

# Strategies

## Contents

**20** Potential Risks and Opportunities in  
the Steel Market

**22** Nippon Steel's Strategies

**23** The 100 Million Tons, 1 Trillion Yen Vision

**23** Rebuilding domestic steel  
business

**27** Deepening and expanding overseas  
steel business

**33** From procure to earn profit in raw  
material business

**34** Incorporating distribution into the  
business portfolio

**36** Carbon Neutral Vision

**47** Infrastructures that Support the Strategies

**47** R&D Activities

**49** Intellectual Property Activities

**52** Digital Transformation Strategies

# Potential Risks and Opportunities in the Steel Market

Domestic steel demand will gradually decrease in line with the declining population, but global demand is expected to increase, mainly in emerging countries, especially for high-grade steel, which can contribute to solving social issues.

## Point 1 The world's steel demand keeps increasing, mainly in emerging countries

Steel products are accumulated around the world in the form of end products such as buildings, bridges, factories, ships, automobiles, and household appliances. At present, the world's steel stock amounts to approximately 30 billion tons, with steel stock per capita of about 4 tons. The amount is between 8 to 12 tons per capita in developed countries. Projections indicate that China is on track to attain a steel stock per capita of 10 tons by the mid-21st century, while India is

forecasted to achieve a similar figure by the end of the century.

If economic growth in emerging countries, SDGs initiatives, and other factors result in a steel stock per capita of 7 tons globally in 2050, the total amount of global steel accumulation is projected to reach 70 billion tons, taking population growth into account.

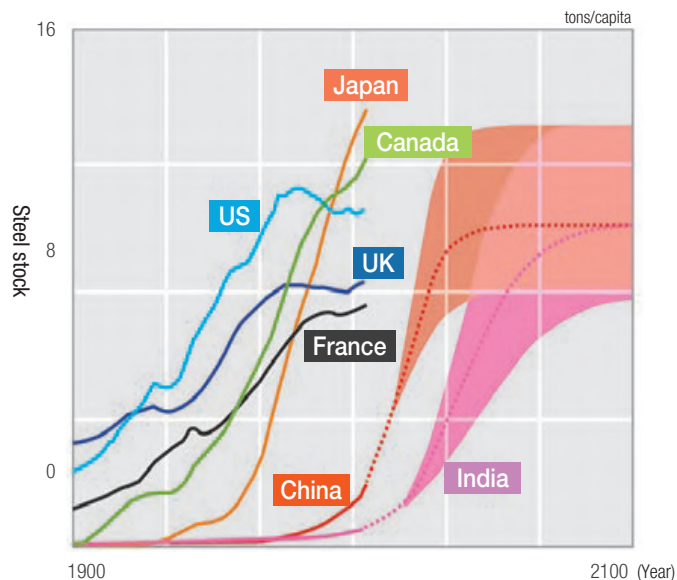
To accumulate 70 billion tons of steel by 2050, the world needs to increase its crude steel production to approximately 2.7 billion tons

per year by that time.

However, steelmaking only with recycled steel is insufficient to meet the steel production requirements due to the limited amount of scrap available.

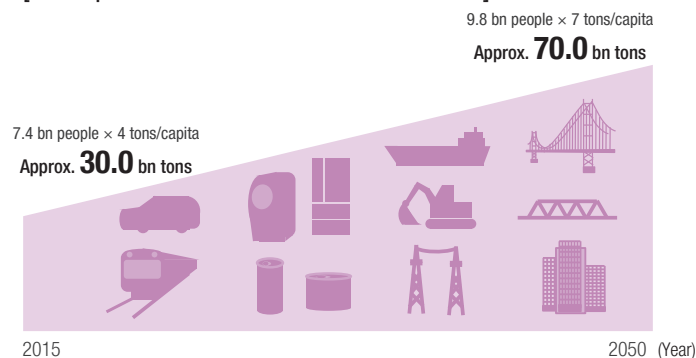
Therefore, even in 2050, there will still be considerable need for pig iron production through iron ore reduction at a similar scale to the present.

[Steel stock per capita]

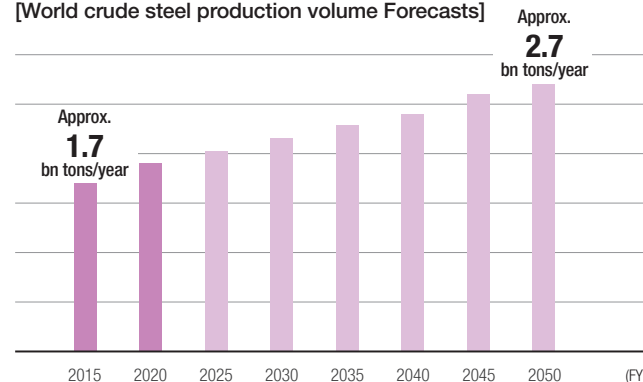


Source: "Sustainable steel: at the core of a green economy," World Steel Association, 2012

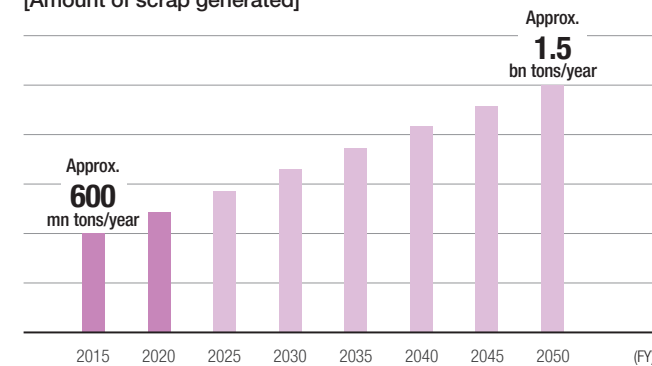
[Assumption of world steel accumulation trends]



[World crude steel production volume Forecasts]



[Amount of scrap generated]



[New production from iron ore (pig iron production)]



