fisheries** □ As on left (situation worsens)	**Agriculture/forestry/fisheries** □ As on left (situation worsens)

Source: Compiled by Industry Research Department, Mizuho Bank, Ltd.

Looking ahead: Impact on each sector (2): Product and service prices

- As the supply capacity for products and services weakens, prices will rise across the board. Until now, Japanese consumers have enjoyed affordable services, but going forward, appropriate (or sometimes even higher) prices relative to quality will be the norm

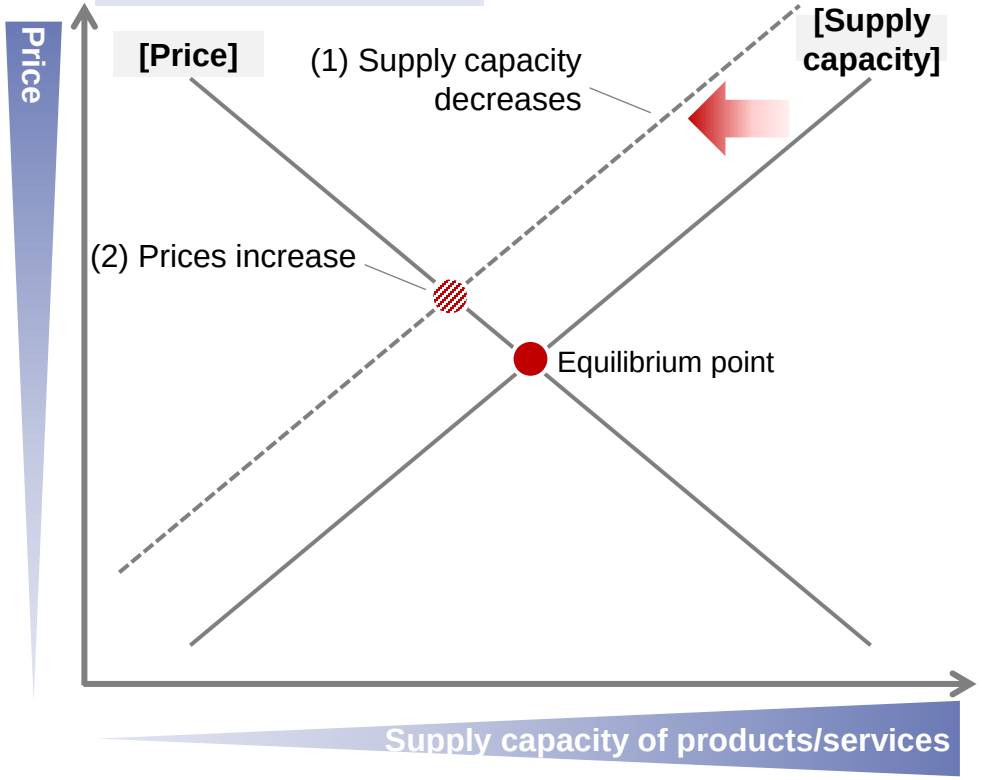
Impact on prices from declining product/service supply capacity

<Current state>

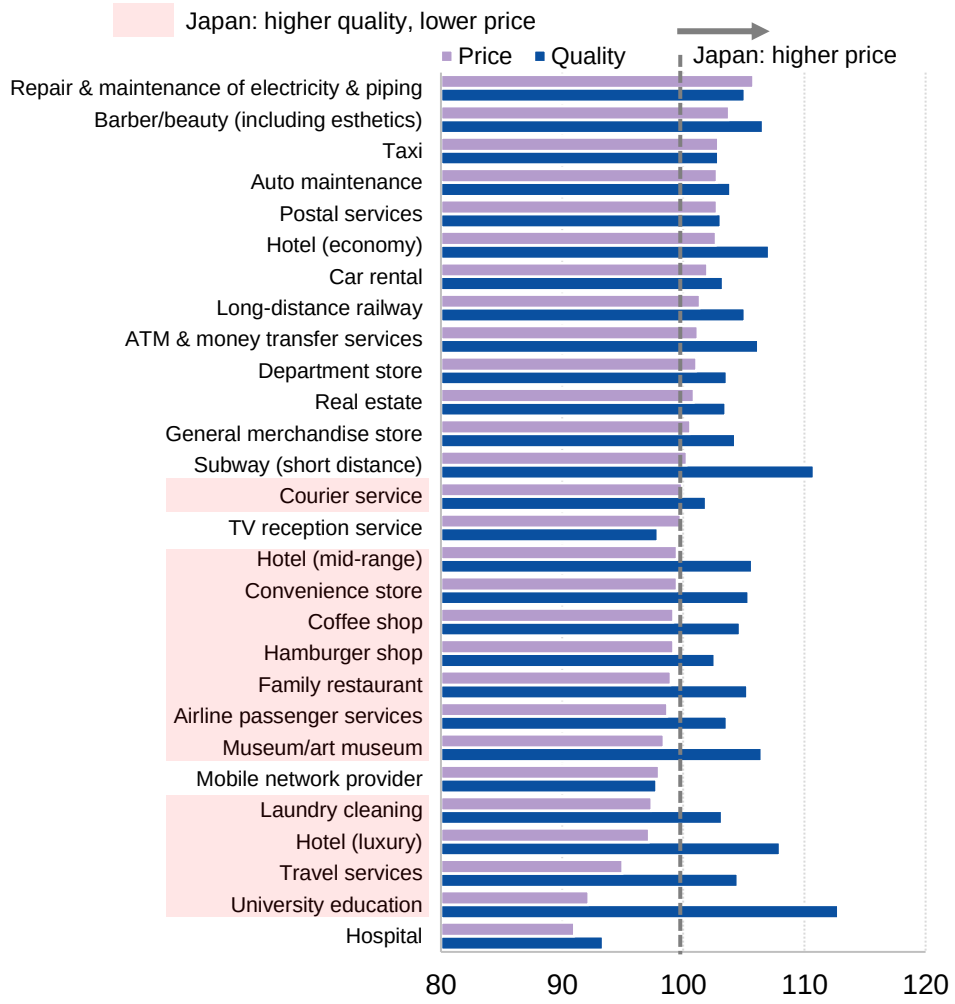
- Some products/services are becoming difficult to maintain, but generally, previous provision continues

<Future>

- A decline in supply capacity will lead to overall price increases in products and services
- The sense of value felt by consumers will gradually fade



<Assessment by Americans who have stayed in Japan (ranked by price level)>



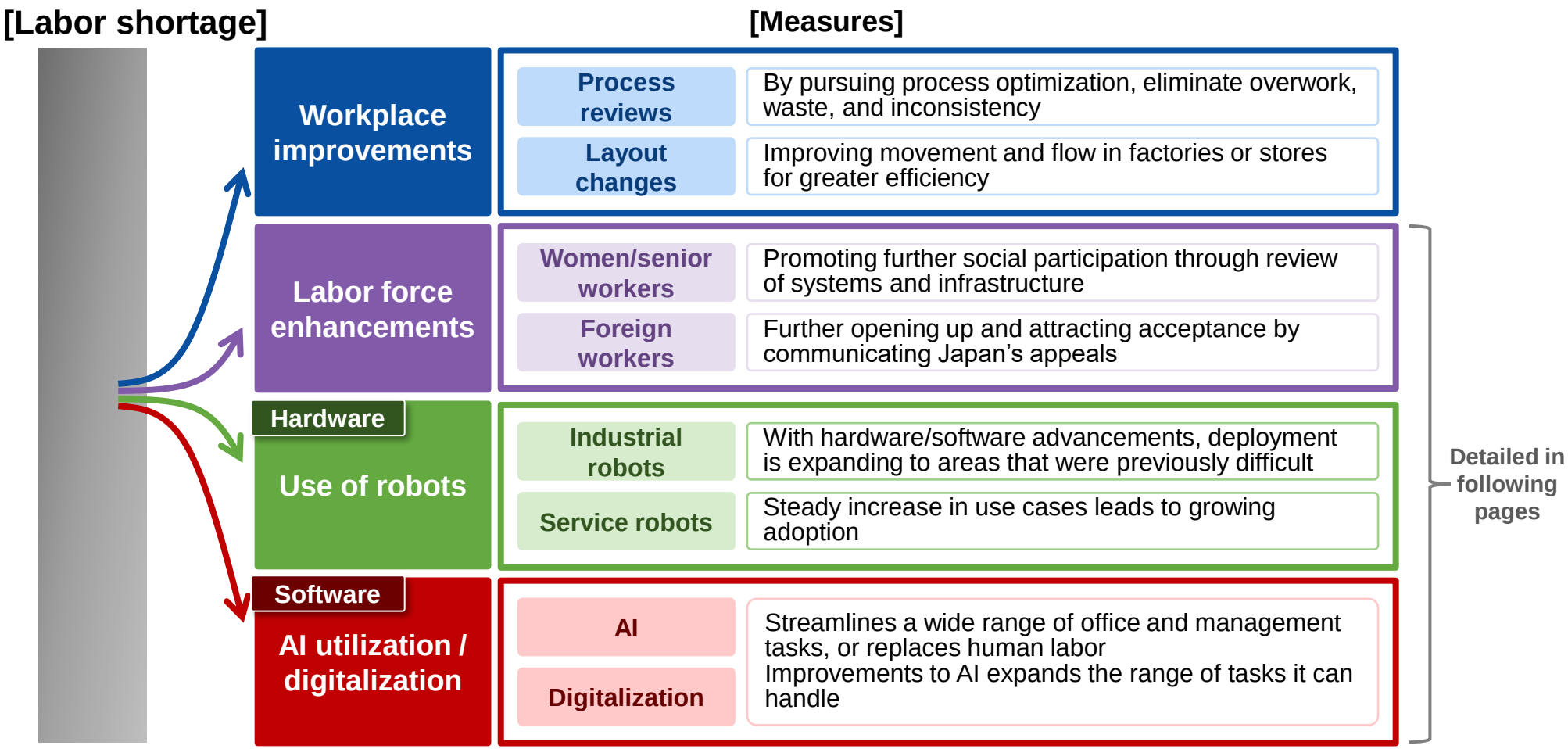
Source: Japan Productivity Center's comparison of US-Japan service quality (July 2017) Compiled by Industry Research Department, Mizuho Bank, Ltd.

4. Measures to Address Labor Shortages

There are four major types of measures to resolve labor shortages

- To overcome the upcoming labor shortages, in addition to conventional improvements in specific fields and strengthening the labor force, it is necessary to master technologies that can substitute for or support humans, such as robots and AI

Specific measures to resolve labor shortages

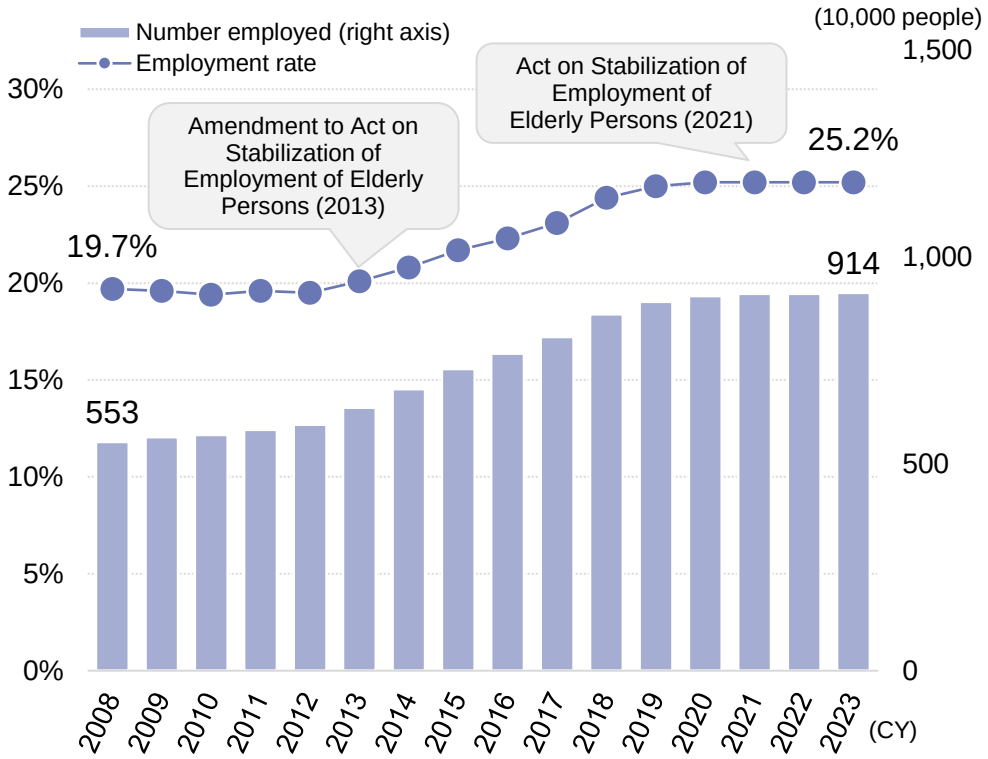


Source: Compiled by Industry Research Department, Mizuho Bank, Ltd.

Labor force enhancement: Efforts to promote senior and non-regular employee employment

- Due to retirement age extensions through amendments to the Act on Stabilization of Employment of Elderly Persons, senior employment rates are rising long-term, but have stalled recently
- Efforts are also underway to remove disincentives to work, such as revising the ¥1.03 Million Income Threshold, for all generations

Trends in number/employment rate of seniors (2008–2023)



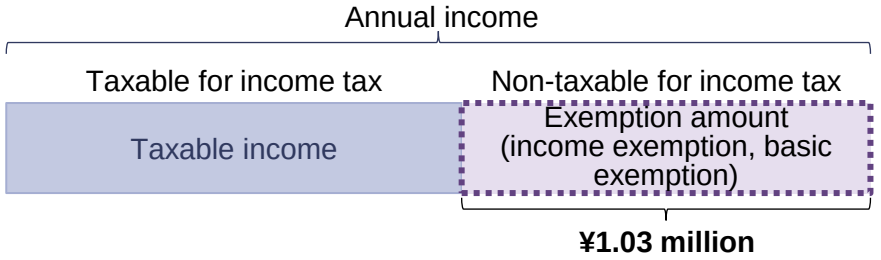
<Amendment to Act on Stabilization of Employment of Elderly Persons>

Amendment to Act on Stabilization of Employment of Elderly Persons (2013)	Amendment to Act on Stabilization of Employment of Elderly Persons (2021)
Retirement age raised to 65	**Retirement age raised to 70**

Source: Ministry of Internal Affairs and Communications materials, compiled by Industry Research Department, Mizuho Bank, Ltd.

Addressing work disincentives among non-regular workers: Revision of the ¥1.03 million income threshold(Note)

<What is the ¥1.03 million income threshold?>

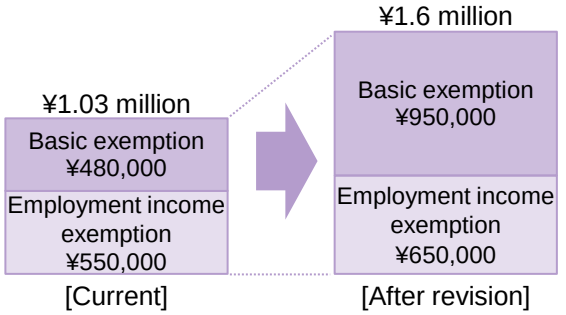


When annual income exceeds ¥1.03 million, it becomes subject to income tax, so workers limit their hours to stay under this threshold

<From ¥1.03 million income threshold to ¥1.6 million income threshold>

- In February 2025, the LDP's tax commission announced plans to revise the tax law
- The combined amount of the basic exemption and employment income deduction, which forms the minimum taxable income for income tax, is expected to be raised from ¥1.03 million to ¥1.6 million

(Minimum taxable income raised)

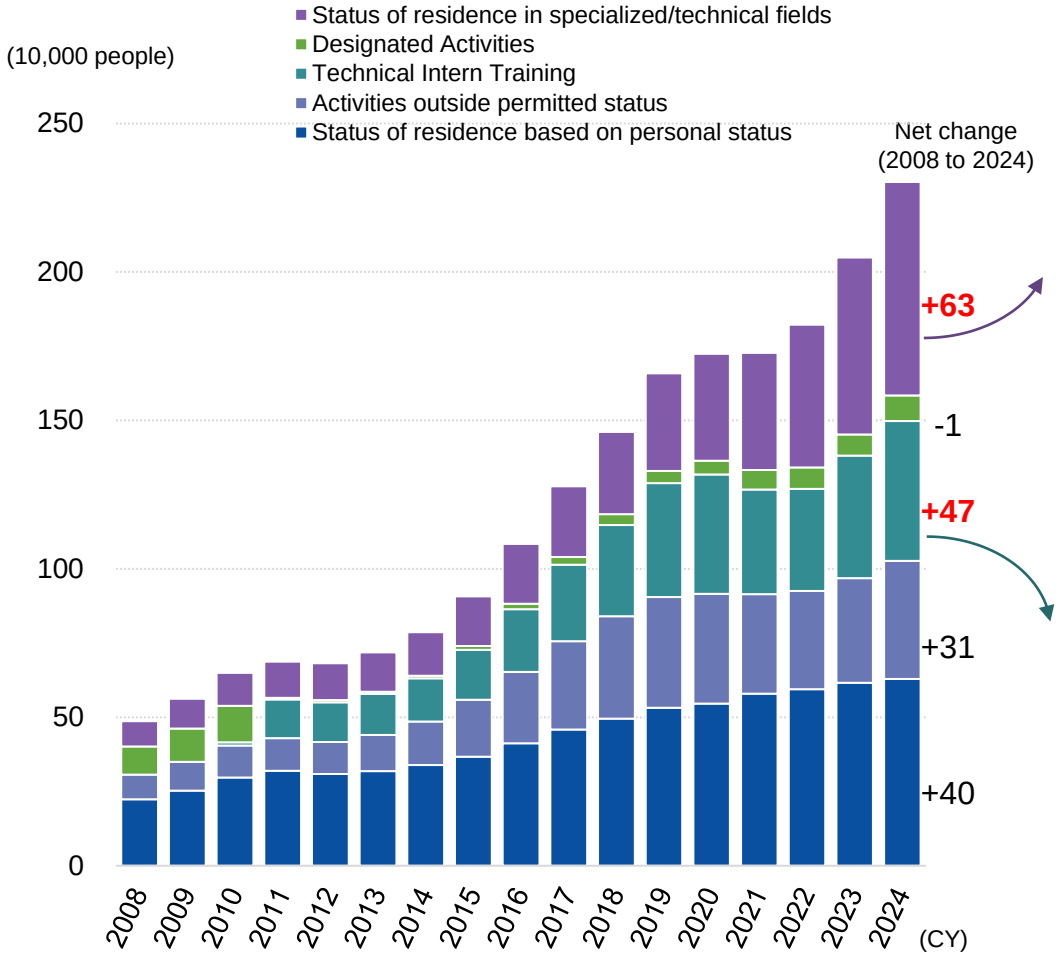


Note: Based on information as of March 2025
Source: Public information, compiled by Industry Research Department, Mizuho Bank, Ltd.

Labor force enhancement: foreign workers: increase centered on technical interns and highly skilled personnel

- Over the past 16 years, the number of foreign workers has grown by 1.8 million, reaching 2.3 million, mainly through highly skilled professionals and technical intern training. A further increase in participation across diverse industries is expected (Note: starting in 2027, technical intern training will transition to the Employment for Skill Development system.)

Trends in foreign workers by residence status (2008–2024)



Specialized/ technical Residence status

For advanced professional jobs, university grads, engineers, or roles making use of unique or specialized skills of foreigners

Highly Skilled Professionals

Highly skilled professionals contributing to Japan's academic research or economic growth

→ Since 2012, the Highly Skilled Professional Points System(note) grants preferential immigration treatment to qualified individuals, rapidly expanding their acceptance

Specified Skilled Worker

People with knowledge, experience, and skills in 12 designated industries with labor shortages

→ Since the system launched in 2019, the number accepted has grown to 200,000 (as of October 2024) as labor shortages progress

Technical Intern Training

A program to transfer skills/techniques to trainees and contribute to developing human resources in their home countries

→ Acceptance is expanding in light of domestic labor shortages and the need for skills development/acquisition among people from developing countries

Note: From 2027, a new Employment for Skill Development system will focus on domestic human resource development/retention. In principle, after three years of training, workers aim to obtain Specified Skilled Worker status

Note: The points system grants residence to those whose educational background, career, salary, etc. total a required number of points
Source: Ministry of Health, Labour and Welfare's Employment Status of Foreign Workers, compiled by Industry Research Department, Mizuho Bank, Ltd.