## Point 2 Japan's steel market anticipates a gradual decline

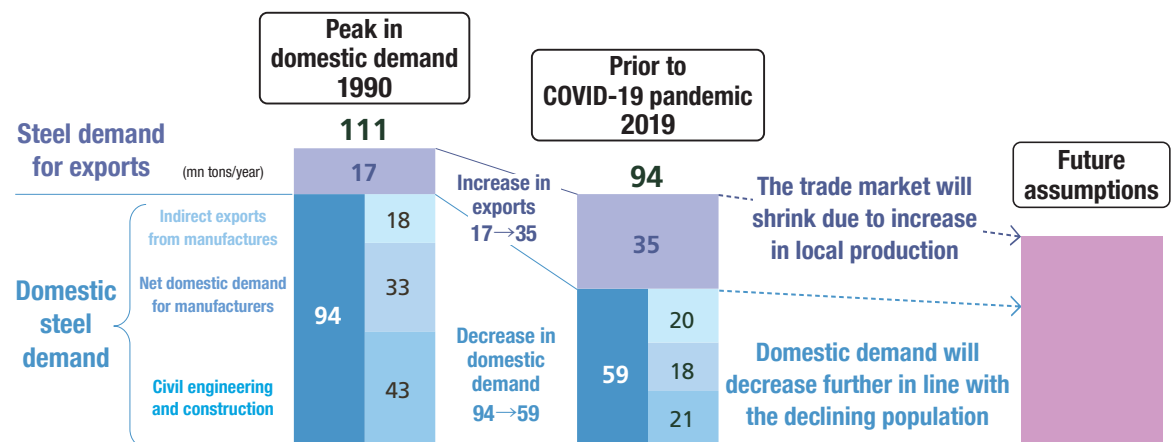
### Gradual decline in domestic demand

Domestic steel demand peaked at 94 million tons per year in 1990, during the bubble period, and has since been on a downtrend due to a fall in demand for civil engineering and construction, manufacturers' overseas shift of production, and other factors. The Japanese steel industry has maintained its level of domestic production by balancing the decline in local demand with an increase in exports. Japan's declining and aging population is likely to further reduce domestic steel demand for domestic consumption of the manufacturing industry and for the civil engineering and construction sector.

### Increasing difficulty to export

Steel demand is projected to grow overseas, especially in emerging economies. Nevertheless, the export outlook for steel products from Japan is likely to become more challenging. The main reasons behind this are the growing trend toward local production in various regions of the world and intensified competition resulting from the expanded capacity of new mills along the East Asian coastline.

#### [Shifts in Japanese Steel Industry's product destinations]

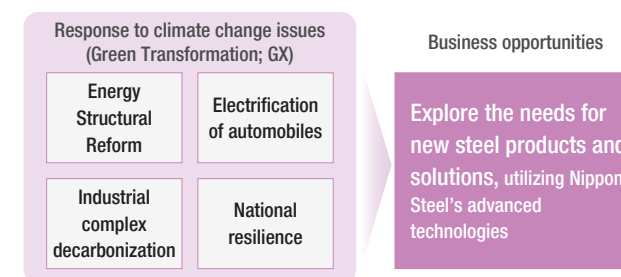


## Point 3 Anticipating growth in the high-grade steel market in quality and quantity

High-grade steel products are products which make use of various properties and limitless potential of steel, are designed to meet various specifications for steel quality, depending on the needs of customers, demonstrate superb functionality in use, and contribute to value creation of end products. Our wide range of high-grade steel includes the ultra-high-tensile steel sheet, which plays a key role in reducing the weight of automobiles, electrical steel sheet that contributes to energy efficiency improvement in motors and transformers, and Prostruct™, a construction solution brand that supports the development of safe, secure and disaster-resistant infrastructure. These high-grade steel products deliver an impact in addressing a range of societal challenges.

As global efforts towards carbon-neutrality and Sustainable Development Goals (SDGs) progress, the demand for high-grade steel is expected to increase, requiring improvements in both quality and quantity.

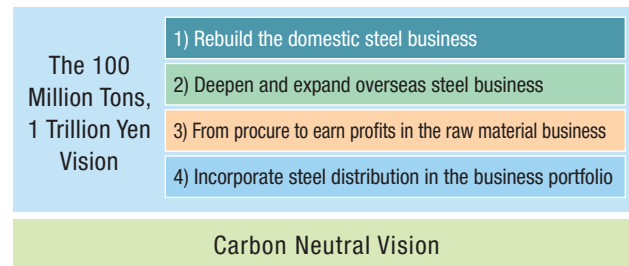
#### [New business opportunities in the times of social transformation]



# Nippon Steel's Strategies

In light of long-term and structural changes in the steel supply and demand environment and the role that the steel industry should play in solving social issues such as the realization of carbon neutrality, Nippon Steel aims at continually growing to become “the best steelmaker with world-leading capabilities” and contribute to Japan’s industrial competitiveness from the present and into the future.

We are striving to do our utmost to achieve our “The 100 Million Tons, 1 Trillion Yen Vision” and “Carbon Neutral Vision.”



## The 100 Million Tons, 1 Trillion Yen Vision

In the future, we expect steel demand to decrease in Japan and exports to become increasingly difficult. As we would require high-level capital spending including the renewal of aging facilities in order to maintain our domestic steelmaking capacity, we believe our conventional business model to maintain domestic production scale by raising the export ratio is difficult to sustain.

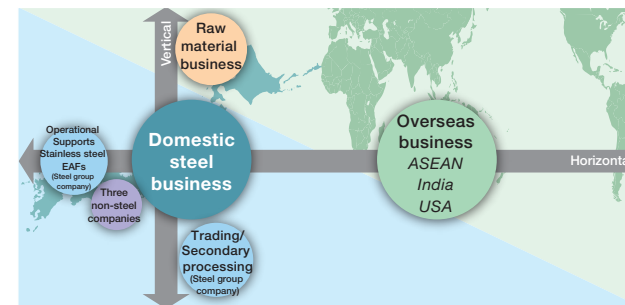
Based on this recognition, in the domestic steelmaking business, we strategically select products and equipment and build an optimal production system to efficiently produce high-grade steel, so as to strengthen domestic steelmaking ability as mother mills.