Utilization of robots/AI: Current state and future direction in Japan

- Japan maintains a strong presence in industrial robots, but is still developing its service robot market
- For AI, Japan is taking steps to establish rules while searching for winning approaches such as developing industry-specific AI

Current state and future direction for Robots/AI in Japan

Robots	Making	☐ Industrial robots: Several manufacturers with high global share; leading the world in functionality and reliability ☐ Service robots: Fourth largest by number of companies globally (after the US, China, and Germany, in 2023). Not as much presence as industrial robots
	Using	☐ Industrial robots: Second most annual installations worldwide (2023), behind China ☐ Service robots: Deployed in specialized applications such as medical or transportation, but overall usage remains limited. Note: adoption pace is slow globally, so there is little gap
AI	Making	☐ Academia: In number of research papers, US, China, UK, Germany, and Canada lead; Japan ranks 11th, 2023 ☐ Infrastructure: Japan ranks 12th on the AI Preparedness Index, which measures AI-readiness globally (2023) ☐ Companies: Japan ranks 10th in new AI startups receiving funding (2023)
	Using	☐ Companies: 19% are using generative AI in operations. This indicates a large gap with other countries: US 37%, Germany 34%, China 27% (2024) ☐ Individuals: 9% have used generative AI, compared to 46% in the US and 56% in China; Japanese individuals are also trailing behind other countries (2024)

Direction

[Industrial robots]
- Automation of the three goods industries (food, cosmetics, pharmaceuticals), requiring flexibility in variety and volume, has been a long-term challenge
- Small, highly flexible collaborative robots are also gradually spreading

[Service robots]
- Facing challenges in technology, quality, cost-effectiveness, social acceptance, and infrastructure
- Social demonstration/deployment and new use cases are being created, especially in industries with labor-shortages

Direction

[Rulemaking]
- Ensure AI transparency and enforce proper development/use of AI
- Promote both innovation and risk mitigation: combine laws with guidelines appropriately
- International coordination: ensure cross-border compatibility/interoperability

[Industry-specific AI]
- Develop AI designed and optimized for specific industry needs

Source: Ministry of Internal Affairs and Communications, Cabinet Office, IMF, IFR materials, compiled by Industry Research Department, Mizuho Bank, Ltd.

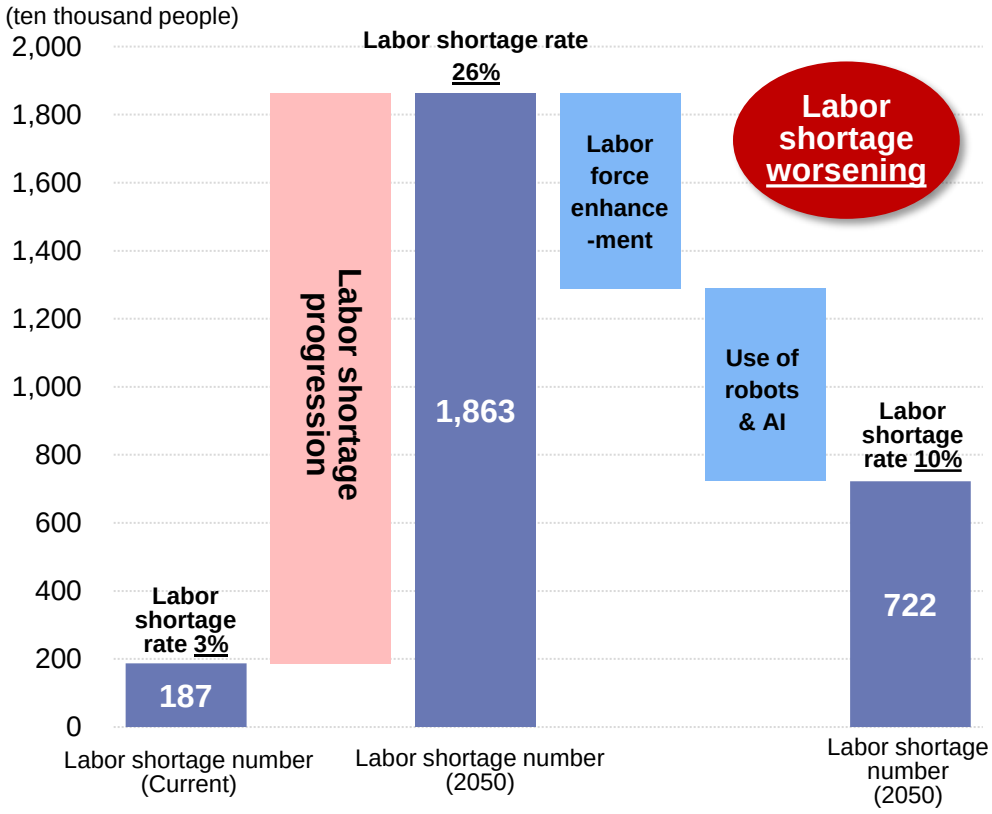
Two scenarios for resolving labor shortages

■ By advancing robot and AI adoption, it will be possible to substantially resolve labor shortages by 2050

Labor shortage situation in 2050

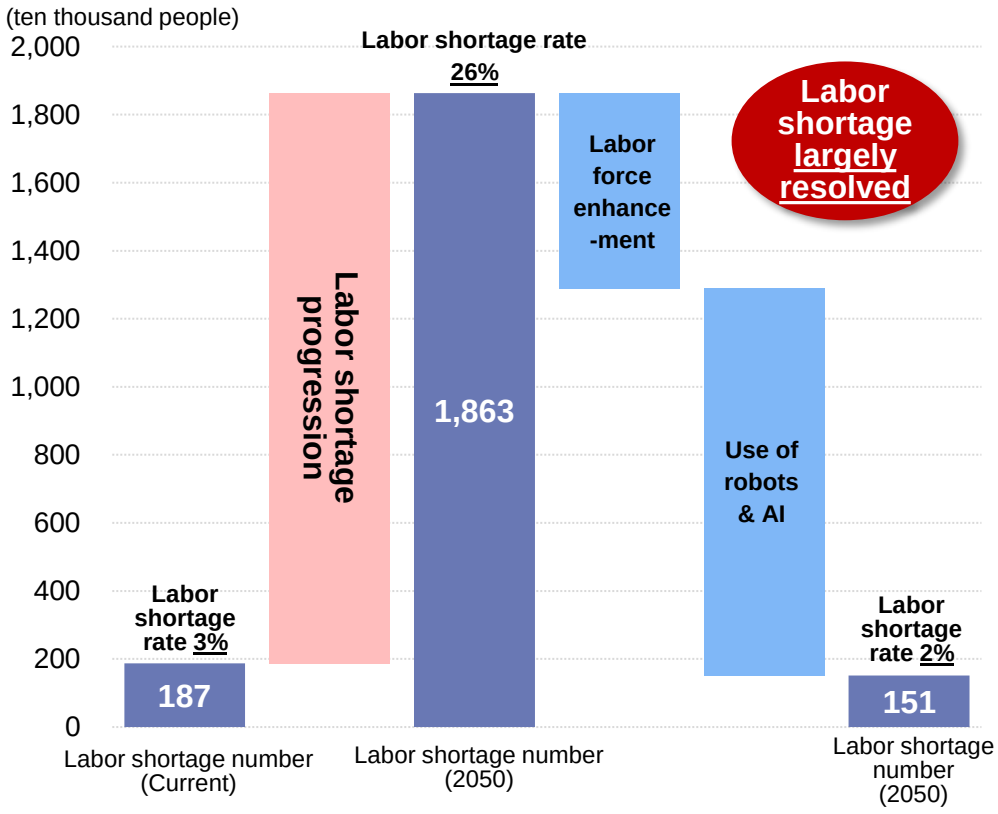
(1) Partial adoption scenario for robots & AI

Robots & AI substitute for only part of labor shortages



(2) Active adoption scenario for robots & AI

With widespread robot & AI adoption, most labor shortage is eliminated



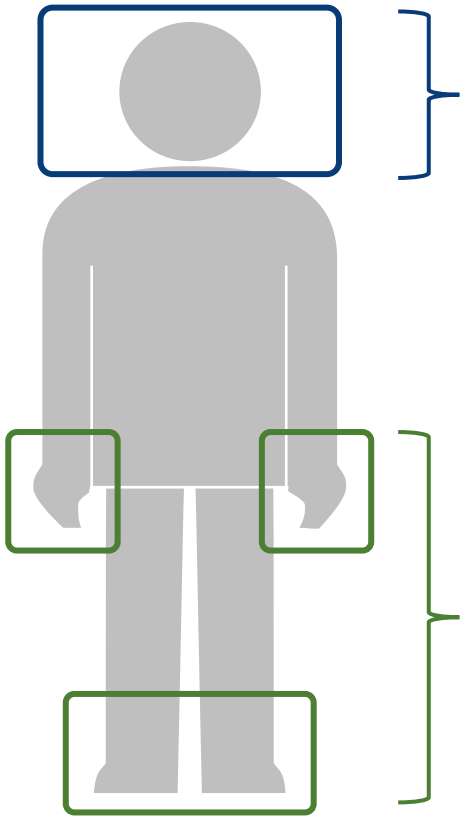
Note: Forecasts of labor shortage numbers in 2050 and increases from labor force enhancement and use of robots & AI are by Industry Research Department, Mizuho Bank, Ltd. Labor force enhancement assumes promotion of senior employment and greater intake of foreign labor. For seniors: assumes that, in 2050, labor force rate for age 60–64/65–69 matches today's rate for 55–59/60–64. For foreign labor: increase is estimated by referencing a JICA survey on coexistence with foreigners in 2030/40 with updated foreign labor supply/demand forecasts (July 2024). It uses the report's foreign labor supply potential for 2040

Source: Compiled by Industry Research Department, Mizuho Bank, Ltd.

Robots/AI utilization: Human tasks are classified into cognitive and physical tasks

- Tasks currently performed by people can be divided into two broad categories: primarily cognitive tasks and primarily physical tasks
- For both, robots & AI will develop to replace and support humans in domains where they excel

Classification of human tasks and automation potential by robots/AI



<Classification of human tasks>

Cognitive tasks
(Tasks mainly using the mind)

Thinking, decision-making, planning, problem-solving, information processing, etc.

(e.g. planning, R&D, customer service, management, office work, etc.)

Physical tasks
(Primarily uses the body)

Uses physical abilities like strength, stamina, dexterity, and physical movements or force to perform

(e.g. assembly in manufacturing, cleaning, caregiving, construction, transport, etc.)

<Approach for substitution>

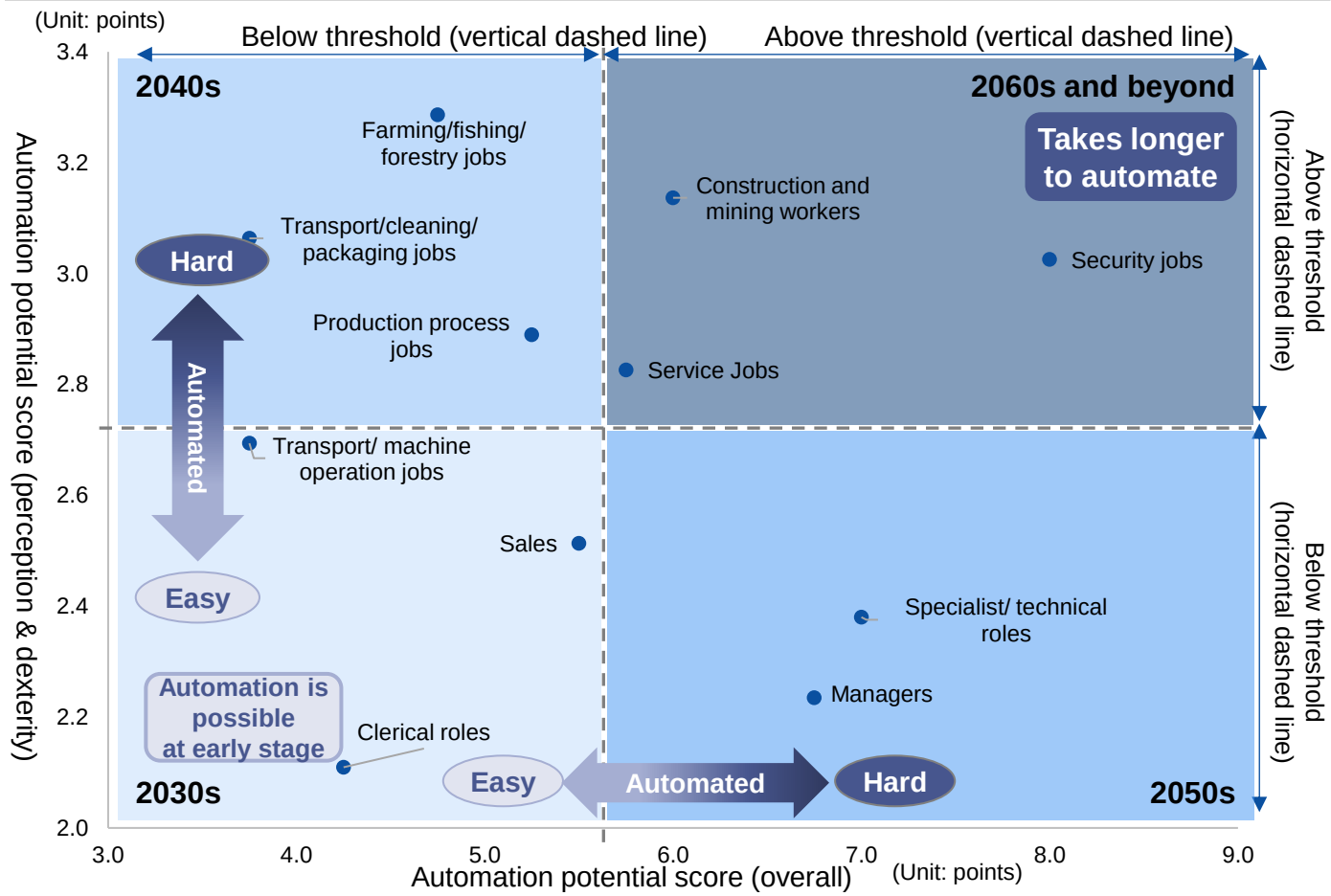
	[Domains where humans excel]	[Domains where robots & AI excel]
Cognitive tasks	■ Tasks requiring decision-making ■ Tasks requiring responsibility ■ Tasks requiring hospitality	■ Routine/repetitive tasks ■ Tasks judged by rules
Physical tasks	■ Tasks needing delicate force adjustment ■ Flexible/adaptive tasks ■ Tasks needing continuous, complex movements ■ Tasks in tight/unstable environments	■ Tasks handled at constant output ■ Tasks with standardized items ■ Tasks completed with a single motion ■ Tasks in organized surroundings

Source: Compiled by Industry Research Department, Mizuho Bank, Ltd.

Potential for labor substitution with robots/AI: Technical automation potential by occupation - Forecast by job classification

■ We have predicted the technical potential for labor automation by focusing on automation bottlenecks and using occupational data

Automation potential by job with focus on automation bottlenecks



How automation potential scores were calculated

- Frey & Osborne (2013, 2017) used the US Dept. of Labor's ONET database to extract values for possible automation bottleneck variables and estimate the automation probability for jobs
- Chiba & Fukuda (2023)(note 3) replicated this for Japan, extending it to the Japanese O-NET. This report uses Chiba & Fukuda's automation potential score

Horizontal axis — Automation potential score (overall)

- For Japan O-NET jobs, the main job categories were grouped and average bottleneck variable values calculated. The average value of each bottleneck variable for every major job category is converted into qualitative variables as follows (hereinafter LMH): "Low" <= 25th quantile < "Middle" <= 25th quantile < "High" <= 75th quantile < "Very High"
- For each major job category, the number of LMH values was counted and assign as Low = 1, Middle = 2, High = 3, Very High = 4; the weighted average was then calculated, which is defined as the "overall automation potential score"

Vertical axis — Automation potential score (perception & dexterity)

- For each major job category, the maximum value for bottleneck variables regarding perception & dexterity was calculated and defined as the perception & dexterity automation potential score

Notes1: Years on the chart are the predicted timing when AI/robotics technology is expected to enable automation, as based on technology trends

Notes2: On the chart, the vertical dashed line indicates the average of the "overall automation potential score," and the horizontal dashed line indicates the average of the "perception and dexterity automation potential score"

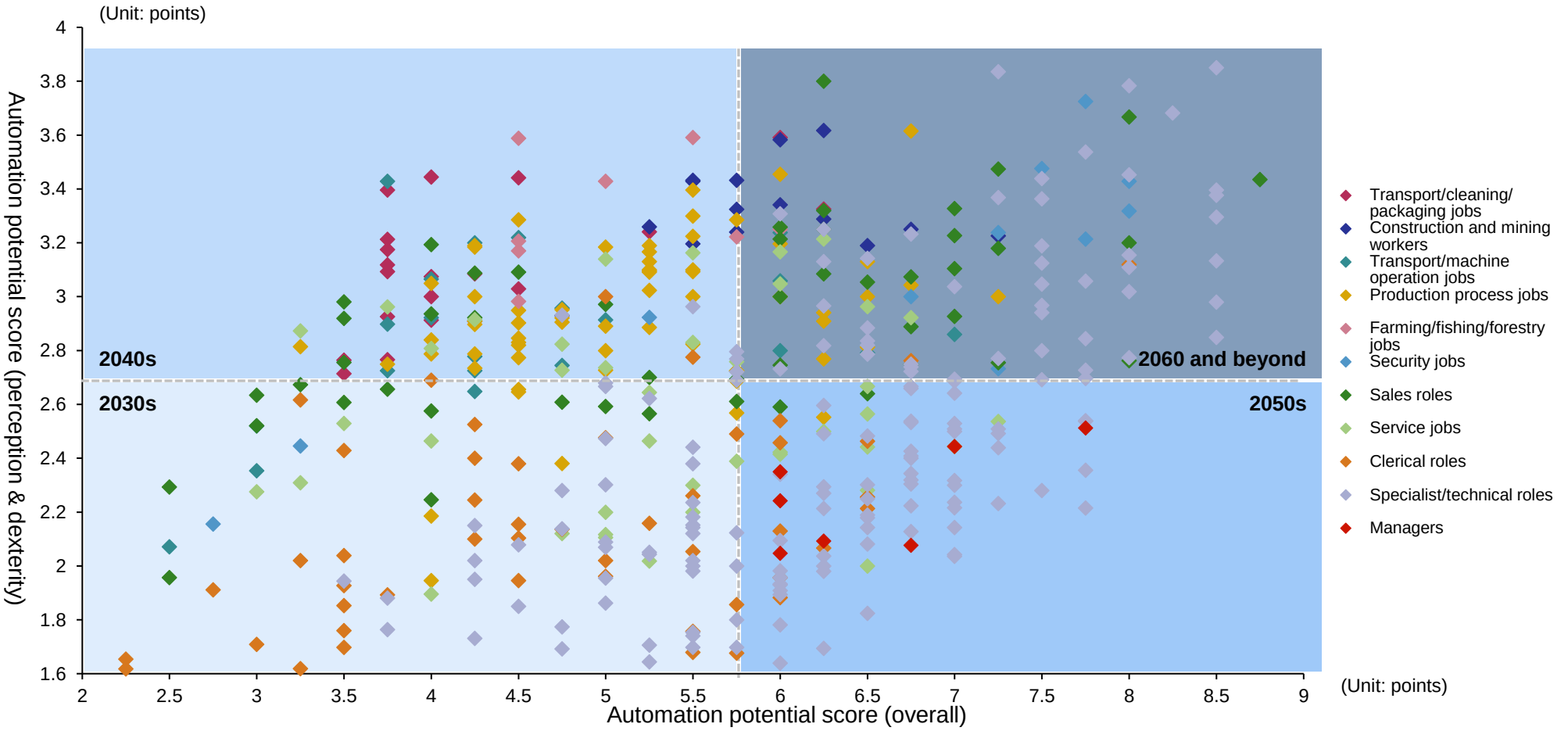
Notes3: Chiba, Shigeki & Fukuda, Setsuya. Japan-US Comparison of Job Automation Probability: Replication of Frey & Osborne Model & Extension to Japan O-NET Data (Feb 2023)

Source: Japan Institute for Labour Policy and Training materials, compiled by Industry Research Department, Mizuho Bank, Ltd.

Potential for labor substitution with robots/AI: (Reference) Automation scores without job type aggregation

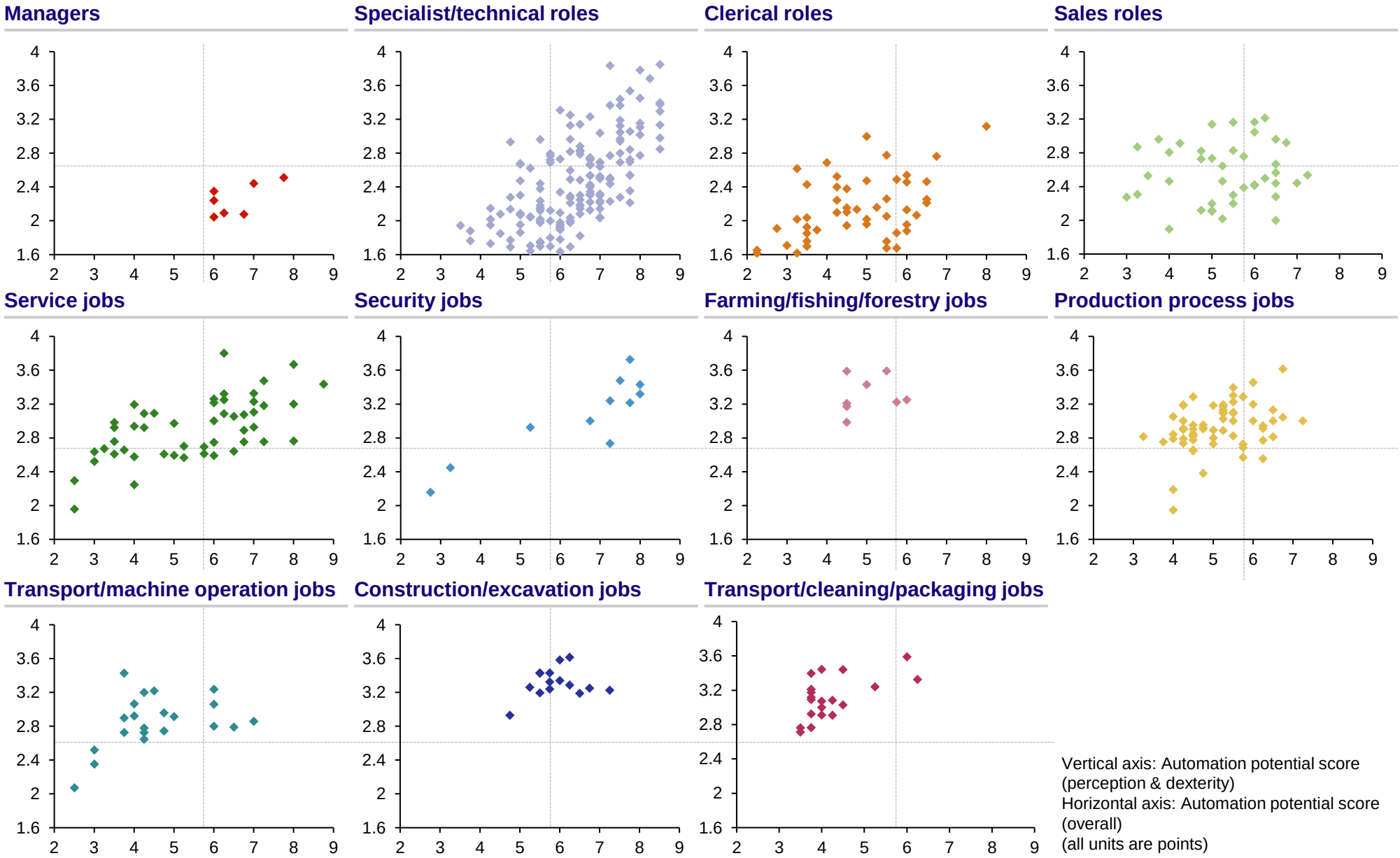
- Without aggregating to major job categories, automation scores were calculated for the smallest job classification unit
  - Within these, even occupations grouped under the same major category show variation in score, but most fall into the same quadrant (2030s, 2040s, 2050s, 2060s and beyond)

Automation potential score by individual occupation at smallest classification unit



Source: Japan Institute for Labour Policy and Training materials, compiled by Industry Research Department, Mizuho Bank, Ltd.