Our strategy in the overseas steel business is to expand our integrated production bases to ensure capturing of local demand, in “markets where demand growth potential is assured” and “areas where its technology and product capacity can be utilized.” We will increase the width of our business (horizontal growth) with the aim of achieving 100 million tons/year in global crude steel production capacity.

We will also increase the depth of our business (vertical growth) by moving the raw materials business from procurement to business in the upstream direction of the steel business supply chain, and by moving distribution in our business portfolio domain in the downstream direction.

Through these efforts, we will evolve into a more robust business

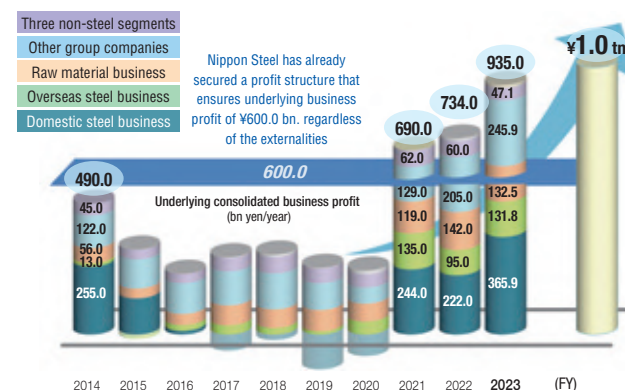
## [Developing a robust business structure with vertical and horizontal Expansion]



structure with breadth and depth, and realize a profit structure that can secure stable business profits of 1 trillion yen regardless of the external environment.

As a result of these efforts to date, we have already established a profit structure that ensures stable underlying business profit of 600 billion yen or higher, regardless of the external environment, and underlying business profit significantly exceeded 600 billion

## [Toward achieving 100 Million Tons and 1 Trillion Yen]



yen for the third consecutive year since FY2021. Further, we are moving forward toward a profit structure to stably realize profit of 1 trillion yen.

## Carbon Neutral Vision

For realizing a carbon neutral society, we are striving to reduce CO<sub>2</sub> in our supply chain by providing two types of value: by providing high-performance steel products and solutions that contribute to reducing CO<sub>2</sub> emissions throughout society, and by providing carbon neutral steel through decarbonization of the steelmaking process.

To reduce CO<sub>2</sub> emissions across society, under the NSCalbolex™ Solution brand, we are developing and selling high-performance steel products and solutions that contribute to the reduction of CO<sub>2</sub> emissions at the time of processing of steel products and the use of finished products, as well as to the energy transition of society.

To achieve decarbonization of the steelmaking process, we aim to achieve a 30% reduction in CO<sub>2</sub> emissions compared to 2013 by 2030 and carbon neutrality by 2050 by taking a multi-track approach of developing three breakthrough technologies. We are committed to the research and development of these technologies and are steadily making progress. At the same time, from the perspective of ensuring the predictability of decarbonized investment recovery, we are lobbying the government and relevant associations in various industries to help establish a green steel market and support for the rise in capital investment and operating costs. We are also working to ensure the social implementation of infrastructure such as green hydrogen, green power, and CCUS.

# The 100 Million Tons, 1 Trillion Yen Vision

## (1) Rebuilding domestic steel business

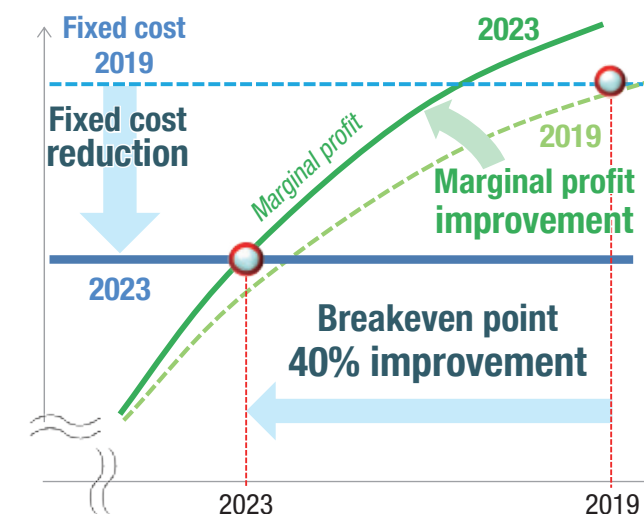
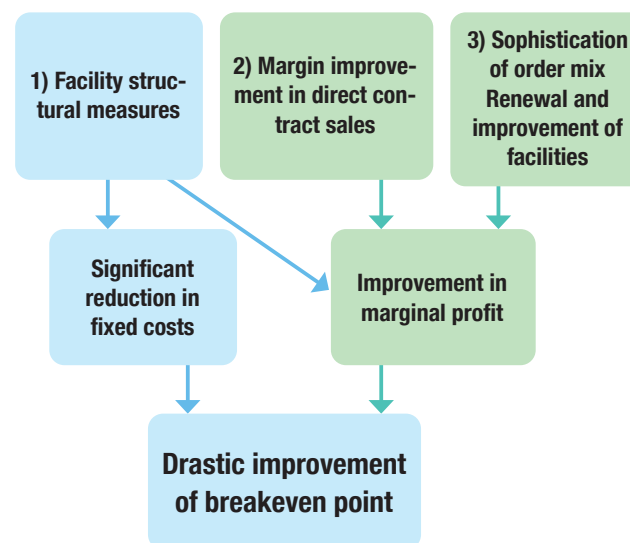
Our mother mills play a crucial role in strengthening the domestic steelmaking business structure and perform a central part in our global strategy aimed at establishing an optimum production system capable of producing high-grade products. We are building a profit base that is not solely reliant on volume by drastically improving the breakeven point. This will be done by improving marginal profit per ton through margin optimization and order mix improvement, and by reducing fixed costs through measures involving structural adjustments within our production facilities. We will continue to work at well-timed and accurate assessment and analysis of demand trends and other factors in order to establish an optimal production system and will develop further measures, if needed.