Potential for labor substitution with robots/AI – (Reference) Automation scores by major job category



Vertical axis: Automation potential score (perception & dexterity)
Horizontal axis: Automation potential score (overall)
(all units are points)

Source: Japan Institute for Labour Policy and Training materials, compiled by Industry Research Department, Mizuho Bank, Ltd.

As the timing for automation materializes, robots & AI are expected to be deployed gradually by job type

■ For both the partial and the active adoption scenarios, an implementation pathway for robots and AI is set according to the timeline of when automation becomes feasible

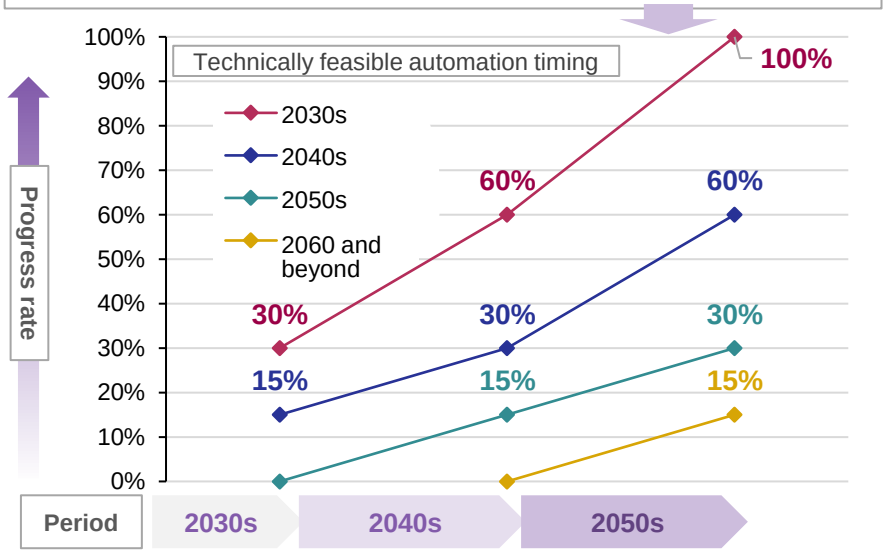
Assumptions for progress in robot/AI implementation

Partial adoption scenario for robots & AI

Robots & AI are only introduced to fill actual labor shortfalls

- Each industry introduces technology to address its own labor shortages, matching technology implementation to the number of workers lacking in that sector
- The number of jobs substituted by technology is calculated by multiplying the labor shortage number in each occupation by the technology adoption rate for that occupation (note 1)

Labor substitution rate example: About 18 million people (note 2) Labor shortage number ✖ Progress rate

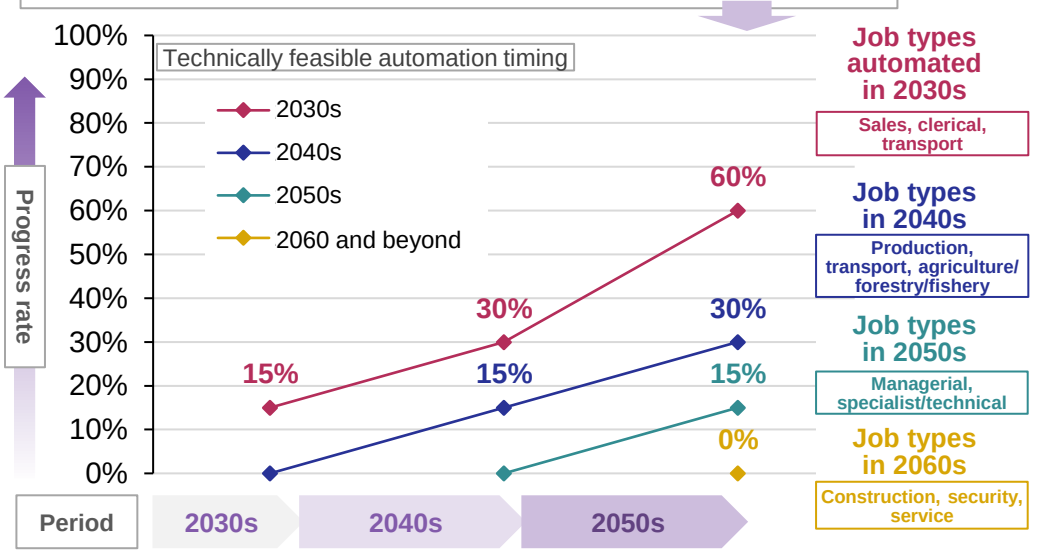


Active adoption scenario for robots & AI

Automation substitutes for all labor demand, not just shortages

- With a view to both resolving labor shortfalls and achieving greater overall efficiency through tech, robots/AI are deployed to replace all labor demand (including shortages)
- The number of jobs substituted is calculated by multiplying labor demand for each occupation by the implementation progress rate (Note 1)

Labor substitution rate example: About 70 million people (note 2) Labor demand ✖ Progress rate



Note 1: For each occupation, the progress rate of substitution across all duties. Based on the fact that employees at large companies account for 30.3% of all workers in Japan (FY2024 SME White Paper), the active adoption scenario assumes that roughly 30% of the workforce will have been substituted as automation is fully implemented in large companies about 10 to 20 years after automation becomes technically feasible. Additionally, in the active adoption scenario only, it is assumed that, based on the level of bottleneck variables for each occupation, some tasks within each job category may remain non-substitutable

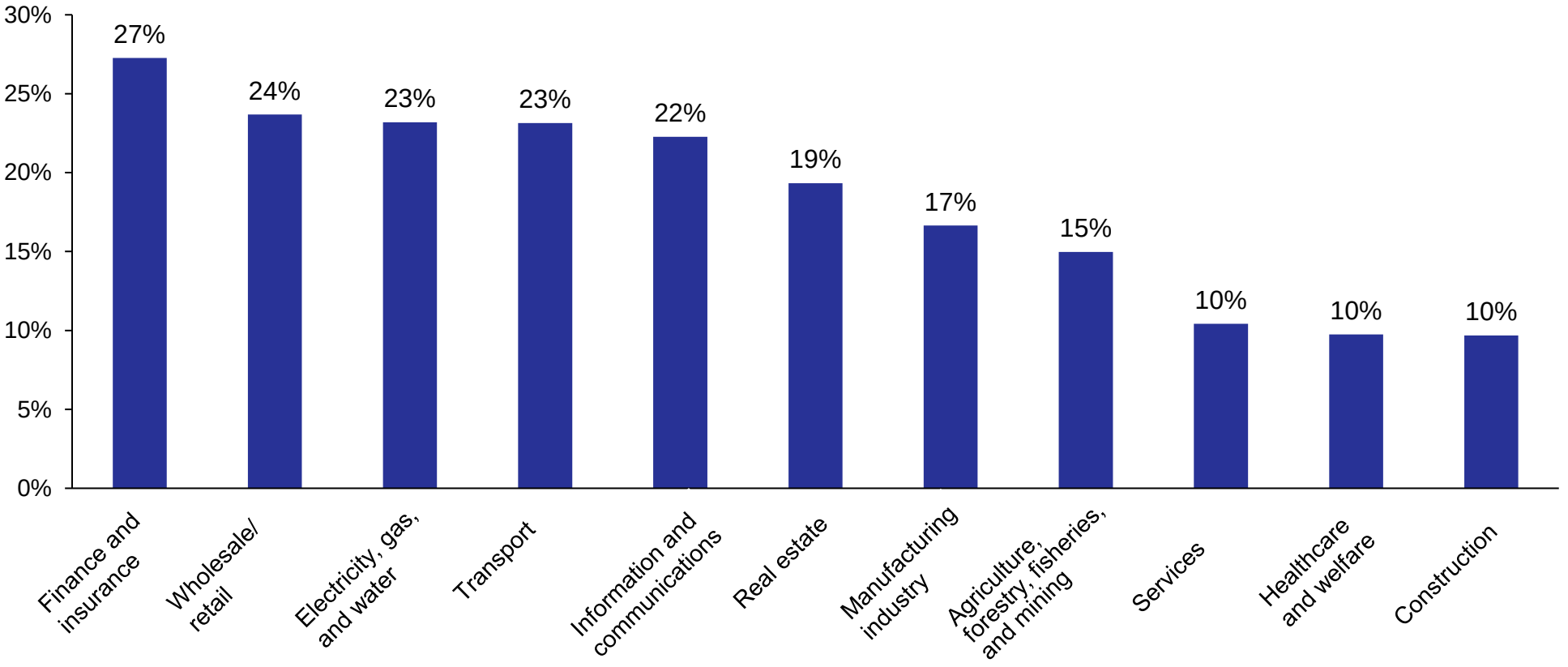
Note 2: Value is for all occupations combined as of 2050

Source: Both charts: Industry Research Department, Mizuho Bank, Ltd.

Potential for labor substitution with robots/AI: Automation progress differs by industry, with pathways varying by sector

- Examining by industry, labor substitution by automation will progress fastest in sectors with many clerical and sales workers, such as finance and insurance, toward 2050
- Meanwhile, in construction, health/welfare, and service industries, automation will remain limited as of 2050

Labor substitution rate by industry in 2050 (robot/AI active adoption scenario)



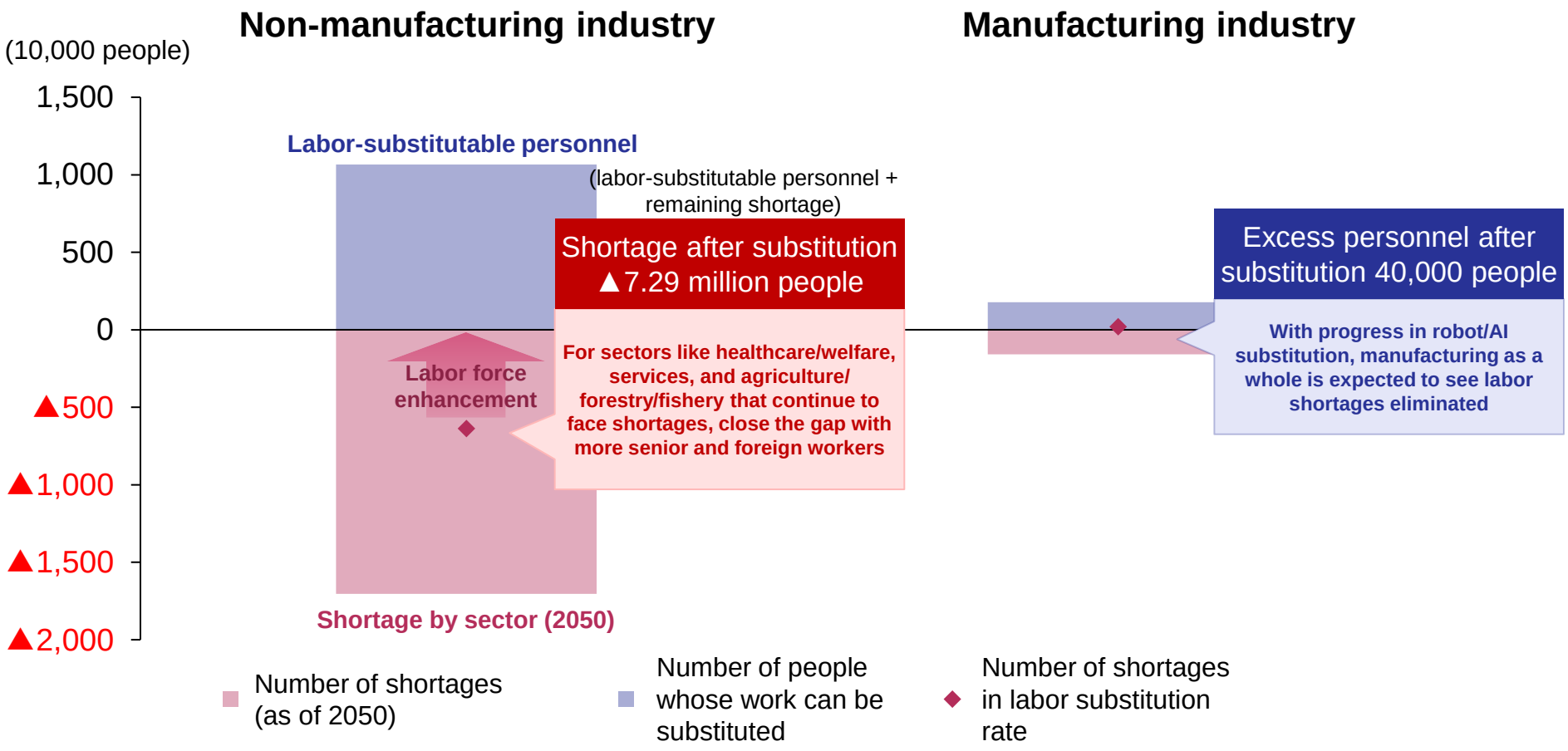
Note: Based on the per-occupation labor substitution rates calculated according to the assumptions on the previous page, the rates are aggregated by industry in proportion to the share of each occupation within each industry

Source: Japan Institute for Labour Policy and Training materials, Ministry of Internal Affairs and Communications Labour Force Survey, compiled by Industry Research Department, Mizuho Bank, Ltd.

While labor substitution will largely resolve labor shortage by 2050, some industries will still experience shortages

- With robot/AI substitution, by 2050 manufacturing is expected to largely resolve labor shortages, but non-manufacturing, including health/welfare, services, and agriculture/forestry/fishery, will continue to face shortages

Labor shortage and substitutes after robot/AI introduction in 2050 (active adoption scenario)



Source: Both charts: Industry Research Department, Mizuho Bank, Ltd.

Key challenges for further robot adoption

- Robot performance is improving daily, but challenges remain regarding fully utilizing them to further resolve labor shortages

Manufacturing industries Non-manufacturing industries

[Performance]

- Compared to humans, grasping is where robots lag most. Gentle gripping or handling irregular objects remains difficult
- Even if human-like grasping is achieved with high-performance sensors and materials, movement is slower and throughput is worse compared to humans

[Acceptance]

- For high-price services, many customers want a human touch, and robots may feel cheap in such situations
- There are those who respond negatively when robots take over jobs previously done by humans. Some robots gain steady acceptance (like meal delivery), while others remain just novelties

Cost

[Safety]

- Robots may bump into or knock over people when moving in human spaces
- In fields where delays are unacceptable (surgical robots, self-driving cars), communication lags could be critical
- Robots often connect to the internet/cloud, so cybersecurity is essential

[External environment]

- Existing facilities aren't designed for robots, so doors, elevators, etc. must be made robot compatible
- Flow lines, flooring type, steps, etc. can also hinder robot operation (in contrast, new buildings, factories, stores can be designed robot-ready)

Source: Compiled by Industry Research Department, Mizuho Bank, Ltd.

The path to further robot adoption: Triggered by worsening human cost-performance

Cost × Performance

Performance

Accuracy | Speed | Flexibility | Safety | Creativity | Fatigue tolerance

Cost

Initial cost

[Humans]
Hiring costs, training costs

[Robots]
Deployment costs, System construction cost

Running cost

[Humans]
Wages, benefits

[Robots]
Lease costs (if leased), communication, electricity costs

	Humans perform better	Robots perform better
Humans are cheaper	**1 Society built on human labor** ■ Currently, especially in services, employing people is lower cost and higher performance for many tasks ■ However, as the working age population declines, people will become scarcer and it is likely that wages will rise overall	**(Exists only in some areas)** ■ Humans will be used mainly in fields where criteria aren't just economic rationality (life-or-death situations, etc.) • Surgical robots: Expensive, but can perform highly accurate, delicate, consistent actions • Robots for harsh environments (space, disaster zones, nuclear facilities, etc.)
Robots are cheaper	**2 Robots become the real solution** ■ Currently, performance/cost is inferior, but over time robots will gain cost advantage (plus, jobs will arise that humans can't fill) ■ If companies wait until they truly can't find people, it will be too late, and some are already piloting robots for the future, even with higher short-term costs	**3 Hopes for long-term adoption** ■ Use in niche fields: Industrial robots for painting/welding, transport robots, etc. ■ As on the left, with higher robot cost competitiveness, scope and technology evolve. In performance, robots may catch up with humans

Sense of value of humans gradually fades

Technology development, use case creation accumulating know-how

Source: Compiled by Industry Research Department, Mizuho Bank, Ltd.

Key issues for wider AI adoption: Addressing power demand increase due to AI progress

- In addition to the rise in electricity usage at data centers driven by the spread of generative AI and digitalization, factors such as electrification in industry, the growth of EV adoption, hydrogen production, and increasing semiconductor demand are also expected to contribute to rising power demand
- To support further AI implementation, it will be crucial both to expand electricity supply to cover this increase in demand and to pursue initiatives such as reducing power consumption through AI utilization (see the Energy Constraints section for details)

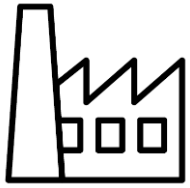
Factors that increase electricity demand (examples)

Digitalization progress

- ✓ Electricity demand at data centers increases due to digitalization progress such as AI adoption

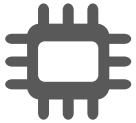
EV spread

- ✓ Charging demand increases due to further EV adoption



Electrification progress in industrial sector

- ✓ Electricity demand increases due to progress in electrification in industrial sectors, such as expansion of electric furnace utilization in the steel industry and expansion of robots aimed at labor-saving



New semiconductor plant construction

- ✓ Rising semiconductor demand and security importance mean more domestic semiconductor plants in Japan
- ✓ This will cause increased power consumption

Factors helping restrain energy demand include:

- Development of technologies to reduce computational costs and power consumption associated with AI learning and inference (examples: DeepSeek, etc.)
- Business efficiency and energy saving through AI utilization (example: optimization of factory operations and logistics utilizing AI)

Note: Power demand outlook involves uncertainties, so caution is required

Source: Compiled by Industry Research Department, Mizuho Bank, Ltd.

4. Business opportunities Created by Addressing Labor Shortage

Both providers of labor shortage solutions and industries facing labor shortages can seize business opportunities

- There are business opportunities for companies that provide solutions such as AI, robots, and autonomous driving that are in higher demand due to labor shortages, as well as for industries experiencing labor shortages themselves, where resolving those shortages can create new business opportunities

Opportunities for labor shortage solution providers and industries facing shortages

Labor shortage solution providers

AI service providers | Robot manufacturers | Autonomous driving service providers | etc

Labor shortage industries

Nursing care | Accommodation | Construction | Logistics | Food | Aviation | etc

AI

Deployment of industry-specific AI using closed data

- First, for each industry segment, identify labor-intensive areas and develop AI applications tailored to those areas as a strategy to address labor shortages
- By using federated learning technology to scale closed data and developing/rolling out industry-specific AI, business opportunities can be created

Robots

Deployment of robots for unstructured tasks, primarily in non-manufacturing sectors

- Develop business focused on non-manufacturing unstructured tasks where robotization demand is high due to severe labor shortages
- By targeting sectors where Japanese robotics excel, such as high precision and high safety, there is potential to achieve a competitive advantage over foreign robot makers

Auto-nomous driving

Acquisition of new business fields such as autonomous driving systems and dispatch platforms

- As autonomous driving services become more widespread, new business fields such as autonomous driving systems, dispatch systems, and remote monitoring systems are expected to expand
- Existing companies are anticipated to see an extended value chain, along with possible entry from different industries

Resolving labor shortages avoids lost sales, achieves cost savings
Effectively using the labor resources freed up to gain business opportunities

Before addressing labor shortage → After addressing labor shortage

Lack of slack in human resources, leading to lost demand

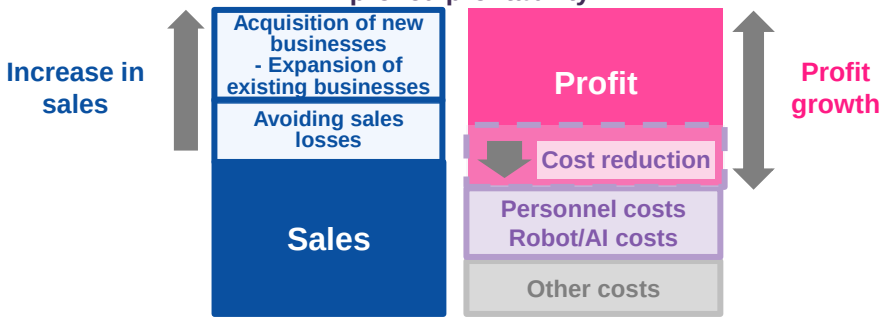
Concern over lost sales plus higher personnel costs due to talent scarcity pressures profitability

Leveraging robots, AI, and other technologies to increase sales and reduce labor costs

Generation of human resources

Deploy newly available human resources into marketing and new businesses, etc.

Avoiding lost sales, business expansion, and cost reduction can all lead to improved profitability



Source: Compiled by Industry Research Department, Mizuho Bank, Ltd.

Labor shortage solution (AI): Identify AI deployment domains by industry type and develop/expand industry-specific AI

- Since the areas with high labor cost burden rates differ by industry type, AI deployment domains are also expected to differ in preparing for the impact of labor shortages.
- First, it is necessary to identify areas requiring human labor and develop/deploy AI applications in those areas as a countermeasure against labor shortages.
  - To develop AI applications tailored to specific domains, it is necessary to secure closed data based on the problems to be solved

Images of AI Deployment Domains and Specialized AI Applications by Industry Type

Labor Intensive × Knowledge Intensive

Information & Communications / Advertising

Images of Initial AI Deployment Domains and Specialized AI Applications	
Planning & Development / Production / Sales	➢ Content based on advanced expertise is the source of added value, with high labor cost burden rates in the planning stage ⇒ **Streamlining planning and development operations using user data (reducing workload)**

Labor Intensive

Service / Retail

Images of Initial AI Deployment Domains and Specialized AI Applications	
Procurement / Distribution	➢ On-site service provision and product sales are the source of added value, with high downstream labor cost burden rates ⇒ **Streamlining administrative work using workflow data from non-face-to-face operations (reducing workload)**
Service Sales	⇒ **Business model transformation based on digital premises**

Capital Intensive × Knowledge Intensive

Manufacturing / Chemical

R&D / Manufacturing / Sales	➢ Advanced products created through R&D are the source of added value, with high labor cost burden rates in R&D and manufacturing processes ⇒ **Advancing R&D through higher-value material exploration** ⇒ **Automating manufacturing operations using manufacturing process workflow data (reducing workload)**

Capital Intensive × Labor Intensive

Transportation

Procurement / Service / Maintenance	➢ Asset-based service provision is the source of added value, with high labor cost burden rates in services and maintenance ⇒ **Automating operations using workflow data (labor-saving in services)** ⇒ **Optimizing maintenance using data generated from assets (reducing workload)**

Capital Intensive

Electric Power / Real Estate

Procurement / Manufacturing / O&M	➢ Infrastructure requiring substantial capital investment is the source of added value, with high labor cost burden rates in infrastructure O&M ⇒ **Optimizing maintenance using data generated from infrastructure (reducing workload)** ⇒ **Converting tacit knowledge into organizational knowledge (advancing technical succession)**

Source: Compiled by Industry Research Department, Mizuho Bank, Ltd.

Labor shortage solution (AI): Federated learning as a measure to address challenges in data scaling

- When scaling up closed data, it is desirable to centralize industry domain knowledge through data integration across companies, but actual data integration is difficult due to regulations, compliance, and competitive dynamics between companies.
- For AI to contribute to resolving labor shortages, it is necessary to overcome the challenges of scaling up closed data, and federated learning is effective for this.
  - This technology enables the construction of AI models while data remains distributed across organizations/companies, potentially serving as a countermeasure when data collaboration is difficult.

Countermeasures and Challenges for Scaling Up Closed Data

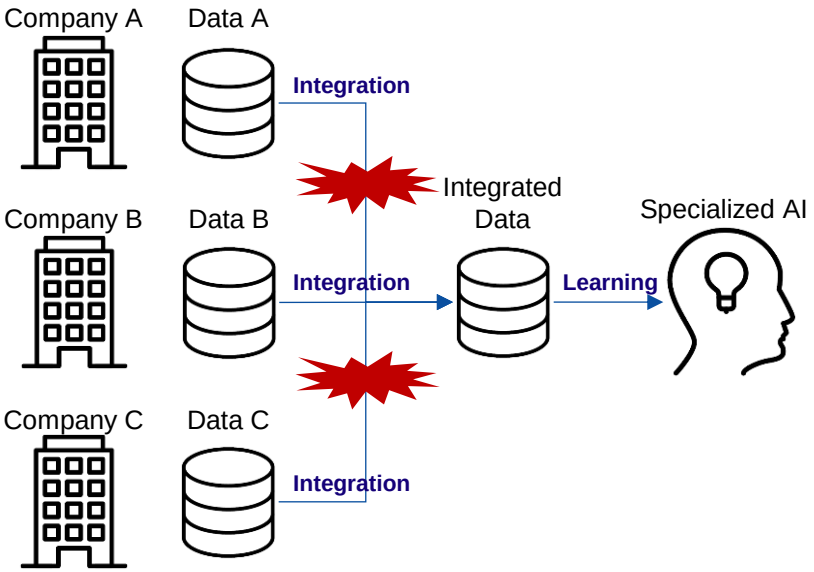
Ideal

- Integrate data across companies and scale up closed data to train industry-specialized AI

Gap

Reality

- Data integration is difficult due to regulations, compliance, competition with competitors, etc.



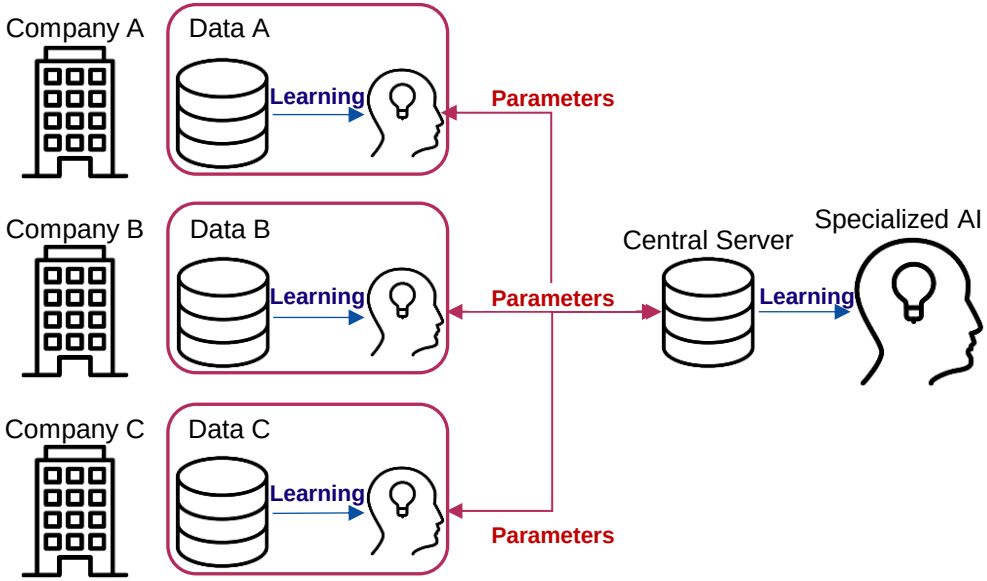
Source: Industry Research Department, Mizuho Bank, Ltd.

Building Industry-Specialized AI Models Using Federated Learning Technology

Technical Features of Federated Learning

- Train local AI within each company's server and collect only learning results (parameters) in the central server to train industry-specialized AI.

⇒ **It is possible to improve model accuracy while keeping data distributed**



Source: Compiled by Industry Research Department, Mizuho Bank, Ltd.

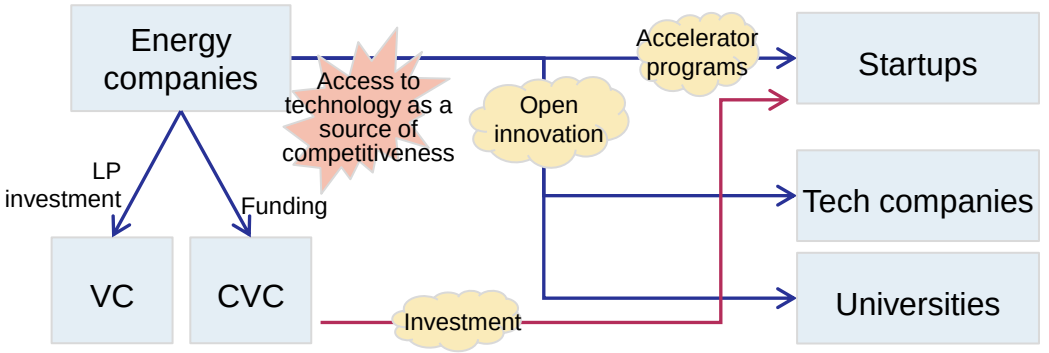
Labor shortage solution (AI): In the power industry, it is vital to reach tech firms and drive efficiency with generative AI

- With labor shortages making labor-saving essential, the use of technology to improve operational efficiency is increasingly necessary
  - In the power industry, operational streamlining using generative AI is expected
- As technology continues to advance, the ability to reach tech companies and startups may become the key to competitiveness; building relations via open innovation and investment will become more important than ever

Expected effects of generative AI use in the power industry

Accelerating talent development	✓ Creating manuals for workforce training ✓ Producing trouble-case scenarios to support accident response
Streamlining power plant development	✓ Assistance with site selection for development ✓ Supporting plant design ✓ Supporting preparation of required documentation for development, etc.
Advanced demand-supply control	✓ Assistance in creating optimal demand-supply scenarios

Policies to accelerate access to tech firms and startups



The impacts, risks, and opportunities of generative AI for the power industry

	Industry impact from generative AI	Risks	Opportunities
(1)	■ Efficient talent development supports stable power plant operation	■ Relying excessively on generative AI for troubleshooting may weaken ability to handle issues unforeseen by AI	■ Maintaining personnel quality by summarizing past experience into manuals ■ Contributes to safe and accurate restart of long-idle (reserve) power sources
(2)	■ Accelerated decarbonization through efficient site selection and document generation for non-fossil power development shortens development periods	■ If these initiatives accelerate rapidly and the grid or balancing power sources cannot be developed in time, there is a risk that output control for renewable energy may need to be expanded	■ Being able to supply decarbonized power at appropriate prices in response to demand for decarbonized electricity will strengthen the revenue base ■ Speedy decarbonization enhances IR effects

Areas where energy firms must gain access

1 Areas contributing to operational efficiency in existing processes	■ Link with firms owning AI/DX-promoting technology — Replacing skilled work previously done by veterans with AI, etc. for greater efficiency ■ Link with firms owning robotics/drone technology — Reduce required staff by automating maintenance/inspection work
2 Fields possibly replacing existing business	■ Link with firms holding clean energy technologies that replace fossil fuel business — Use as a way to pursue future core businesses

Source: All charts: Industry Research Department, Mizuho Bank, Ltd.

Labor shortage solution (robots): Leverage Japan's robotics strengths to deploy to non-manufacturing businesses

- Develop business for unstructured work in non-manufacturing sectors, where robotization needs are high due to ongoing labor shortages. Focusing on areas where Japan's robotics industry excels will offer potential competitive advantage over foreign robot makers
  - Fields that warrant particular attention include the welfare sector, which faces severe labor shortages and requires especially high safety standards in human interaction, and the construction industry, where precise and durable robots are needed to ensure the safety of work and buildings

Robot-ready tasks and advantages in utilization by user industry

	User industry	Example of unstructured task for robotics	Key robot performance criteria	Leveraging of robot industry strengths
Targets	Medical/welfare	✓ Human contact (nursing, etc.) ✓ Indoor transport (medicines, medical/care devices, etc.)	High speed / High precision / High durability High safety / High reliability	◎～○
	Construction	✓ Construction work (material anchoring, welding, painting, etc.) ✓ Outdoor transport (materials, tools, etc.)	High speed / High precision / High durability High safety / High reliability	◎～○
	Transport/post	✓ Bulk picking ✓ Indoor/outdoor transport (loading, final delivery, etc.)	High speed / High precision / High durability High safety / High reliability	○～△
	Agriculture/fishing/forestry	✓ Harvesting, logging ✓ Outdoor transport (agriculture/forestry/fishery products, etc.) ✓ Patrolling	High speed / High precision / High durability High safety / High reliability	○～△
	Wholesale/retail	✓ Indoor transport (cardboard, etc.) ✓ Shelf management	High speed / High precision / High durability High safety / High reliability	△～×
	Food service	✓ Serving, clearing ✓ Cooking ✓ Cleaning	High speed / High precision / High durability High safety / High reliability	△～×
	Accommodation	✓ Indoor transport (meals, linen, etc.) ✓ Cleaning	High speed / High precision / High durability High safety / High reliability	△～×

Source: Compiled by Industry Research Department, Mizuho Bank, Ltd.

Labor shortage solution (Robots): Build partnerships on both demand and supply sides to establish robotics in non-manufacturing

- Robot developers should gather user needs to aim for industry standards, and aggregate component tech to establish a base for non-manufacturing robots
  - On the demand side, include multiple industry users; on the supply side, enable co-development of necessary tech, creating partnership structures on both ends

Measures to expand robots for unstructured non-manufacturing tasks

Challenges in unstructured non-manufacturing tasks

- **Accurate understanding of user performance expectations**
- **Address factors limiting performance**
- **Balance with cost**

Required steps

Demand: Capturing needs and standardization

Partnering structure

- Non-manufacturing users
- Non-manufacturing users
- Industry groups, etc.

✓ Aggregate needs
✓ Share development costs
✓ Develop / standardize robots meeting typical demands

Robot developers

Supply: Joint development of technologies that meet needs

Partnering structure

✓ Approach multiple technologies via M&A, alliances, etc.
✓ Create use cases by applying tech to robots

- Motors, reducers, controllers
- Autonomous AI development
- Hand, sensor, communication technologies, etc.

Establish industrial base for robots addressing unstructured non-manufacturing tasks

- ✓ **Search for tech resources matching diverse user needs and involve multiple users from the industry to create initial demand**
- ✓ **From the start, adopt design/development premised on industry standardization, creating de facto standards and promoting within-industry robot rollout. Lower robot costs via mass production and expanding demand at an early stage**

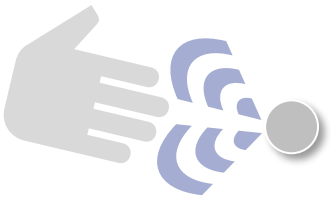
Source: Compiled by Industry Research Department, Mizuho Bank, Ltd.

Labor shortage solution (robots): Leveraging component tech as business opportunities (expectations regarding haptics)

■ Haptics, which artificially replicates touch, is currently used mainly in entertainment but is expected to contribute to relieving labor shortages as its implementation expands in industrial use

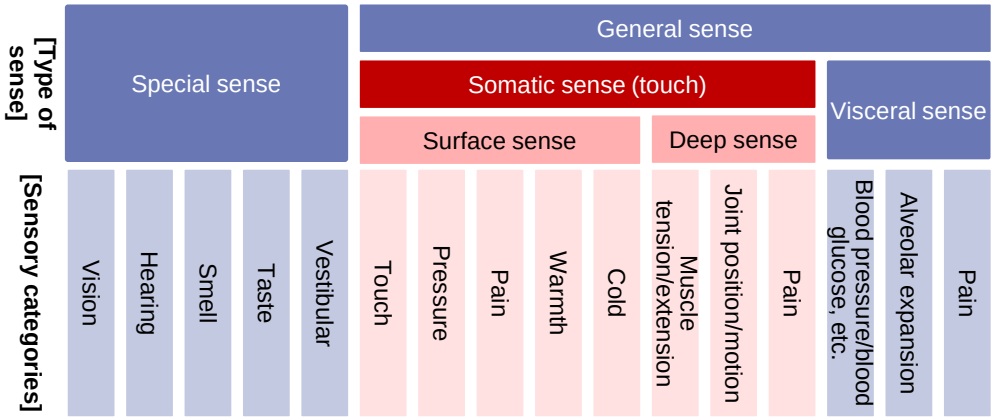
What is haptics? – A technology for replicating touch

- Technology that provides a sensation as if actually touching an object, using force, vibration, or motion
- Feedback of sensation has potential benefits like improved safety, operational accuracy, a sense of presence, and immersion



Contact-based	Devices	Generate reaction force using sensors, actuators, etc.(note)
Non-contact	Ultrasound	Focus multiple ultrasound beams to generate radiation pressure at a point in air

<Classification of human senses>



Note: A force that arises and balances (stabilizes) in response to external force
Source: Ministry of Internal Affairs and Communications materials, public information, compiled by Industry Research Department, Mizuho Bank, Ltd.

Utilization strategies to address labor shortages

- Three main benefits: (1) Resolving regional disparities, (2) automating dangerous/heavy tasks, (3) promoting skills transfer
- Note: For (1) and (2), operation is currently assumed to be 1-on-1 (not 1-to-n), so work per operator is one unit

1 Resolving regional disparities	■ Remote operation of surgical-assist robots enables high-precision treatment even where there is no local specialist ■ In rural areas with severe labor shortages, skilled experts can manage and execute multiple operations remotely
2 Automating dangerous/ heavy work	■ Operate robot arms/special tools in hazardous environments remotely. Feedback of tactile sensation enables safe, precise work ■ Enables the elderly and women to participate in heavy or strength tasks with fewer physical limitations
3 Promoting skills transfer	■ Turning skilled-worker actions (force adjustment, body use, etc.) into data enables new employees to learn through simulators, etc. ■ Conversely, skilled workers can experience new workers' sensations, clarifying which steps differ

Source: Compiled by Industry Research Department, Mizuho Bank, Ltd.

Labor shortage solution (autonomous driving): Business areas will expand as autonomous driving services spread

- As autonomous driving services expand, new business areas are expected to emerge, with existing companies extending their value chains and possible entry from other industries

Expected ecosystem during the spread of autonomous driving services (2030s: early to mass adoption phase)

	Key elements	Outline	Barriers to entry	Sales size	Profitability	Assumed players
Upstream (Development / Manufacturing)	Vehicle development/manufacturing	✓ Develop highly safe, reliable vehicles ✓ Establish mass production technology to enable cost-effective deployment of services	High	Large	Low	OEM
	Autonomous driving systems	✓ Develop software and algorithms to integrate multiple sensor inputs and handle recognition, decision-making, route planning, and control	High	Medium	High	OEMs, autonomous driving system firms/IT
Downstream (Operations/services)	Dispatch systems	✓ Enhance transport efficiency by forecasting passenger and vehicle demand ✓ Provide a UX/UI similar to current ride-hailing apps	High	Large	Medium	Dispatch platforms, transport providers, OEMs
	Remote monitoring systems	✓ Build real-time monitoring for early detection of emergencies/abnormalities	High	Medium	Medium	OEMs, remote monitoring system firms/IT
	Remote monitoring, on-call response, maintenance, and related services	✓ Remote control for situations not suitable for autonomous operation (centralized management of multiple vehicles) ✓ Log sharing for abnormal events (engineers, insurers, etc.)	Medium	Medium	Low	Transport providers, service providers
	Mobility experience services	✓ Provide optimal experience/service for each travel area, use scenario, and destination	Low	Small → Medium	Medium	Transport providers, service providers, OEM

Source: Compiled by Industry Research Department, Mizuho Bank, Ltd.