### Drastic improvement of breakeven point

By promoting our strategy based on the “facility structural measures,” “margin improvement in direct contract-based sales,” and “sophistication of order mix,” we reduced fixed costs, significantly enhanced marginal profit per unit, and as a result improved the breakeven point by 40% between FY 2019 and FY 2023. Japan’s annual crude steel production, which stood at approximately 100 million tons before the COVID-19 outbreak,

dropped to about 90 million tons after the pandemic. Our domestic steelmaking business can remain profitable even if the production falls further to 70 million tons. We expect an increase in depreciation expenses because of capital investments in strategic products. However, we will mitigate this impact by implementing production facility structural measures and considering other factors to maintain a low level of fixed costs.

#### [Drastic improvement of breakeven point]





## The 100 Million Tons, 1 Trillion Yen Vision (1) Rebuilding domestic steel business

### 1) Production facility structural measures

Nippon Steel's production facility structural measures aim at concentrating production in competitive facilities while shutting down less-competitive ones, in order to make the production framework to be streamlined and more efficient, and to optimize the scale of production capacity and fixed cost. We have already implemented more than 70% of our planned measures of the Medium- to Long-term Management Plan by March 2024, significantly reducing fixed cost.

#### [Structural measures for production facilities in the Medium- to Long-term Management Plan]

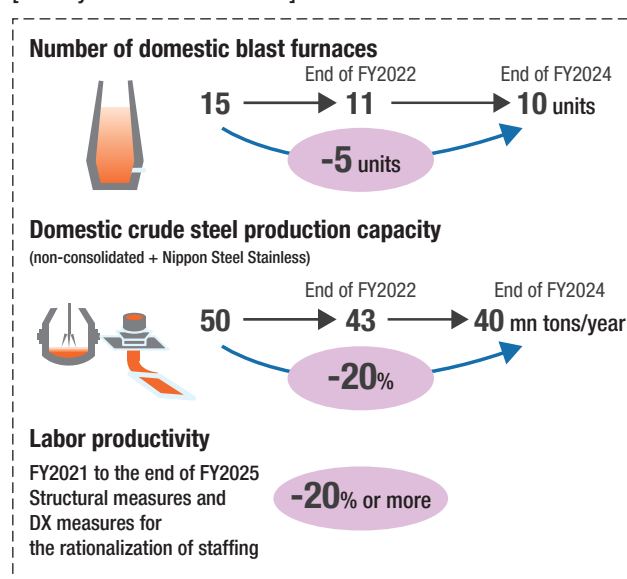
##### ■ Product manufacturing process

- Shut down some production lines, and concentrate production in lines that are more competitive or closely located to centers of demand, so as to strengthening the business and make an optimal, more efficient production system,.
- Withdrawing from certain products in light of their long-term demand trends.

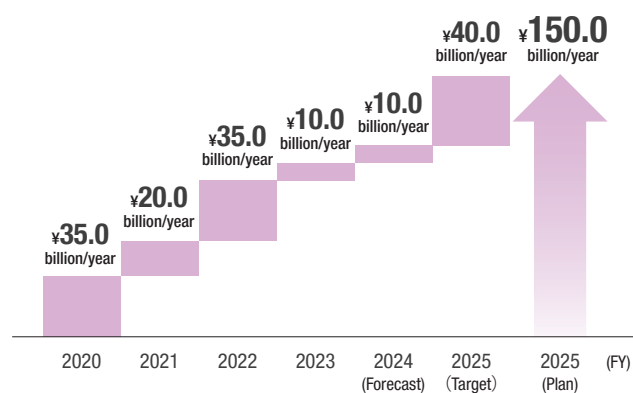
##### ■ Upstream steelmaking process

- Shut down all facilities at the Setouchi Works Kure Area and the No. 1 blast furnace and related facilities at the Kansai Works Wakayama Area by considering each steelworks' competitiveness in terms of integrated production/shipment capacity, cost, product strength, and other factors, with the aim of increasing competitiveness in the integrated steelmaking process.
- Shut down the No. 1 continuous casting machine at the Kimitsu Area of the East Nippon Works and the No. 3 blast furnace and related facilities at the East Nippon Works Kashima Area by taking into account the overall situation including company-wide upstream steelmaking balance and the integrated production/shipment capacity, and cost of the areas where the product manufacturing lines were shut down,.

#### [Facility structural measures]



#### Cost reduction impact of the structural measures



#### [Structural measures for production facilities: Changes in the number of main target lines]

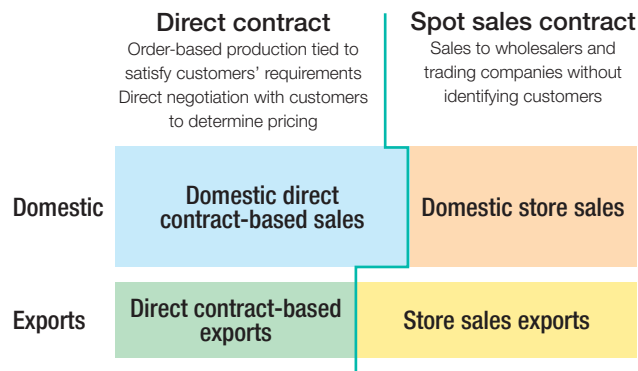
		Closure	Before → After
	Blast furnace	5 units	15 → 10 units
	Continuous caster	8 units	32 → 24 units
	Steel plate mill	2 lines	4 → 2 lines
	Large shape mill	2 lines	4 → 2 lines
	Seamless pipe mill	1 line	3 → 2 lines
	UO pipe mill	2 lines	2 → 0 line
	Hot rolling mill	1 line	7 → 6 lines
	Cold rolling mill	2 lines	17 → 15 lines
	Plating lines	3 lines	19 → 16 lines
	Special stainless steel cold rolling mill	2 lines	4 → 2 lines
	Titanium raw material plant	1 line	1 → 0 line
	Titanium round bar plant	1 line	1 → 0 line
	Titanium welded pipe plant	1 line	1 → 0 line
	Nippon Steel Stainless Steel's cold rolling mill	4 lines	13 → 9 lines
	Nippon Steel Stainless Steel's electric arc furnace	1 unit	4 → 3 units