Labor shortage industry (nursing care): Capturing expanding demand through technology adoption and service model transformation

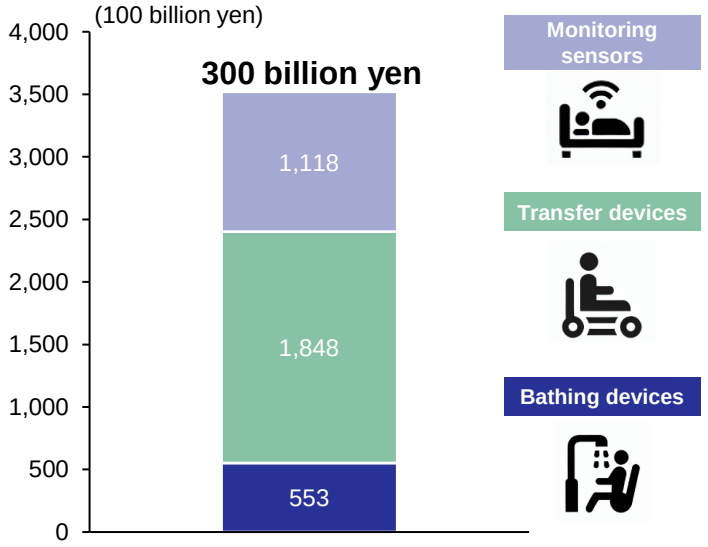
- In the nursing care industry, where severe labor shortages are expected, it is essential to boost productivity by not only utilizing technology for high-burden tasks such as bathing, transfer assistance, and anomaly detection (like falls or fever), but also by shifting to more efficient service models, such as day care services
- By 2040, the market for nursing care robots is projected to expand to 300 billion yen, while the market for day care services could reach 3.1 trillion yen

Business opportunities from resolving labor shortages in the nursing care sector

1 Productivity improvements through use of technology (nursing care robots)

Leveraging technologies like monitoring sensors, transfer devices, and bathing equipment can improve productivity and profitability alongside alleviating labor shortage

<Market size needed for nursing care robots in 2040(note 1)>



In 2040, the required market for care robots will be 300 billion yen

2 Enhancing productivity and capturing new business opportunities by proactive utilization of day care services

Expanding the number of users for relatively high-productivity day care services (where users come to care facilities) raises productivity of overall care services

Raising productivity through use of day care services

No need to visit user homes, shorter service hours make day care more productive than other forms of care

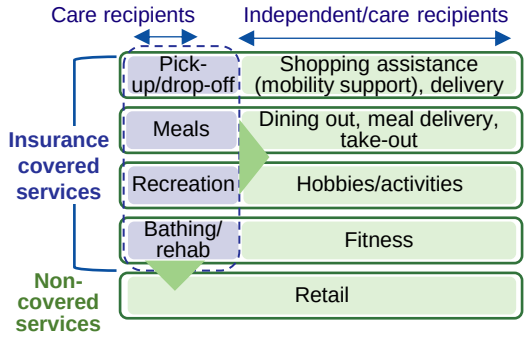
<Comparison by care service model>

	Home visit to user	Service time per visit
Home-visit	Required	Short time (approx. 10 min–1 hour)
Day care	**Not required**	**Medium time** (approx. 3–9 hours)
Facility/ institutional care	Not required	Long time (all day)

Possibility to expand services offered through use of day care

For care providers, using day care creates opportunities to offer non-care services

<Future image of day care>



In the future, not only covered insurance services but also non-covered services can be provided

In 2040, the day care services market will reach 3.1 trillion yen(note 2)

Note 1: Nursing care robots: devices leveraging robotics technology to support user independence or reduce caregiver burden. This analysis focuses on bathing devices, transfer devices, and monitoring sensors
Note 2: Market estimate uses 2023 per-user service costs
Source: All charts: Industry Research Department, Mizuho Bank, Ltd.

Labor shortage industry (hospitality): Avoiding sales loss and expanding revenue by leveraging freed-up labor

■ Measures being implemented in the hospitality industry to resolve labor shortages not only help avoid lost sales, but by strengthening marketing and capturing both limited domestic demand and growing inbound demand, also have the potential to drive further sales growth

Business opportunities from resolving labor shortages in the hospitality sector

Initiatives and business chances to resolve labor shortages

Ongoing efforts to address labor shortages help avoid sales loss and create business opportunities

<Types of immediate action to resolve labor shortages>

Increase labor supply	Grow workforce	Strengthen recruitment	• Raise wages • Revise HR systems (transfers, career paths, leave, etc.) • Improve benefits • Enhance training programs
		Improve staff retention	
Reduce labor demand	Adopt	Labor-saving technology	• Implement PMS(note) • Install self check-in/out machines • Implement revenue management systems • Deploy FAQ chatbots
		Use of robots	• Use of cleaning robots • Use of serving robots

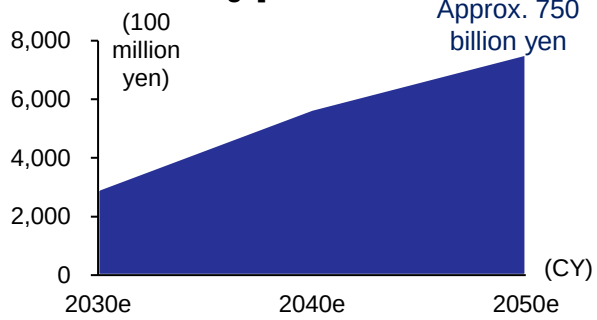
<Effects and expected business opportunities of initiatives>

Effect of initiatives	1	Cost reduction through efficiency
		Avoiding sales loss by increasing guest capacity
Expected business opportunity	2	Sales growth from effective use of labor freed by resolving staff shortages

1 Avoiding lost sales by increasing guest capacity

Currently, hotels lose sales due to restricted operations from staff shortages.
Efforts to address labor shortages support the capture of inbound and other demand

[Estimated value of hotel lost opportunities from labor shortage]



[Estimation basis]

- Number of hotel rooms: projected from historical data
- Lost operation rate (%): assumed to rise as labor shortages intensify, leading to rooms being made unavailable
- Proportion of lost operation due to labor shortage (%): estimated using surveys
- ADR (yen): Actual figures for 2024
- Does not account for labor demand reduction from increased automation investment

By avoiding lost sales, the market size expected by 2050 is 700 billion yen

2 Expanding sales by utilizing labor freed by resolving labor shortages

Freed labor from addressing staff shortages can be used for improved marketing or even productizing marketing knowhow, potentially driving further revenue growth

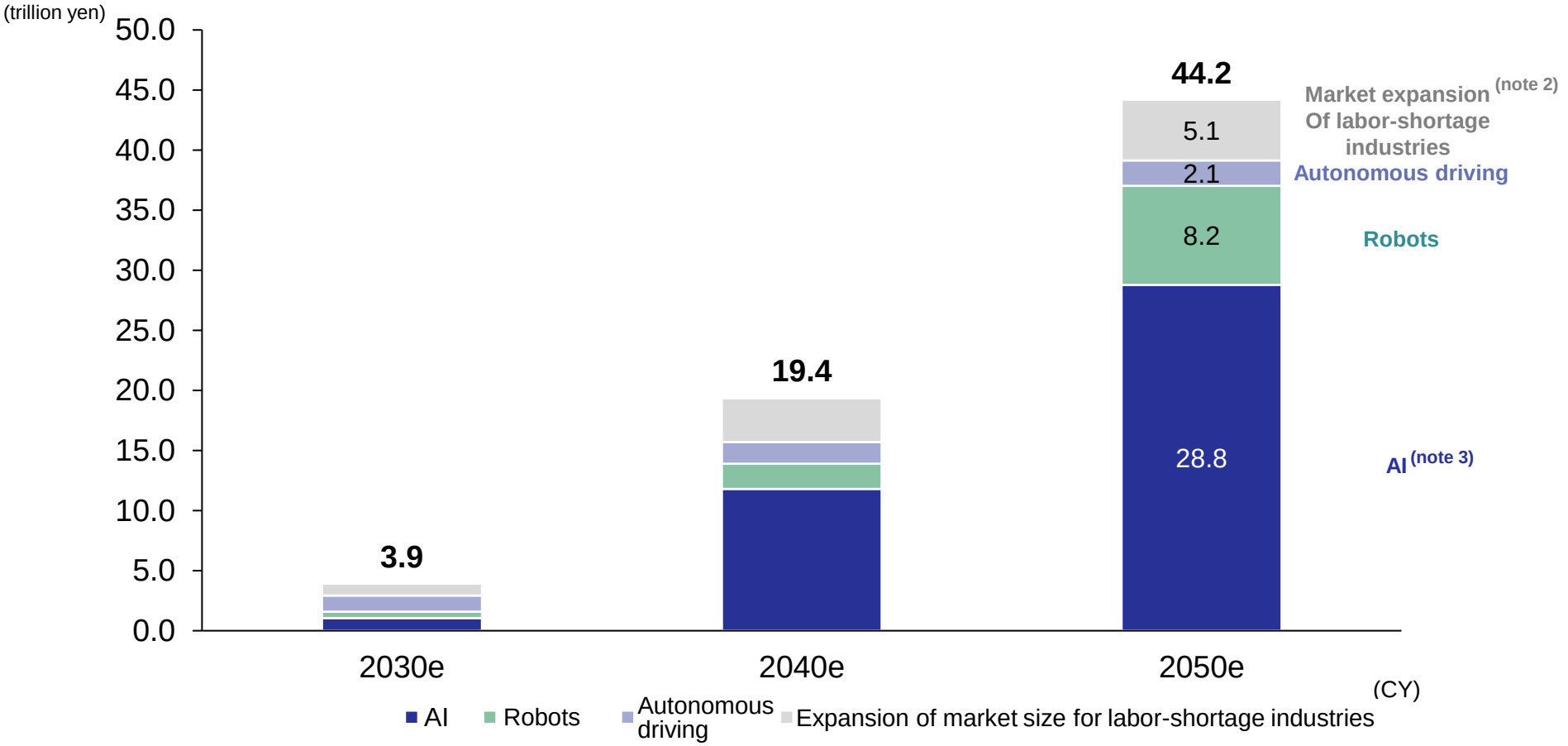
Strengthening in-house marketing via DX	Labor freed by labor-saving can be devoted to marketing, enhancing competitiveness to capture more demand
Creating products from marketing knowhow	By reallocating labor made available through labor-saving initiatives to strengthen marketing, companies can not only enhance their own marketing but also turn their know-how into products and offer marketing solutions to other companies or entire regions

Note: PMS = Property Management System. A system used by hotels/inns for reservation and room management
Source: All charts: Industry Research Department, Mizuho Bank, Ltd.

Market size created by resolving labor shortages will reach 44 trillion yen

- The total market created by resolving labor shortages for both solution-providing and affected industries is expected to be around 44 trillion yen
- In addition to the growth of the labor shortage solutions market, further demand capture is expected for industries experiencing labor shortages as they resolve staffing issues

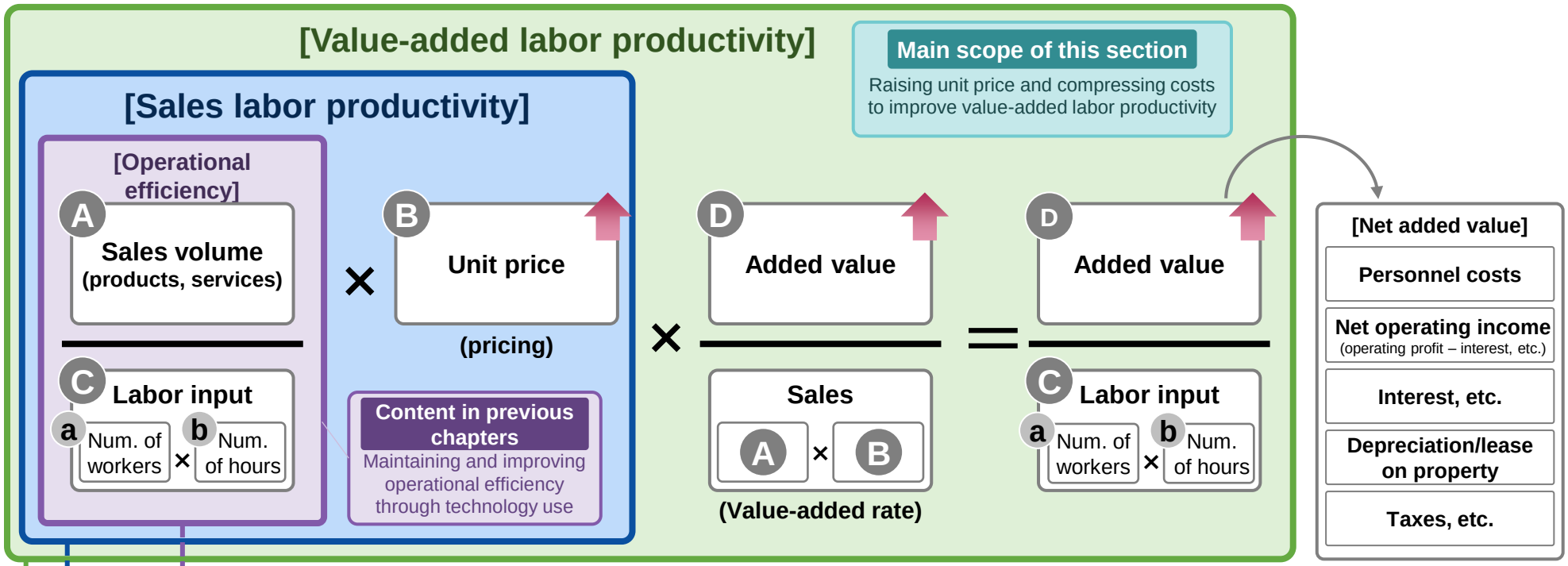
Estimated market size created by solving labor shortages(note 1)



Note 1: Market size estimate assumes current labor cost levels and progress in robot/AI substitution
Note 2: For logistics, nursing care, accommodation, and aviation, reflects market expansion from avoiding lost sales
Note 3: AI embedded in robots or autonomous driving is not included in market estimation
Source: Compiled by Industry Research Department, Mizuho Bank, Ltd.

5. Continued Growth in a Talent-scarce Society

Labor productivity: Improving value-added labor productivity is essential for growth in a talent-scarce society



	[Measures]	[Examples]
Operational efficiency	Throughput improvements	☐ Streamlining operations/processes to eliminate waste and optimize steps ☐ Introducing machinery/software to reduce required staffing, boost speed/accuracy, and standardize quality ☐ Cost savings also expanding added value (profit)
Sales labor productivity	& Raising unit price	☐ Pursuing more advanced, higher-quality products/services to improve competitiveness ☐ Establishing unique appeal, raise brand value in the eyes of customers
Value-added labor productivity	& Compressing costs	☐ Efforts like economies of scale, competitive bidding, group purchasing to suppress procurement costs ☐ Balancing in-house strengthening of core areas with outsourcing of generic tasks (collaboration)

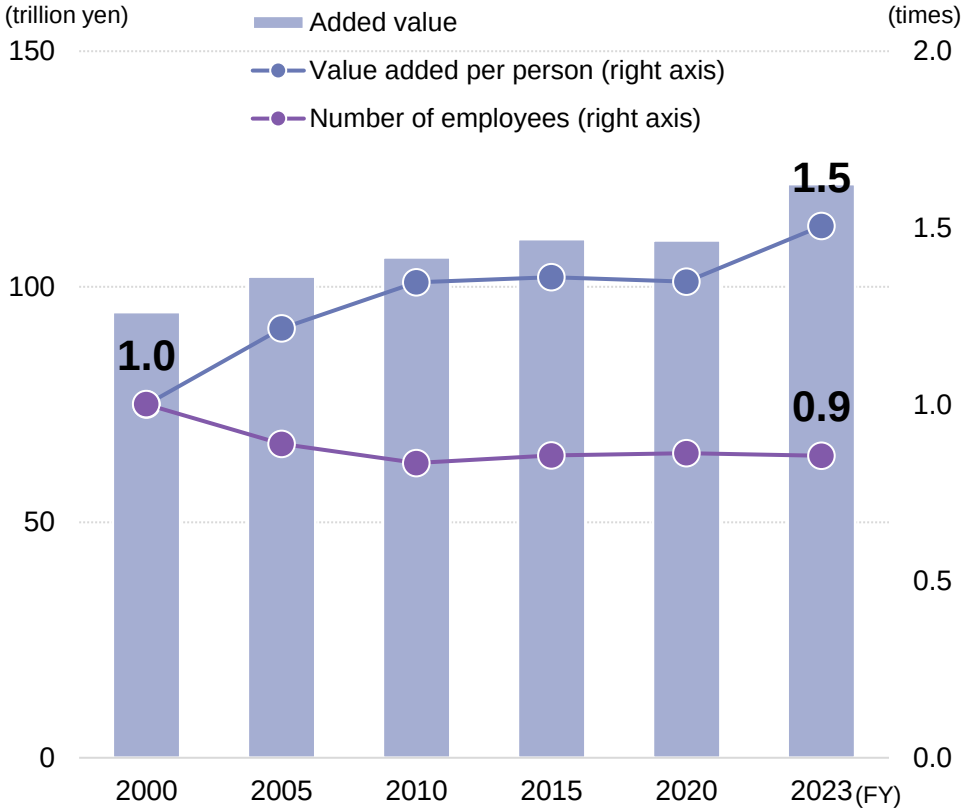
Source: Public materials, compiled by Industry Research Department, Mizuho Bank, Ltd.

Labor productivity: Manufacturing increased value-added productivity, while non-manufacturing remained flat

■ Manufacturing increased added value even as employment fell; non-manufacturing, except during COVID, kept hiring, so value-added per worker diverged significantly

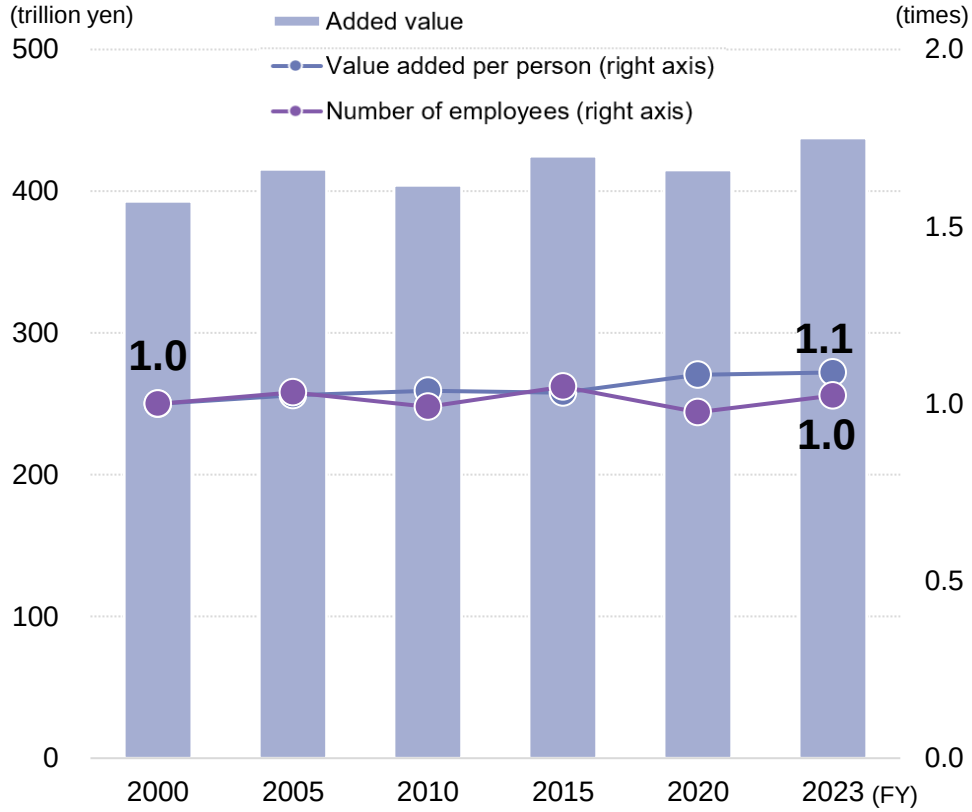
Trends in manufacturing industry value-added, per-capita value-added, and number of employees(note)

• With fewer workers, added value rose, so value-added per person increased 1.5x from FY2020



Trends in non-manufacturing industry value-added, per-capita value-added, and number of employees(note)

• Non-manufacturing kept number of workers flat and value-added only showed minor gains, so per-person value-added barely improved

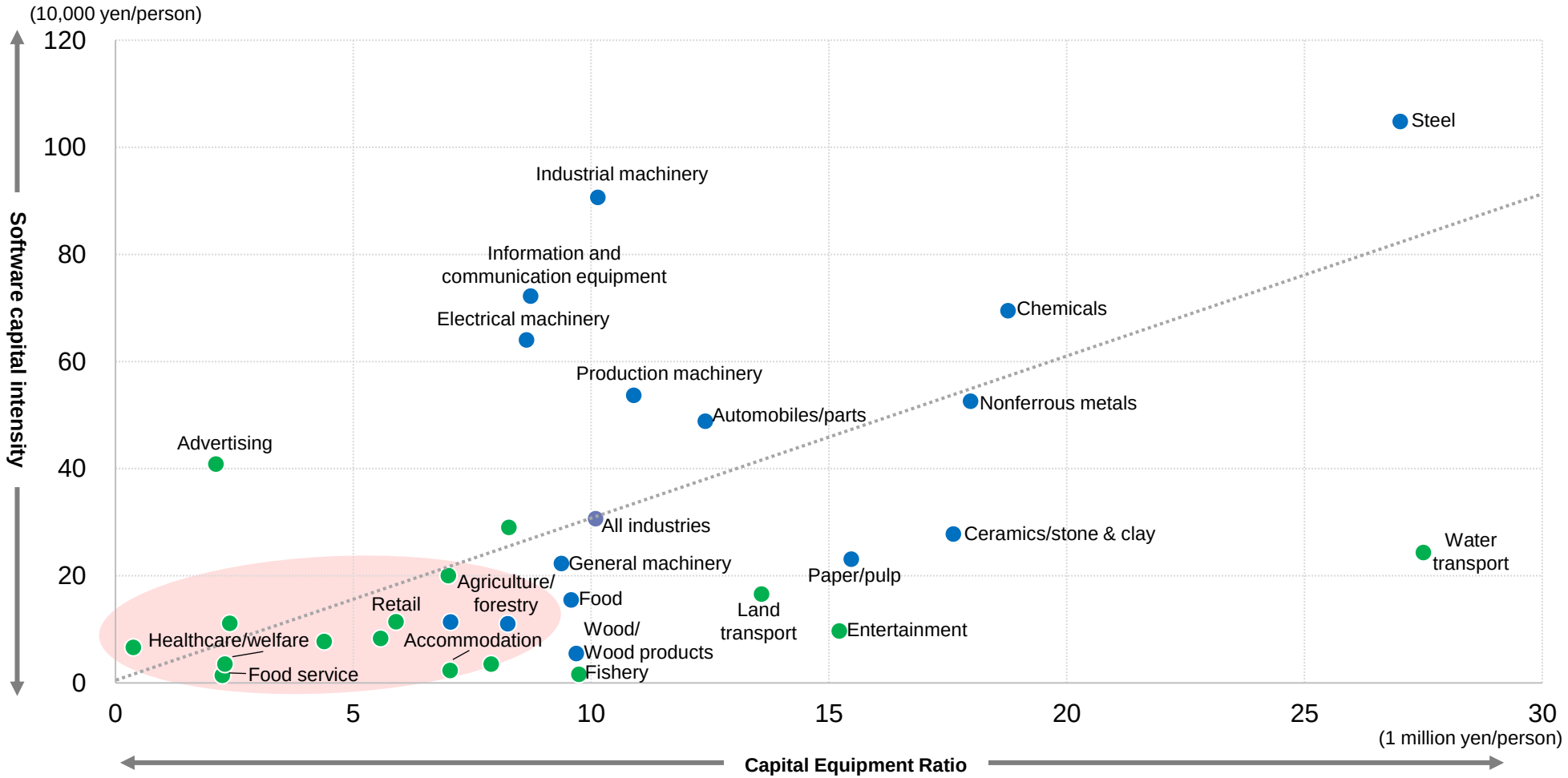


Note: Value-added per person and worker numbers indexed to FY2000 = 1.0. All value-added measures are real (inflation-adjusted)
Source: Both charts: Cabinet Office materials, compiled by Industry Research Department, Mizuho Bank, Ltd.

Labor productivity: Non-manufacturing lags in automation/digital utilization versus manufacturing

- When examining software capital equipment and capital equipment by industry, many non-manufacturing sectors such as healthcare, welfare, food service, retail, and hospitality fall below the all-industry average, indicating that analog business processes still persist in these fields

Software and capital equipment by industry (FY2023, blue = manufacturing, green = non-manufacturing)(note)

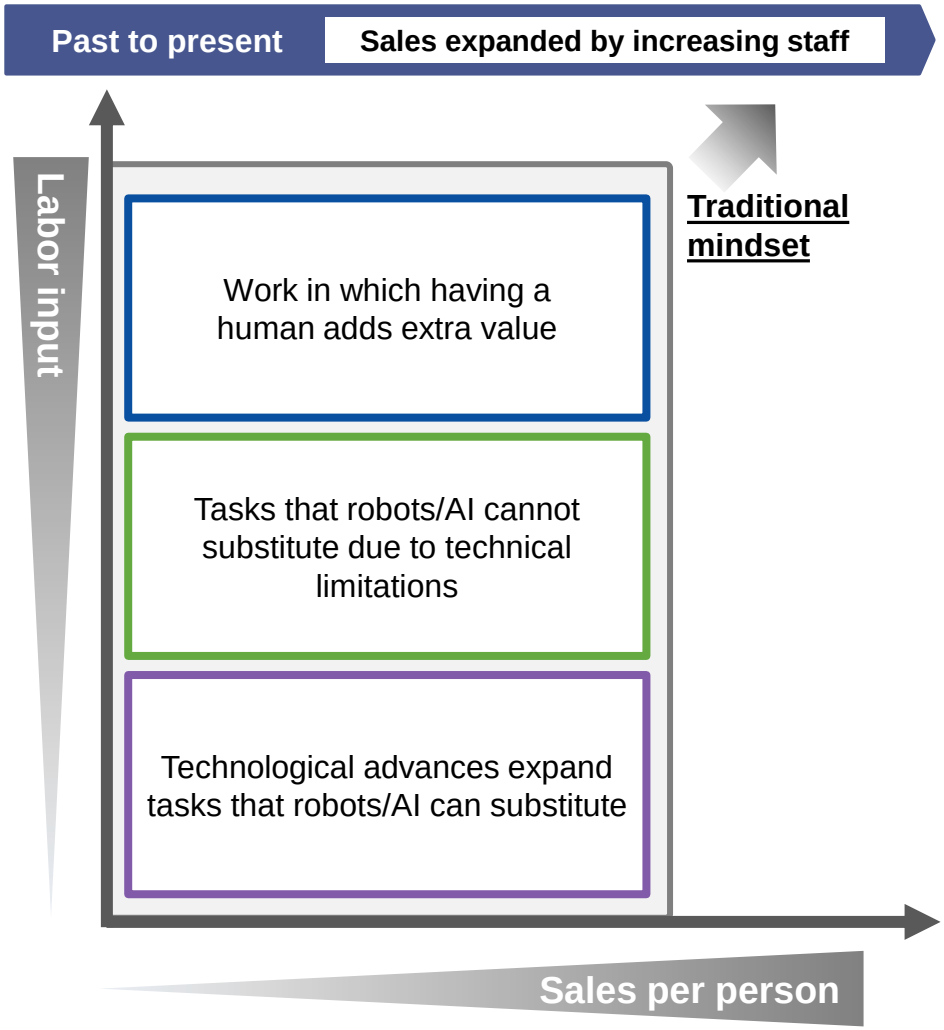


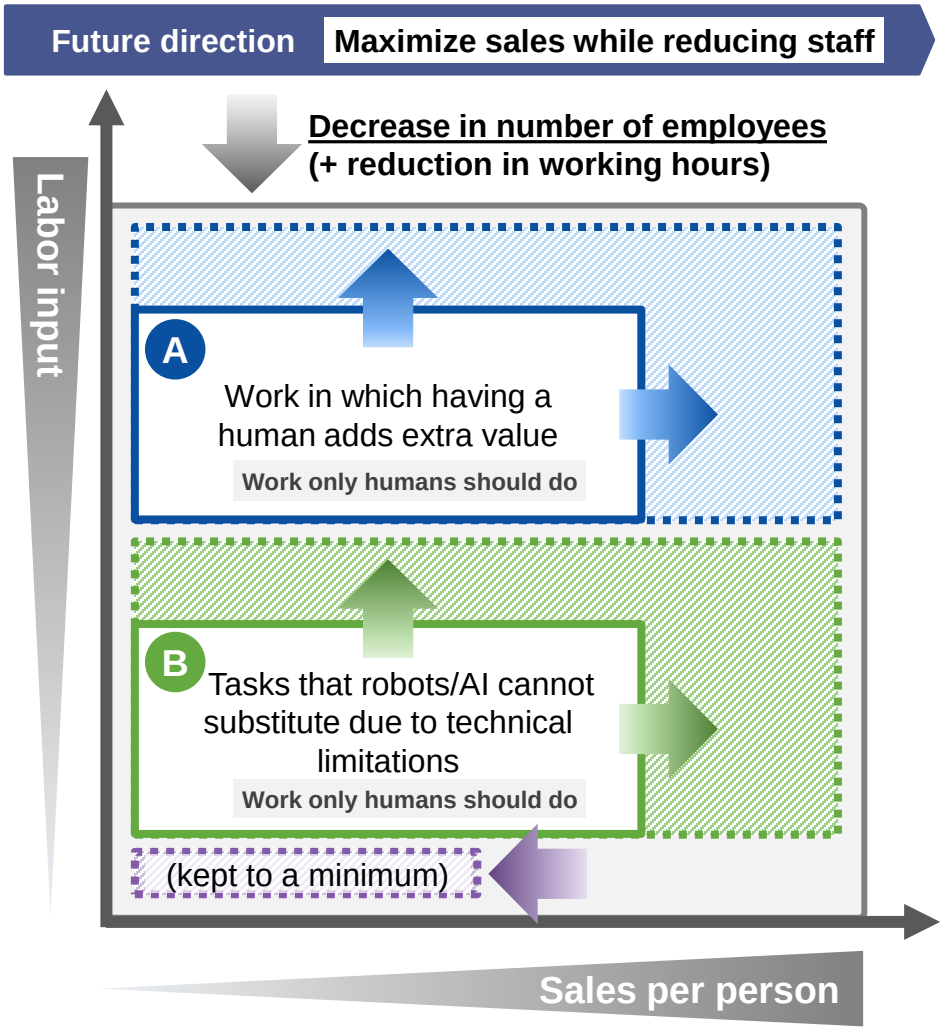
Note: Software capital equipment: software ÷ number of employees, capital equipment: (tangible fixed assets – construction-in-progress) ÷ number of employees
Source: Ministry of Finance's corporate statistics, compiled by Industry Research Department, Mizuho Bank, Ltd.

Labor productivity: Aim to raise unit price by focusing labor on work only humans can do

- As labor shortages increase, it is essential to allocate human resources to work only humans should do, while having robots and AI handle tasks they can substitute. In addition, it is important to raise sales per person, primarily by increasing unit prices, to maximize overall sales

Concept of labor input and sales





Source: Compiled by Industry Research Department, Mizuho Bank, Ltd.

(A) Work that gains added value with human involvement: Only humans provide emotional value at present

- Robots/AI can often substitute for functional value that can be quantified or objectified; however, emotional value is strongly tied to individuals and remains unique to humans

Classification of functional vs. emotional value

Functional value

Tangible value that consumers receive from products/services

- Possible to objectively show the quality, performance, and utility of products or services using quantitative measures
- Performance, quality, convenience, efficiency, safety, etc.

[Domains where robots & AI excel]

- Objectivity: Analyzing massive data sets statistically and using algorithms to produce conclusions
- Uniformity: Fast, accurate handling of rule or pattern-based tasks/processes

[Domains where robots & AI struggle]

- Creativity: Designing concepts, developing new products, branding
- Comprehensive judgment: Factors such as environmental considerations or building relationships with the local community, which cannot be measured by economic rationality alone

Emotional value

Invisible value appealing to consumers' sensibilities

- Subjective value felt through the five senses
- Emotional satisfaction or a sense of superiority gained in the process of consumption, empathy for the provider of the product or service, etc.

[Domains where robots & AI excel]

- Few domains at this time

[Domains where robots & AI struggle]

- Empathy/understanding: Partial understanding is possible, but genuine empathy or deep understanding is not
- Premium feeling: Uniform/standardized product or service provision

Corporate strategies are diverging

(1) One path is to maximize value-added by providing emotional value that only humans can deliver
- **By providing consumers with a sense of exclusivity or empathy, customer loyalty and brand image can be enhanced**

(2) Another method is to minimize human involvement and use robots/AI for functional value, aiming for low prices
- **Consumers' desired functional value can be quantified and products or services delivered within expected ranges**

Source: Compiled by Industry Research Department, Mizuho Bank, Ltd.

On the other hand, emotional value isn't universal

- Emotional value is seen as unique added value that robots/AI can't replicate. However, not all products/services require it
- If AI reaches the level where consumers are fooled into thinking it has heart, it could also encroach into this domain

When emotional value ceases to work

1 Consumer acceptance

- For infrastructure, daily necessities, and commoditized goods, where consumers prioritize stable supply, cost, and efficiency, practical factors are given greater importance
- For B2B or systems products, avoidance of trouble/reliability are key, so there is little room for emotional value
- Furthermore, factors such as consumer age, gender, region, and product or service price range also have an impact, so not everyone necessarily seeks emotional value

2 Regulation and rules

- For products and services where meeting regulations and safety standards takes top priority, such as financial products, insurance, medical devices, and public works, there are many restrictions in the development and delivery process
- Because companies have limited freedom, it is difficult (or even not permitted) to differentiate through design or user experience, leaving little room for emotional value to be added

3 Technological advancement

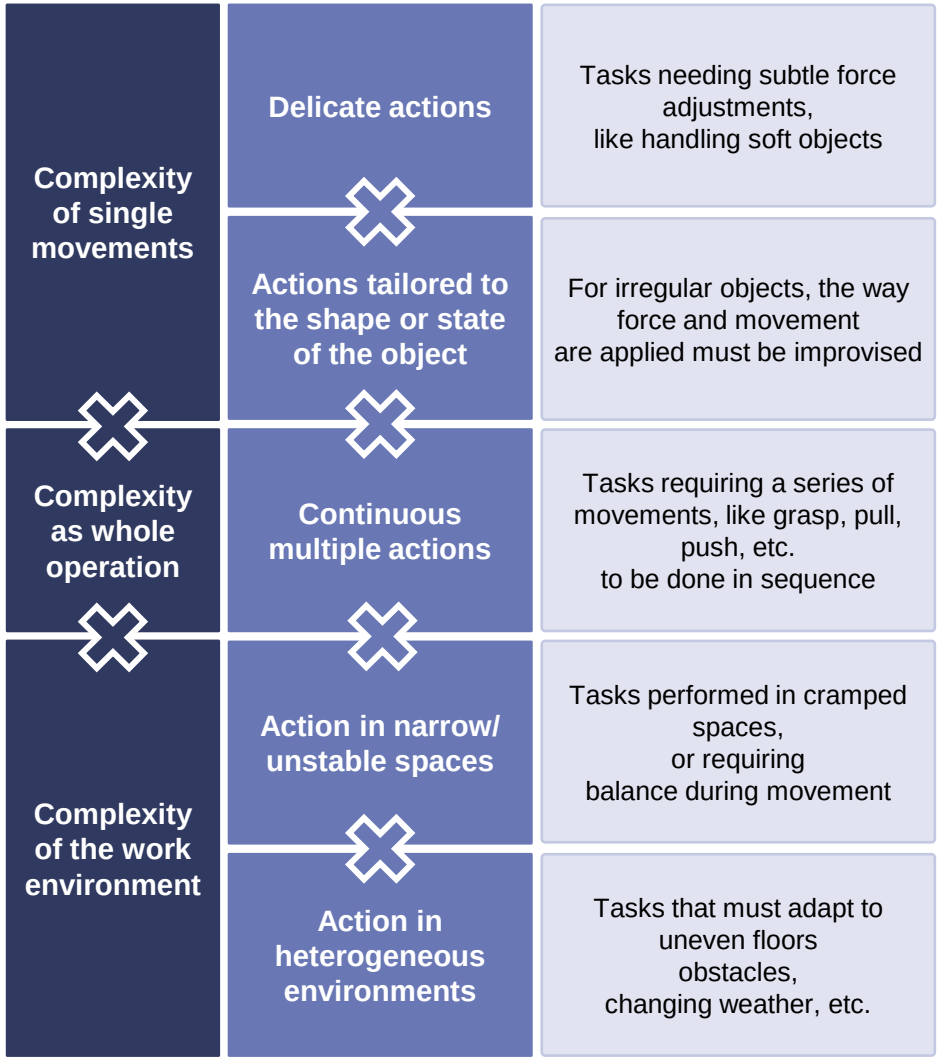
- Once AI reaches a level of complex behavior where consumers see it as having a heart, consumers may interact with it as if it does
- If robots/AI display complex behavior during service consumption, and the consumer ends up mistaking them as having will/intent, the uniqueness of humans may be threatened

Source: Compiled by Industry Research Department, Mizuho Bank, Ltd.

(B) Tasks robots/AI cannot readily substitute due to technical limitations (physical tasks)

- No robot can yet match humans for flexible responses so tasks only humans can perform will persist for now

Challenges and future directions for robots



1 Jobs increasingly substituted by robots due to technical advances

- With advances in AI, sensors, actuation, and flexible parts/materials, robots will increasingly be deployed into tasks they currently cannot perform
- On the other hand, in cases requiring advanced technology or expensive components and materials, or when considering the costs and time for commercialization and mass production, it will be difficult to provide such solutions at an economically viable price for the time being

2 Building or retrofitting environments for robot usage

- Based on the assumption of robot utilization, (1) upgrading existing facility environments or (2) constructing new facilities can help mitigate or resolve the challenges posed by overall task complexity and work environment complexity
- For both (1) and (2), the required capital investment, and in the case of (2), the potential for temporary operational shutdown, will be subject to the discretion of building, factory, or office owners

3 Tasks only humans can do will persist

- Robot utilization is expected to broaden, but domains needing human action will remain
- Humanoid robots capable of all human tasks may appear in the future, but considering technical challenges, cost, regulation, and social acceptance, they are not expected to be in regular use by 2050

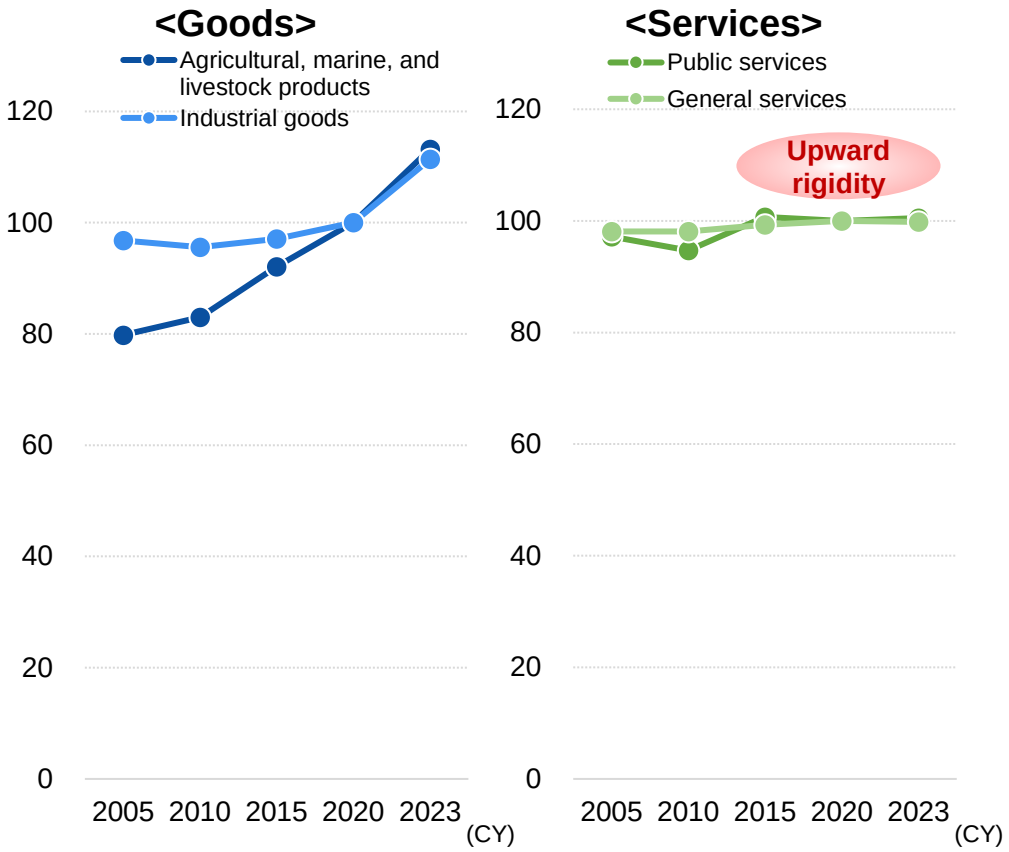
Source: Compiled by Industry Research Department, Mizuho Bank, Ltd.

Especially in non-manufacturing, human-involved tasks may fetch premium prices

■ Currently, although goods prices are rising, service prices remain flat. As talent becomes scarcer, this rigidity will loosen, and services requiring human labor will acquire a premium, leading to a world where their prices rise

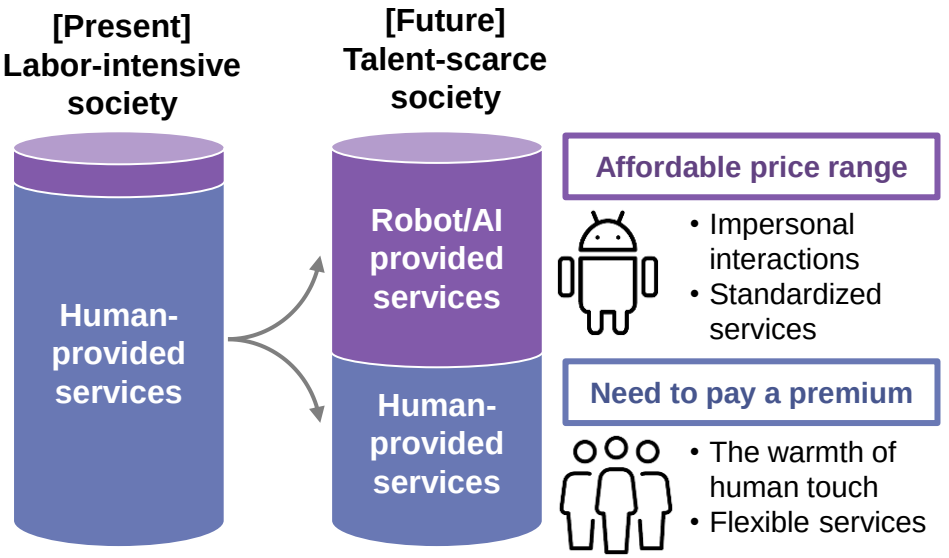
Trends in consumer price indexes (2020=100)

- While the prices of goods are rising, service prices exhibit upward rigidity
- The Japanese tendency to use the term “service” to mean something complimentary or discounted suggests a deeply rooted cultural expectation that services should be inexpensive



Source: Statistics Bureau of Japan, compiled by Industry Research Department, Mizuho Bank, Ltd.