## The 100 Million Tons, 1 Trillion Yen Vision (1) Rebuilding domestic steel business

### 2) Spread improvement in direct contract sales

Order-made steel products based on the direct contracts with the features and quality that meet customers' needs account for a majority of our steel products sales. Sales prices for these products are determined through negotiations with customers. We have asked customers with these contracts for their understanding of our need to adjust direct contract-based prices from the viewpoint of proportionate sharing of the impacts of rising costs of raw materials and fuels in the supply chain, and of the value of the products and solutions provided by us. In FY2021, we gained many customers' understandings and achieved significant improvement of the prices. We also reviewed our business practices for price negotiations. There had been many contracts for which the prices were negotiated and finalized after the order intake, production, and shipment before. We then made a proposal for the pre-fixed pricing system to customers to advance the timing of negotiations and raise the efficiency of this process, so that the price would be fixed before our order intake, which could facilitate our forecast making and coping with longer-term, difficult management issues such as carbon neutrality. Upon discussions, many customers agreed with our proposal. We changed our price negotiation system to the "pre-fixed pricing system" for products shipped after April 2022 under direct contracts. We have also proposed and discussed shorter contract terms, etc., considering different circumstances of each customer, as one of the measures to respond to fluctuating costs of raw materials and fuels. For customers who have already agreed, we have implemented a shorter cycle since April 2022. We will continue negotiating with other customers.

#### [Nippon Steel's types of contracts for sales of steel products]



#### [Trend of direct contract-based spread level]

**1 Securing adequate spread up to 2H FY2021**

**Up to 2H FY2021**

- Proportionate sharing of the fluctuations of external costs across the entire supply chain
- Reasonable price based on the value of the product, solution, and supply chain.

Significantly improved our spread.

**1' Maintaining adequate spread**

Reflect external cost fluctuations in sales prices to structurally secure adequate spread.

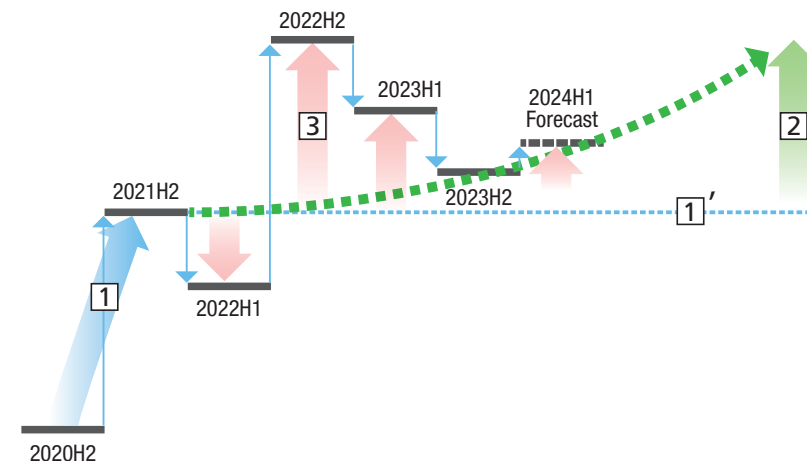
**2 More sophisticated order mix**

Improve the value of products and services to raise the level of average adequate spread.

**Measures to improve the capacity and quality of electrical steel sheets**

Yawata and Hirohata Step 1 and 2: Full operation in 1H FY2023  
 Hirohata Step 3: Full operation in 1H FY2024  
 Yawata Step 3 and Hanshin (Sakai): Full operation in 1H FY2027

**Construction a next-generation hot strip mill in Nagoya:**  
 Full operation in 1Q FY2026



### 3 External cost fluctuation after pricing

Changed the price negotiation system to the "pre-fixed pricing system" after April 2022.

#### A temporary increase or decrease in the adequate spread level, driven by post-pricing fluctuations in external costs

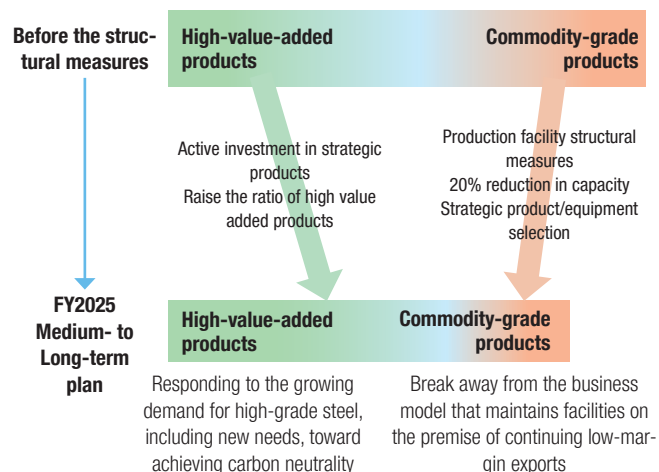
	2022 1H	2022 2H	2023 1H	2023 2H	2024 1H (E)
External cost fluctuations after pricing	Increase	Decrease	Decrease	Nearly flat	Slightly decrease
Change vs. adequate spread	Shrink	Expand	Expand	Nearly flat	Slightly expand

## The 100 Million Tons, 1 Trillion Yen Vision (1) Rebuilding domestic steel business

### 3) Shift to a more sophisticated order mix, and renewal and improvement of facilities

Our strategic focus is on high-grade steel, which is expected to increase in demand both in terms of quality and quantity. Accordingly, we are investing actively in plants and equipment to expand production capacity and improve quality. We intend to advance our order mix by raising the ratio of higher-value-added products and reducing the ratio of commodity-grade products along with the streamlining of production capacity. This leads to our improving average marginal profit.