Service categories & price changes as talent scarcity progresses



Consumers choose their service provider based on both content and price

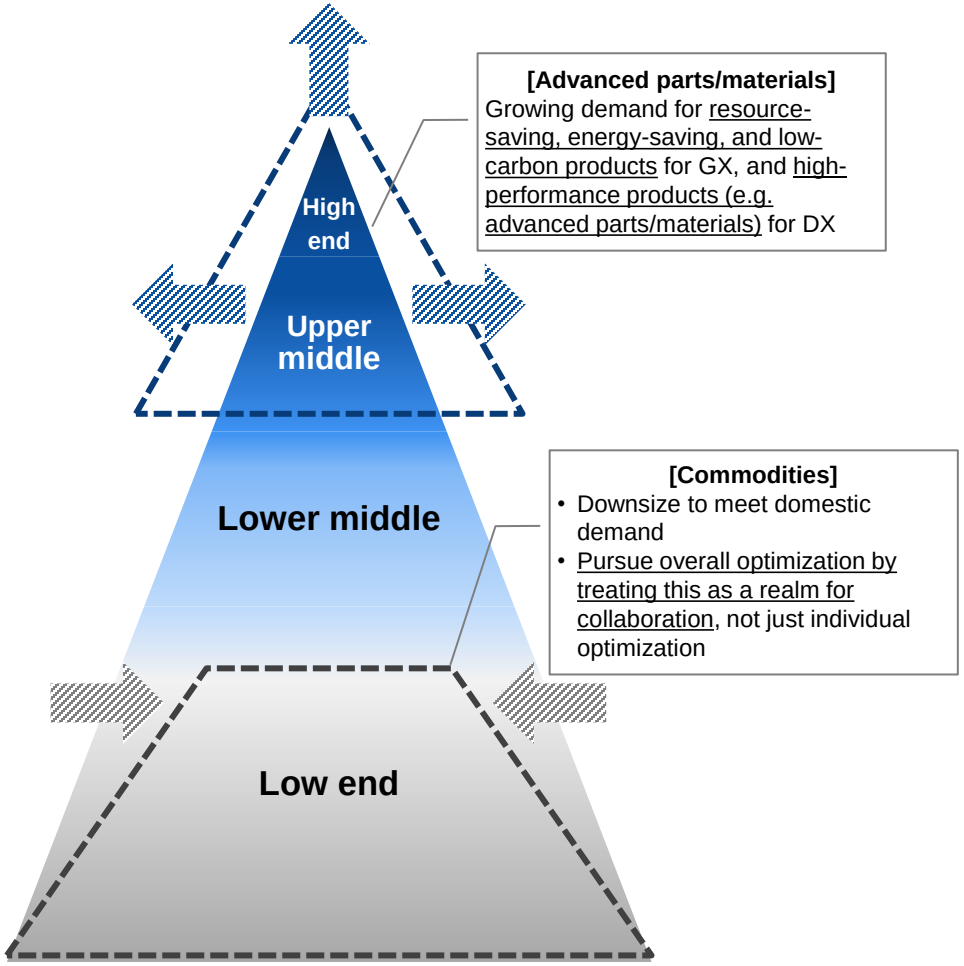
- Consumers weigh (1) robot/AI-provided services and (2) human-provided services, selecting between them according to price and content
- Generally, as the number of workers declines, (2) will increase in price (= higher value added per person in the service industry)
- Businesses need to examine not only how technically substitutable (2) is, but also what customers expect from their services and whether a human is truly necessary, aligning management and HR strategies, including pricing, accordingly

Source: Compiled by Industry Research Department, Mizuho Bank, Ltd.

Improving labor productivity in manufacturing: Raising unit prices and reducing costs by optimizing product mix

- In manufacturing (parts/materials sectors), work can be done with other companies to optimize the commodity segment as a whole (i.e., reduce costs). At the same time, the focus should be on high-value-added advanced parts and materials to capture demand

Improving product mix: Accelerate the shift from commodity to specialty



Source: Compiled by Industry Research Department, Mizuho Bank, Ltd.

Strengths of advanced parts/materials, and the conditions needed to maintain those strengths

<Strengths of advanced parts/materials>

In-house type	Independence	Proposition-based
Original raw material recipes: Proprietary equipment/design or process technologies are the secret sauce	Taste doesn't change, regardless of trends or product life cycles	Propose original recipes by combining raw materials and components
Difficult to imitate, which allows for high profitability	**Unaffected by end-product demand trends Low volatility**	**High switching costs, making it hard to move to other products**

<Conditions needed to maintain strengths>

1 Analog elements remain (must have)

Products that can be digitized and analyzed into 0s and 1s are easy to copy; vagueness/analog factors in raw material or process are key

2 Market size barrier (good to have)

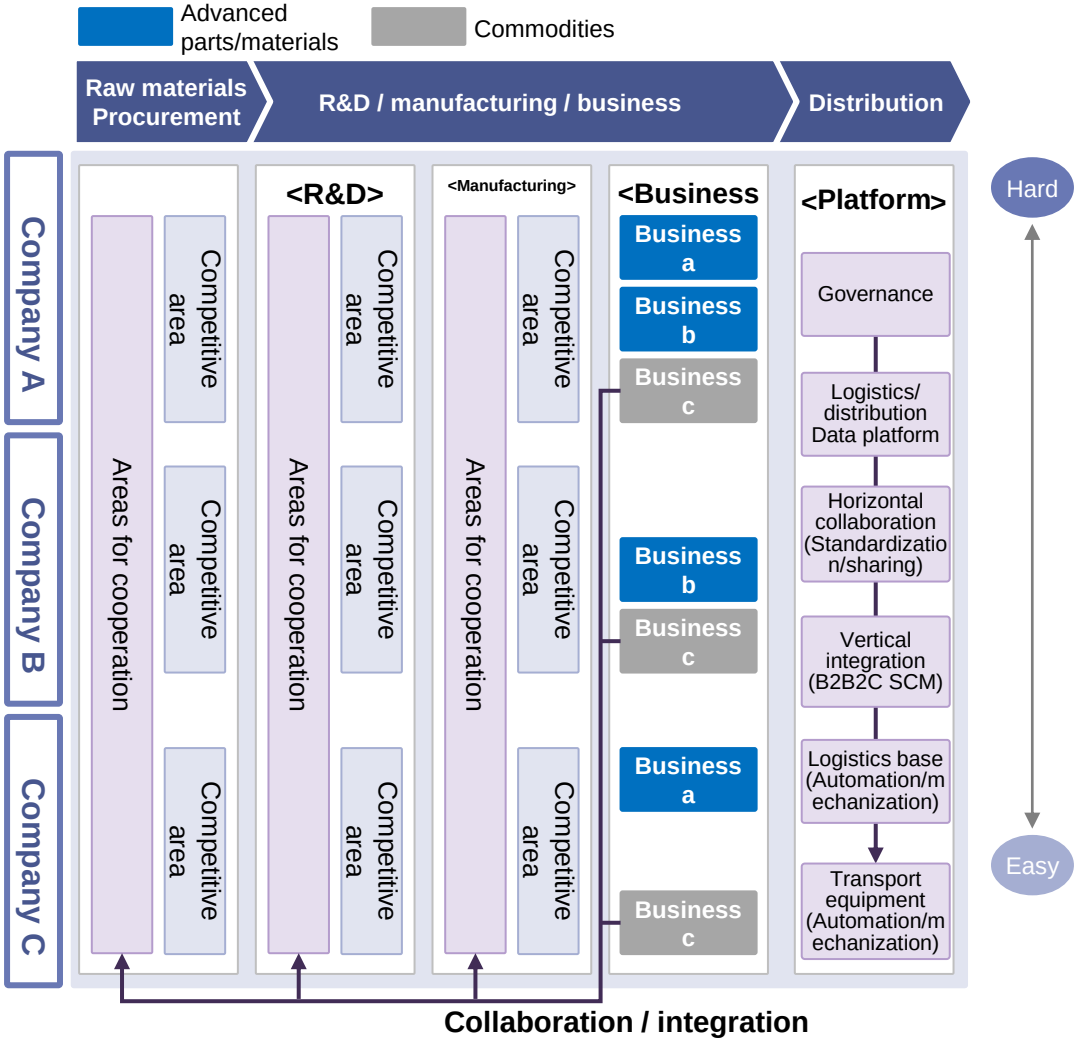
Having a small addressable market when broken down into products/technologies acts as an invisible shield against new entrants

Note: From Mizuho Bank "The Winning Strategies of Japan and its Industries," Mizuho Industry Research No. 75 (March 2024)
Source: Compiled by Industry Research Department, Mizuho Bank, Ltd.

Improving labor productivity in manufacturing: Collaboration/integration with other companies for commodities

- While companies compete fiercely in advanced fields, collaboration with other firms for generic products leads to improved productivity and overall optimization

Schematic of collaboration/integration with other companies



Hard

Easy

Difficulty of collaboration (Expected effect)	Comments
Business integration (✓✓✓)	■ Cannot be judged by economic logic alone: must overcome barriers like control disputes and emotional factors ■ Depending on the level of market concentration, antitrust law can also be a bottleneck
Manufacturing (✓✓)	■ When quality differences are small, companies may consider swap transactions (exchanging their own products with those of other firms) to reduce logistics costs, or even consolidate or integrate manufacturing facilities with other companies to optimize production capacity (the former is relatively easy, but the latter is much more challenging)
Raw material procurement (✓)	■ It is difficult for companies to align their interests, for example in terms of purchase timing control ■ For functional products, procurement routes, recipes, and raw materials themselves are a competitive advantage, making collaboration challenging
R&D (✓)	■ These differentiation points are sources of competitiveness, raising barriers, though basic areas may sometimes be included ■ In general, commodities are not R&D focus areas, so the impact is limited
Distribution (✓)	■ With the labor shortage in the logistics sector becoming more severe, there is a growing trend toward greater collaboration with other companies ■ Some large companies have in-house logistics subsidiaries, but amid investor pressure on non-core businesses, restructuring is also underway

Source: Compiled by Industry Research Department, Mizuho Bank, Ltd.

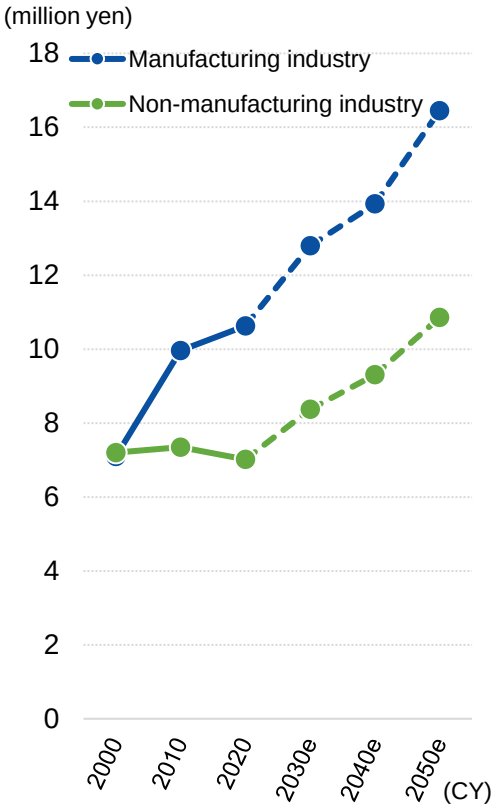
Worldview of rising unit prices and cost compression: Outlook for per person value added and labor costs

■ Enhancing value added per person leads to higher personnel costs per person, serving as twin drivers for sustainable growth

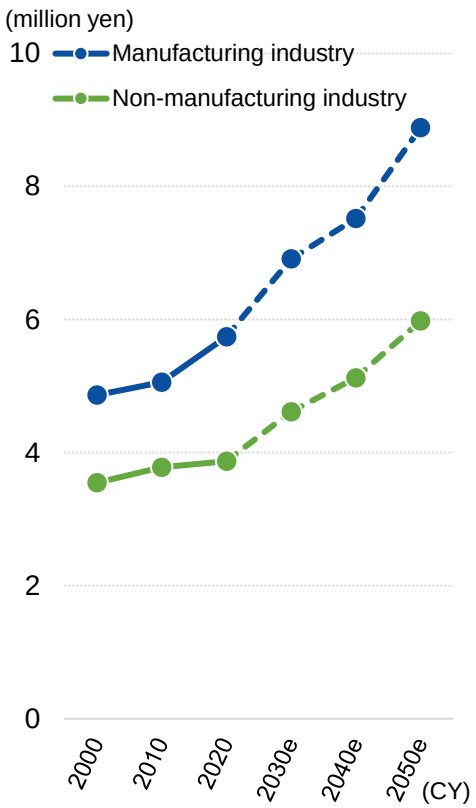
Future outlook for per person value added and labor costs

- Manufacturing boosts value by improving its product mix. Non-manufacturing raises value by promoting automation and labor-saving measures, while also focusing on uniquely human work
- Although intensifying competition for talent may drive this even higher, per person labor costs are expected to rise going forward even under the current labor share

<Per person added value>



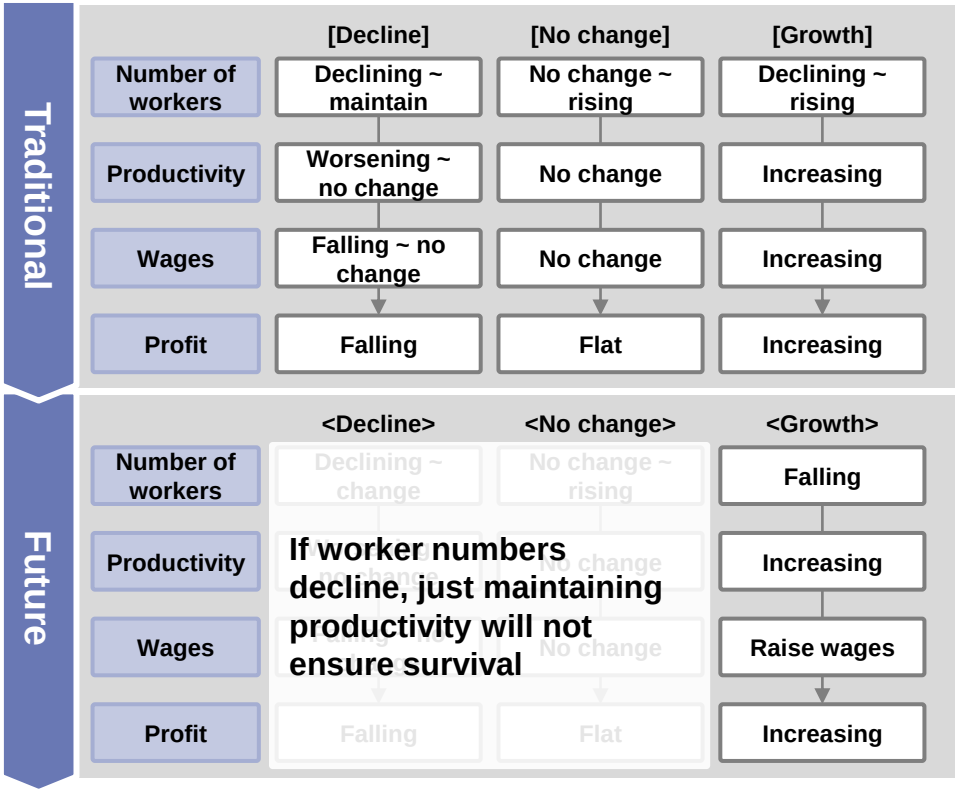
<Per person labor costs>



Note: Post-2030 figures are forecasts by Industry Research Department, Mizuho Bank, Ltd.
Source: Based on Cabinet Office data, compiled by Industry Research Department, Mizuho Bank, Ltd.

Productivity improvement and wage hikes are indispensable for business survival

- When labor was easy to secure, companies could survive without raising productivity or wages, but with a declining workforce, maintaining the status quo becomes impossible
- Improving productivity while rewarding employees is key for survival



Source: Compiled by Industry Research Department, Mizuho Bank, Ltd.

Worldview of rising unit prices and cost compression: The outlook for service/non-manufacturing industries

[At present] Non-manufacturing/ services

Limited use of technology for automation → Operational efficiency does not improve → Long working hours, worsening work environments → Higher turnover deeper labor shortage

No room to invest ← Earning power stagnates ← Upward rigidity in prices (price increases are difficult) → Unable to raise wages

New Lewis Turning Point

1 In the past, labor supply could cover demand

Depending on role, region, or season, labor shortages occurred, in some cases severely, but overall demand was met by increasing people especially women and seniors

2 Now, using technology is essential

- Despite expectations for greater participation by foreign workers, seniors, and women, satisfying labor demand is difficult
- Unless labor-saving and automation with robots, AI, etc. advance, necessary service provision will not be possible

[In the future] Non-manufacturing/ services

Maximum use of technology for automation → Operational efficiency increases → Possibility for more paid leave and shorter working hours → Work conditions improve, turnover falls

Room to invest ← Earning power rises ← Price of human-performed work rises → Employees share in benefits (note) (wages go up)

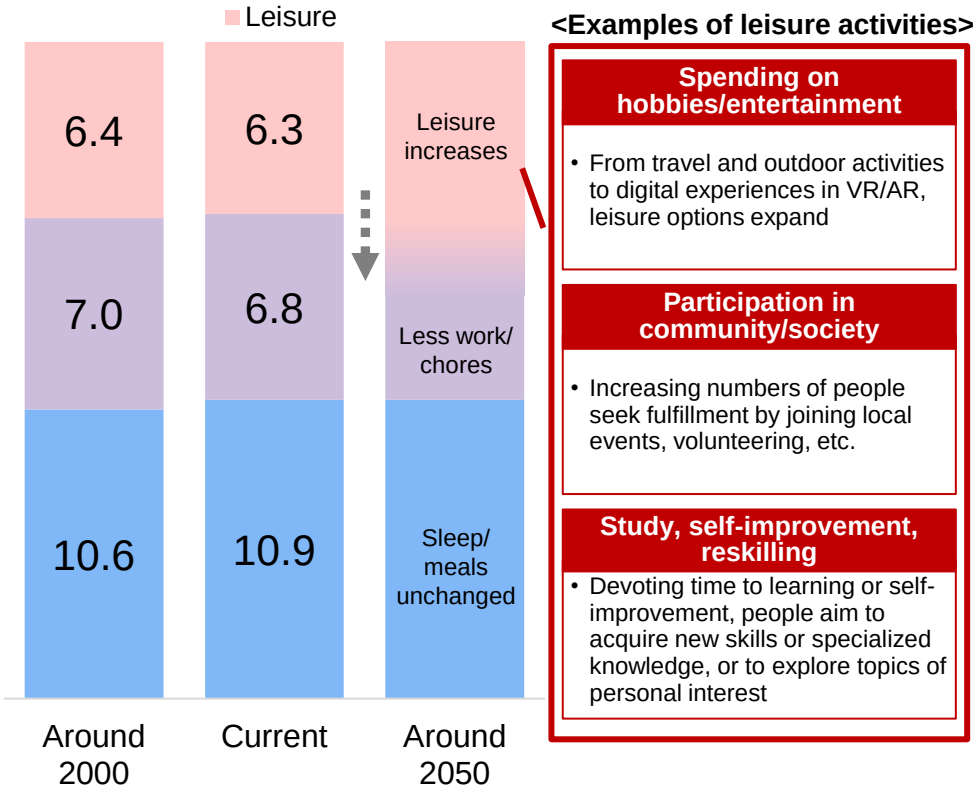
Note: Wage hikes are assumed to match or exceed price increases
Source: Compiled by Industry Research Department, Mizuho Bank, Ltd.

[Supplement] Both joy and pain will accompany this transition

■ On a personal level, we can expect increased leisure time as a joy, while business competition is likely to intensify

How use of time changes: Leisure grows as work and chores shrink

- Robots and AI taking over or supporting jobs and chores people used to do is expected to expand leisure time
- People are expected to use their increased leisure time either to raise quantitative satisfaction through consumption, or to seek qualitative fulfillment and a sense of purpose in life



<Examples of leisure activities>

Spending on hobbies/entertainment

- From travel and outdoor activities to digital experiences in VR/AR, leisure options expand

Participation in community/society

- Increasing numbers of people seek fulfillment by joining local events, volunteering, etc.

Study, self-improvement, reskilling

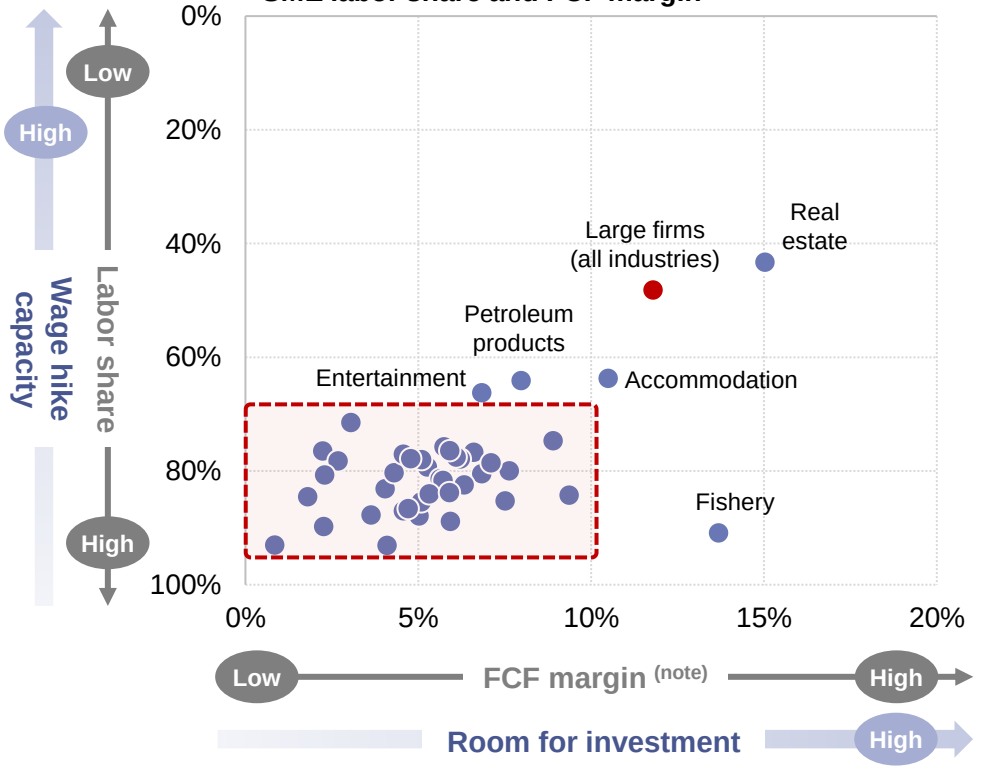
- Devoting time to learning or self-improvement, people aim to acquire new skills or specialized knowledge, or to explore topics of personal interest

Source: Based on data from the Statistics Bureau, compiled by Industry Research Department, Mizuho Bank, Ltd.