#### [More sophisticated order mix]



We are selectively investing in competitive facilities, including investment to improve the capacity and quality of strategic products. Acquiring new facilities will enable us to turn our technological expertise into actual profits.

### ■ Strategic investment in a next-generation hot strip mill at the Nagoya Works

In the automotive industry, where global environmental regulations are tightening and where collision safety standards are becoming more stringent, demand for ultra-high-tensile steel sheets is expected to further grow in response to the need for lighter, stronger vehicle bodies. For the foreseeable future, demand for electric and hybrid vehicles will have high growth potential, creating need to reduce vehicle weight and increase body strength, particularly because of problems concerning mileage and battery weight.

In order to drastically strengthen the production system of high-performance steel sheets such as ultra-high-tensile steel sheets at the Nagoya Works, a core base for automobile steel sheet manufacturing, we are combining the knowledge and experience of many years' R&D in pursuit of the potential of steel materials and are constructing a next-generation hot strip mill with the world's largest load-bearing rolling machine, which will give us dramatically improved rolling control and temperature control.

#### [Investing in a next-generation hot strip mill]

Time to decide	Investing steelworks	Investment	Start of operation	Production capacity
2023.5	Nagoya Works	Approx. ¥270 billion	1Q FY2026 (plan)	Approx. 6mn tons/year



Construction site of a next-generation hot strip mill at Nagoya Works

### ■ Strengthening the manufacturing system of high-end electrical steel sheets

As the world is rapidly moving toward decarbonization, demand for high-efficiency high-grade non-oriented (NO) electrical steel sheets used in the iron core of motors used in electric vehicles (EVs) is also expected to dramatically increase, driven by accelerated growth in demand for EVs, along with the stricter regulations for CO<sub>2</sub>. In the meantime, regulations concerning energy efficiency of transformers have been tightened in a number of countries. With regard to grain-oriented (GO) electrical steel sheets used in the iron core of transformers, the need for higher-grade materials with less energy loss is anticipated to further increase.

We have started construction as we had decided sequentially from August 2019 to May 2023 to invest ¥213 billion in cumulative total for the improvement in capacity and quality of electrical steel sheets at the Setouchi Works Hirohata Area / Hanshin Area (Sakai) and the Kyushu Works Yawata Area.

#### [Investing for improvement of the capacity and quality of electrical steel sheets]

Time to decide	Investing steelworks	Investment	Start of operation	Capacity expansion
(1) 2019.8-2020.5	Setouchi Works Hirohata Area Kyushu Works Yawata Area	¥105 bn	1H FY2023 Full operation	Up approx. 1.5 times in NO + GO electrical steel sheet capacity;
(2) 2021.11	Setouchi Works Hirohata Area	¥19 bn	1H FY2024 Full operation	up approx. 3.5 times in high-grade electrical products
(3) 2023.5	Setouchi Works Hanshin Area (Sakai) Kyushu Works Yawata Area	¥90 bn	1H FY2027 Full operation	Numerical production capacity targets for eco-friendly cars: Approx. 5 times the current level Approx. 1.6 times after implementation of (1) and (2)

(¥213 billion in cumulative total)

**NO**  
Grain-oriented electrical steel sheets  
⇒ For motors



**GO**  
Grain-oriented electrical steel sheets  
⇒ For transformers





## The 100 Million Tons, 1 Trillion Yen Vision

## (2) Deepening and expanding overseas steel business

Nippon Steel's strategy in the overseas steel business is to expand our integrated production framework and downstream bases in the centers of demand, in "markets where demand growth potential is assured" and "areas where its technology and product capacity can be utilized" to ensure that local demand is captured.

Regarding our current international operations, we have actively pursued a strategy of selecting and concentrating. We have focused on expanding international businesses that align with our strategic objectives and have terminated ventures where there is no justification to continue, including businesses that have either served their purpose, lost their synergy potential, or are not expected to generate profits.

Global steel demand is expected to continue to grow at a moderate pace. In order to capture growing global demand, we will not only have supply systems of steel products exports, mainly those of high-grade steel products from Japan, and of supplies from overseas operating companies with cold rolling, plating, and other product processes, but also expand our integrated production framework from the upstream steelmaking processes (blast furnace and electric furnace) to capture overall local demand. In doing so, we are moving toward full-scale overseas business.

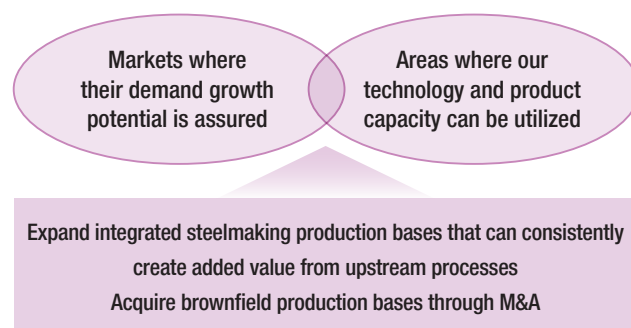
Our basic strategy is to acquire integrated steel mills through acquisitions and capital participation (brownfield investment) and to expand the capacity of existing bases, in order to maintain the supply-demand balance amid a surplus of steel production capacity worldwide and to avoid the risks associated with starting up a new launch. We have acquired Essar Steel (now AM/NS India) in India in December 2019 and G Steel and GJ Steel in Thailand in March

2022. Our present overseas crude steel production capacity is 19 million tons per year, and the total global crude steel production capacity, including the domestic capacity, is 66 million tons.