Room for wage hikes and investment in SMEs

- In many SMEs, the labor share exceeds 70% in most industries. FCF margins are also lower than in large firms, with limited room for reinvestment
- In the future, firms unable to invest in efficiency or raise wages will be increasingly weeded out

<SME labor share and FCF margin>

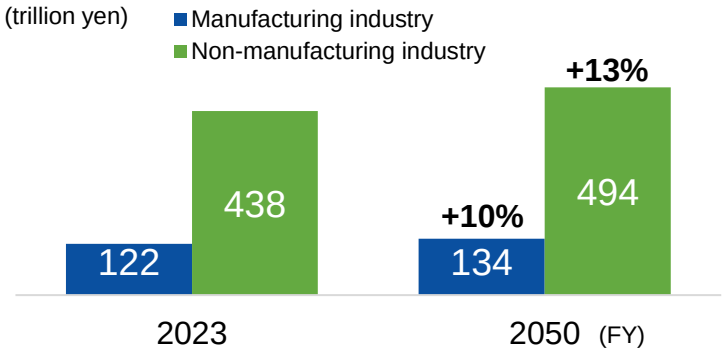


Note: FCF margin = (ordinary income + depreciation – corporate tax, etc.) ÷ sales
Source: Based on Ministry of Finance data, compiled by Industry Research Department, Mizuho Bank, Ltd.

6. Conclusion

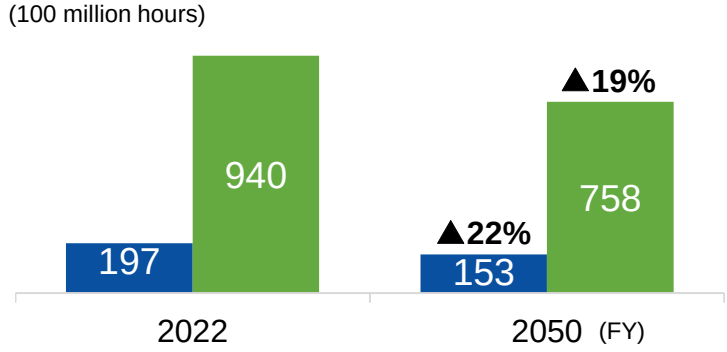
A future where labor shortages drive productivity improvement

Added value (Real GDP)



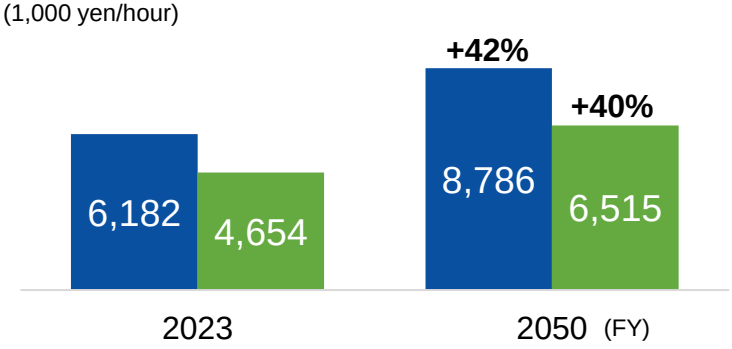
÷

Amount of labor input



=

Amount of labor productivity



- **Manufacturing is shifting from generic to high-tech, with advanced parts/materials driving growth**
- **In markets with expected demand growth, such as healthcare, senior citizen markets, and inbound tourism, there are business opportunities to be gained by addressing social challenges like population aging and labor shortages**

Note: This assumes resolution of the energy constraint above

(1) New products/services created by solving labor shortage

- **Even with greater labor participation from women, seniors, and foreign workers, the population decline will cause about a 20% drop**
- **By utilizing AI and robots, people can focus on work that truly requires human involvement (high value-added areas). Furthermore, productivity improvements will produce new products and services**

Note: In the labor hours graph, per-capita hours are flat; with more tech use, hours could actually fall

(2) Shift to a talent-scarce society (rising value of labor)

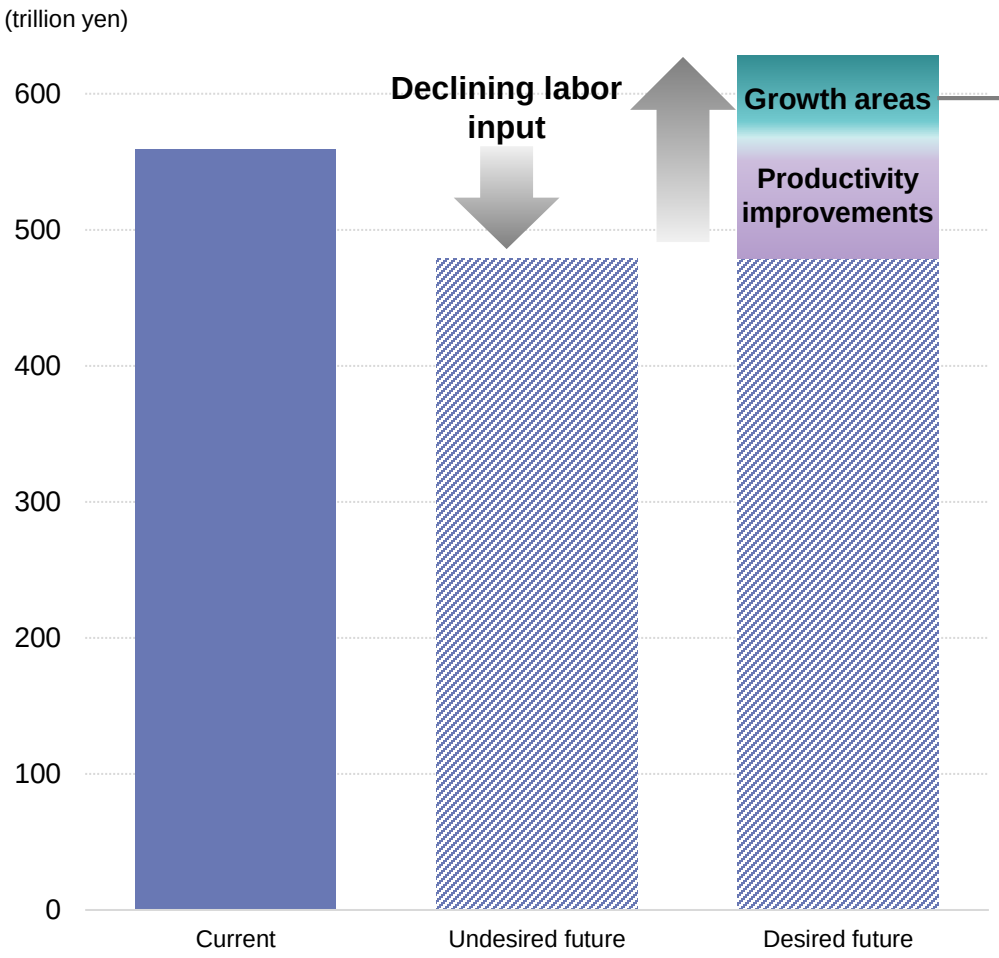
- **With reduced input and increased output, both manufacturing and non-manufacturing are expected to improve productivity by about 40%, reaching an upper middle level globally by 2050**
- **As labor supply and demand tighten (meaning people become scarcer) and high-value-added work becomes the main focus, incomes will increase. In addition, if working hours fall, people will also have more free time**

Source: Compiled by Industry Research Department, Mizuho Bank, Ltd.

Alongside productivity gains, focus on growth fields will drive overall growth

- If labor input by the working-age population drops (with capital and TFP flat), added value will steadily shrink. Labor shortages will trigger moves toward business efficiency and productivity. Further overall growth will be possible through winning in areas of new growth.

Outlook for added value (real GDP) going forward



Mobility

- As product sales decline, experience-based consumption will be integrated with areas such as people movement, logistics, energy, and content. Expanding autonomous driving services triggered by labor shortages will bring new business opportunities

Advanced parts/materials

See energy constraint section

- Advanced components/materials with superior heat resistance, conductivity, low carbon, etc. will support DX and GX
- A constellation of global niche leaders

Inbound tourism

- Alleviating labor shortages at airports and hospitality facilities will expand acceptance capacity and maximize demand. At the same time, various initiatives such as developing new customers and maximizing the value of tourism content IP can be pursued to maximize revenue and achieve stable growth.

Healthcare/Senior Age Industries

- Rising demand as population ages. By leveraging technology to resolve labor shortages, productivity improvements can acquire opportunities from global aging trends in the US, Europe, China, Asia, etc.

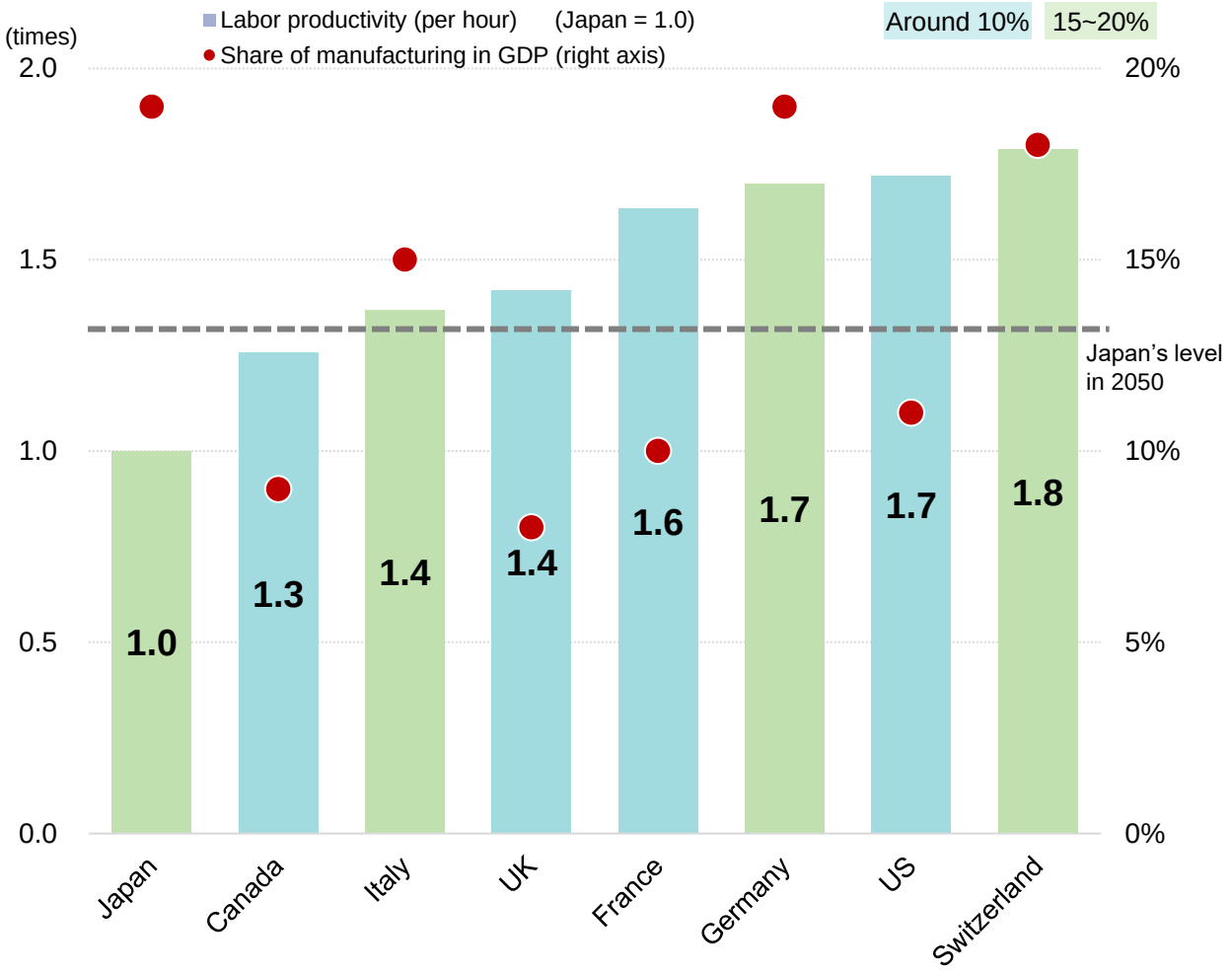
Note: Current as of 2023. The “undesired future” assumes flat capital input and TFP with the labor share remaining at the current level of 70%, while the “desired future” refers to the situation as of 2050. Forecast by Industry Research Department, Mizuho Bank, Ltd.

Source: Public materials, compiled by Industry Research Department, Mizuho Bank, Ltd.

Still a gap with world leaders: Target Italy's levels first, then Germany/Switzerland long-term

■ Japan's labor productivity is about 60-70% of global leaders' and a gradual catch-up can be expected going forward

International comparison: productivity per hour



Current

■ While manufacturing has long experienced productivity improvements, non-manufacturing, driven primarily by increases in non-regular employment, has struggled, resulting in lower productivity compared to other countries

Mid/long-term (Through to 2050)

■ Aim to reach current Italian levels through higher value-added in manufacturing and greater efficiency in non-manufacturing

Long-term (From 2050)

■ With IT and finance strong in the US, whose industrial structure differs from Japan's, a direct benchmark is difficult
■ The aim is to eventually catch up to Switzerland, known for its brand strength and advanced technology, as well as Germany, which stands out for its operational efficiency

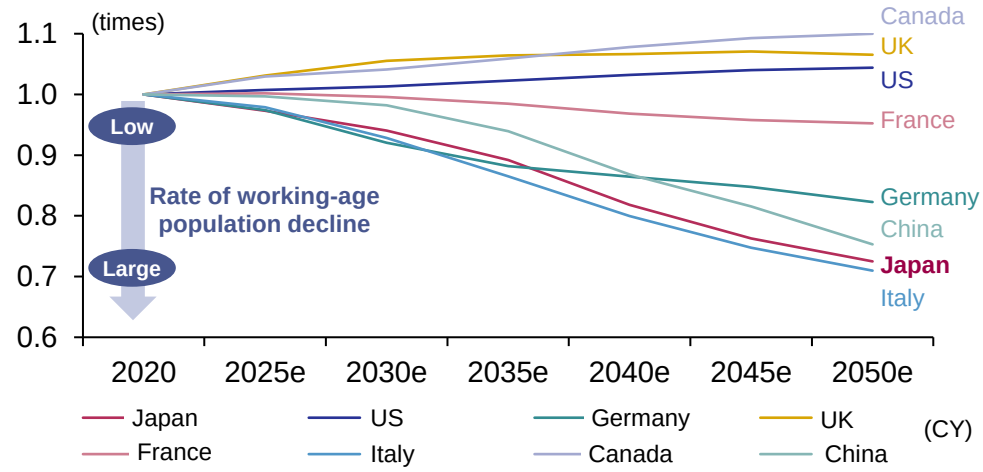
Note: Productivity is for FY2023. Share of manufacturing in GDP by country: Canada: 2020, US: 2021, Japan: 2022, Italy/UK/France/Germany/Switzerland: 2023
Source: Statistics from OECD, World Bank, compiled by Industry Research Department, Mizuho Bank, Ltd.

Japan's working-age population is already falling behind rest of world, but tech adoption remains limited compared to peers

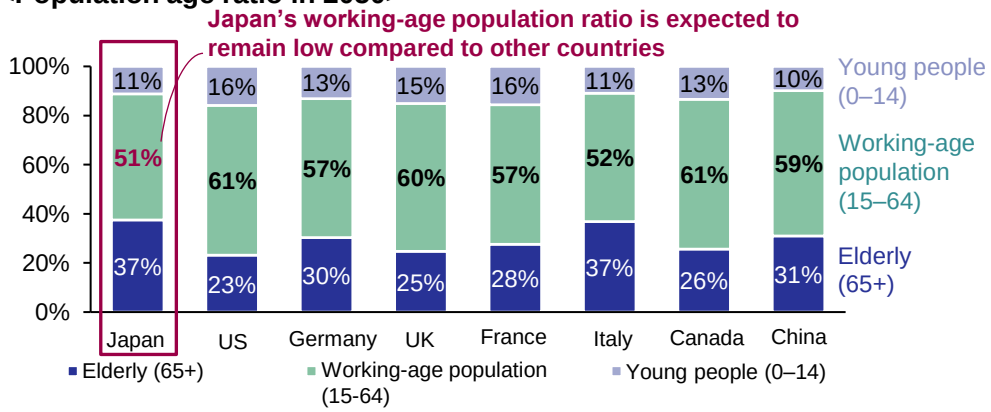
- Through to 2050, Japan's working-age population is expected to decline ahead of other advanced countries, with its ratio to the total population also remaining low.
- Even though efficiency and labor-saving measures with AI, etc. are vital to overcome the labor shortage, Japan lags behind in developing and utilizing AI

Working-age population and age ratio outlook: G7 and China

<Working-age population outlook (2020 = 1.0)>



<Population age ratio in 2050>



Source: Both charts: United Nations 2024 Revision of World Population Prospects, compiled by Industry Research Department, Mizuho Bank, Ltd.

Global comparison of AI use in G7 and China (The Global AI Index)

<The Global AI Index>

- ✓ This ranking evaluates AI competitiveness of countries on implementation, innovation, and investment shows the rank among 83 countries for each element,
- ✓ Japan lags on research/development (innovation). Although it ranks high (5th) in terms of infrastructure needed for AI implementation, it ranks low (53rd) in operating environment (regulations and public opinion regarding AI)

(rank)

	Total Rank	Implementation			Innovation		Investment	
		Talent	Infrastructure	Operating environment	Research	Development	Government investment	Government investment
		Talent	Infrastructure	Operating Environment	Research	Development	Government Strategy	Commercial
US	1	1	1	2	1	1	2	1
China	2	9	2	21	2	2	5	2
UK	4	4	17	4	4	16	7	5
France	5	10	14	19	6	4	9	8
Germany	7	3	13	8	8	11	8	9
Canada	8	8	18	16	9	10	3	6
Japan	11	23	5	53	20	14	12	14
Italy	24	19	27	1	21	45	13	43

Note: Category names translated by Industry Research Department, Mizuho Bank, Ltd.
Source: Tortoise The Global AI Index (2024), compiled by Industry Research Department, Mizuho Bank, Ltd.

As labor shortages deepen, Japan must use its strengths to lead structural change and achieve further growth

■ By viewing its increasingly advanced labor shortage as an opportunity, Japan can leverage local data and technological capabilities to achieve structural transformation and drive further growth

Global changes to the world's environment

Global environmental changes surrounding labor shortages and Japan's position

Accelerating labor shortages in major economies

- While low birthrate and aging spread in advanced economies, Japan leads in the decline of its working-age population. Labor shortages are surfacing, especially in non-manufacturing and are expected to worsen

Faster AI/robot development globally

- Work to develop AI and robots to offset labor globally is accelerating
- Japan lags somewhat in R&D and implementation readiness

Japan's position

- Labor shortage is advancing more quickly in Japan (making it a pioneer this area)
- Somewhat lagging in labor shortage solution development and implementation

Japan's strengths

Japan's strengths that can be leveraged for labor-shortage-driven growth

Abundant real-world data supports AI advancement

Manufacturing industry / Non-manufacturing industry

- Development of AI models and robots requires aggregation of on-site closed data and precise identification of user performance needs
- In both manufacturing and non-manufacturing, Japan often has detailed, standardized process design, making it relatively easy to gather and structure action-level data

Advanced technology to make high-precision, high-safety products

Manufacturing industry

- Robots that work in the same environment as humans and interact with people must have qualities such as high precision and high safety
- Japan's robot industry, with its strengths in high precision and safety, can take the lead as robot adoption expands

Driving implementation in every industry and role

Strategies for Japanese industry

Labor shortage solution providers

Leverage on-site data and advanced tech to develop/implement industry-specific AI and robots, and win overseas markets too

- Scale on-site closed data using federated learning, collaborate across company boundaries, and leverage advanced technical capabilities to develop and implement AI models and robots
- Utilize the developed AI, robots, and their implementation know-how to target overseas markets as well

Labor shortage industries

By introducing AI and robots, automate or outsource non-core areas and focus resources on core strengths for growth

Key fields → Focus resources

- By leveraging technology and concentrating resources on areas of true strength, maximize sales potential
- Humans focus on tasks only people can do and benefit from the premium on scarce labor

Non-key fields → Streamline and outsource

- Promote full automation, labor-saving, and outsourcing of operations using industry-specific AI and robots
- Consider outsourcing non-core domains to companies for which those areas are a core focus (including going fabless, etc.)

Source: Compiled by Industry Research Department, Mizuho Bank, Ltd.

Industry Research Department　Coordination Team　Ryuya Sakade　ryuuya.sakade@mizuho-bk.co.jp
Nozomu Ozaki

Mizuho Industry Research／78　2025　Published May 30, 2025

Edited / issued by Industry Research Department, Mizuho Bank, Ltd　1-3-3 Marunouchi, Chiyoda-ku, Tokyo　ird.info@mizuho-bk.co.jp