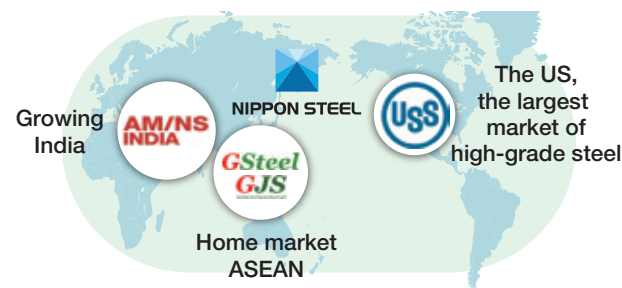
In addition, in December 2023, we decided to acquire U. S. Steel in the United States, a country with the world's largest demand for high-grade steel. We are currently advancing procedures toward closing the deal. When U. S. Steel joins the Nippon Steel Group, our overseas crude steel production capacity will be 39 million tons/year, and our global crude steel production capacity including Japan will be 86 million tons/year.

On top of that, we plan to expand the capacity of AM/NS India, and explore further opportunities to expand our overseas crude steel production capacity to more than 60 million tons, with the long-term vision of achieving a global annual crude steel production capacity of 100 million tons.

## [Expansion strategy of overseas steel business]



## [Diversify Nippon Steel's global footprint by three primary geographies]



## [Global crude steel production capacity]

## Toward 100Mt vision:

- Acquisition of U. S. Steel
- Further capacity expansion in AM/NS India
- Further expansion of existing steel mills

	2014	2023	After acquisition of USS	Long-term Vision
Domestic	52	47	47	
<b>Overseas</b>	<b>6</b>	<b>19</b>	<b>39</b>	<b>&gt; 60</b>
<b>Total*</b>	<b>58</b>	<b>66</b>	<b>86</b>	<b>&gt; 100</b>

\* Fully including nominal capacity of companies subject to the crude steel production standard of the World Steel Association

## The 100 Million Tons, 1 Trillion Yen Vision (2) Deepening and expanding overseas steel business

### Efforts to expand capacity at AM/NS India

#### Growth potential of India's steel market

India has become the world's most populous country with its population that surpassed China to more than 1.4 billion and is expected to continue to grow. India's per capita steel consumption is currently about 90 kg per person per year, which is low compared to industrialized countries such as Japan and China, the U.S. and Europe, as well as to ASEAN countries and Brazil\*. In India, demand for steel products is expected to steadily increase over the long term due to the synergistic effect of rising per capita steel consumption, driven by demand related to the progress of industrialization and urbanization, as well as population growth. Moreover, the Indian government has set a target of increasing crude steel production capacity to 300 million tons by 2030, and is taking various measures.

\* Per capita consumption by country (kg/person/year; round figures): Japan-430, China-630, EU-280, Mexico-220, five ASEAN countries-160, Brazil-110

#### Capacity expansion of AM/NS India

India's government, under its "Make in India" policy, is resolutely protecting India's steel industry as a key industry. The market has a remarkably high ratio of local production, with domestic steelmakers supplying approximately 90% of the demand. Against this backdrop, major steel producers in India are adopting ambitious strategies to expand their production capacities to meet the expected growth in demand in the coming years.

In this Indian steel market, made attractive by market growth prospects and the local production policy, Nippon Steel acquired Essar Steel jointly with ArcelorMittal in December 2019, and began operating it as AM/NS India, based on an equal partnership of Nippon Steel and ArcelorMittal.

To meet with the growth of the Indian steel market, we plan to grow with capacity expansion at AM/NS India leading the way. We have decided to invest in increasing the capacity of the Hazira Works, located on the western coast of India. For this capacity expansion, we will utilize unused owned land, which frees us from land acquisition issues that can be the biggest cause of obstacles in India. Also, aiming for quick and reliable start-up of facilities, we will adopt the already-established blast furnace-converter process to capture growth in demand early and surely. This investment project

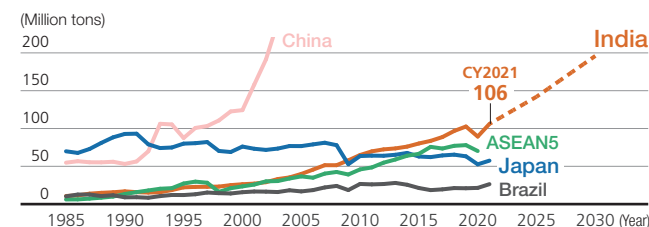
plans to introduce energy-saving equipment and environment control equipment (for dust, odor, water quality, and noise control) that we have developed in Japan, and to incorporate a provision for applying carbon-neutral technology that uses blast furnace equipment, which is under development by us and ArcelorMittal. Also, we started construction for expanding cutting-edge sheet manufacturing facilities (for pickling, cold rolling, and steel plate plating) to capitalize on the anticipated growth in demand for various high-value-added products, such as cold-rolled and plated steel sheets, including those for automotive and construction materials (highly corrosion-resistant) in the Indian market. In December 2023, one plating facility for construction materials commenced production.

We are considering investing in further capacity expansion, which involves building a new steel mill in Eastern India. AM/NS India has already signed an MOU with the government of Odisha state, one of the potential sites, to acquire land for constructing integrated steel mills in Kendrapara and Paradeep districts in Eastern India.

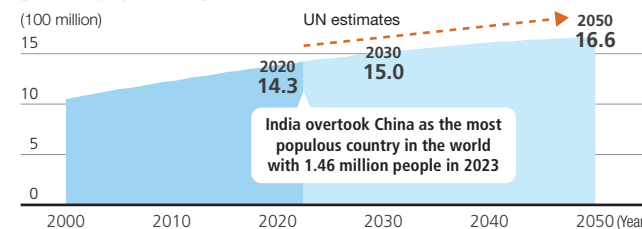
	Project	Facility	Investment	Start of full-scale operation
Sep. 2022: Decided	Hazira integrated steel mill Ironmaking facilities and a hot strip mill: New installation and expansion	Blast furnace: 2 units (4,500m³ X 2 units; 7.0 Mt/y) Pellet plant: 1 unit (approx. 3.0 Mt/y) Sintering: 2 units (approx. 6.0 Mt/y) Coke oven: 3 batteries (2.1 Mt/y) Converter: 3 units (350 t/ch X 3; crude steel production capacity 6.0 Mt/y) Degassing equipment Continuous casting facility: 2 units (2 strands/unit X 2 units) Hot strip mill: 1 unit (5.5 Mt/y, largest scale in India)	INR410 billion (Approx. ¥730 billion)	The First Phase (FY2025): #2 blast furnace and related facilities, new oxygen converters and continuous casters, and a new hot strip mill  The Second Phase (FY2026): #3 blast furnace and related facilities
Apr. 2022: Decided	Hazira integrated steel mill Steel sheet facilities: Expansion	Pickling and cold rolling equipment: 1 unit (2.0 Mt/y) Hot-dip galvanizing equipment: 2 units (1.0 Mt/y) Cold-rolling and aluminum-plating equipment: 1 unit (1.0 Mt/y)	INR85 billion (Approx. ¥140 billion)	Plan to start operation by FY2024
Nov. 2022: Acquired	AM/NS Khopoli Acquired	Acquired the former Uttam Galva Steels Established AM/NS Khopoli Pickling and cold rolling equipment (1.0 Mt/y) Hot-dip galvanizing equipment (0.75 Mt/y) Collar steel plate (0.28 Mt/y) Hammer welded pipe (0.05 Mt/y)	Approx. INR37 billion (Approx. ¥67 billion)	
May 2023: Acquired	AM/NS Gandhidham Acquired	Acquired former Indian Steel Corporation Established AM/NS Gandhidham Pickling and cold rolling equipment (0.60 Mt/y) Hot-dip galvanizing equipment (0.37 Mt/y) Collar steel plate (0.12 Mt/y)		
Under feasibility study	Study for constructing integrated iron/steel works in the east	Signed an MOU with the government of Odisha state on the acquisition of land and other items for the construction of integrated steel mills in Kendrapara and Paradeep districts in east India		

\* Mt/y: Million tons per year

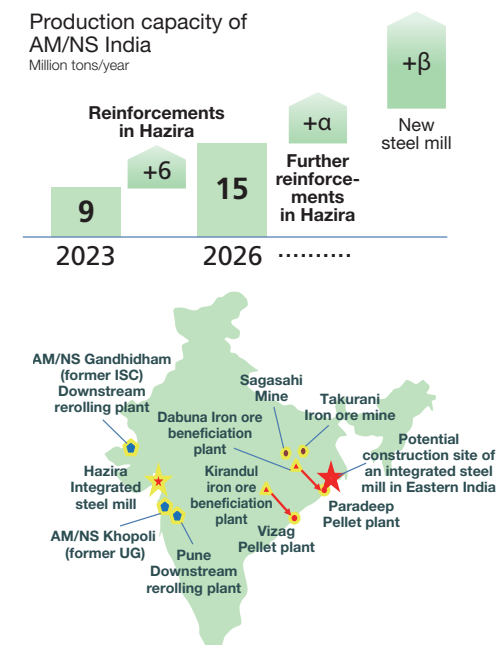
#### [Demand for steel products]



#### [India's population]



#### [Capacity expansion of AM/NS India]



The 100 Million Tons, 1 Trillion Yen Vision

(2) Deepening and expanding overseas steel business

G Steel and GJ Steel in Thailand

Among the ASEAN countries, Thailand has been an essential market for us, where we have established product processing bases since the 1960s. To meet demand for high-grade steel from local automotive and home appliance manufacturers, we have supplied semi-finished products from Japan, which are then further processed locally at our cold-rolling, coating, and other processing facilities and supplied as final products to local manufacturing companies. We have contributed to establishing an extensive supply chain in Thailand, from steel production to end-users. General sheet products are the largest demand segment in Thailand where steady, high growth is expected. It is important that we secure our position as an insider in the Thai market to capture the demand for commodity-grade products.

In March 2022, Nippon Steel acquired G Steel Public Company Limited and GJ Steel Public Company Limited, which are integrated steel production mills that produce hot-rolled steel sheets from electric arc furnaces in Thailand, and made them subsidiaries. Both G Steel and GJ Steel manufacture commodity-grade hot rolled products for which large volume demand is expected. Combined with the high-grade steel business at the conventional product processing sites, this has enabled us to establish a broad-based business (high-grade steel plus general-purpose steel) position in the Thai market. Being Thailand's only integrated steelmakers with EAFs and hot strip mills, the combination of G Steel and GJ Steel provides a stable

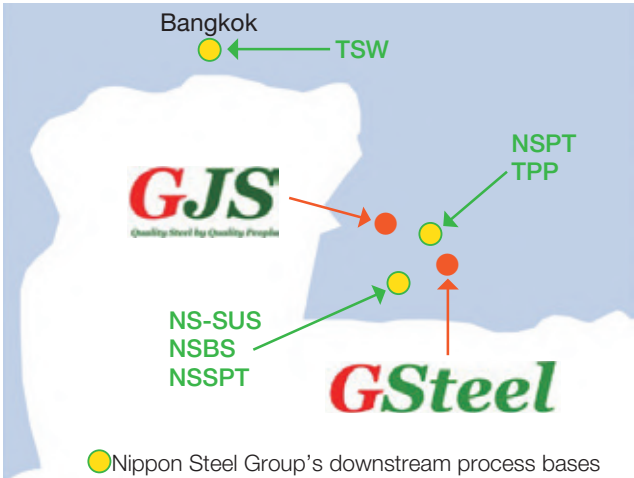
supply mainly to the construction materials and steel pipe fields in Thailand, with short delivery times. In addition, we are actively working on developing new markets, notably by supplying high-strength construction materials and raw plates to reroll makers (cold rolled and plated products), and by exporting to neighboring countries and Europe.

In addition, with the possession of integrated electric arc furnace and hot rolling facilities, G Steel and GJ Steel may potentially become a base to promote “high-grade steel production in a large size electric arc furnace,” which is one of the three breakthrough technologies we are developing for the Carbon Neutral Vision 2050.

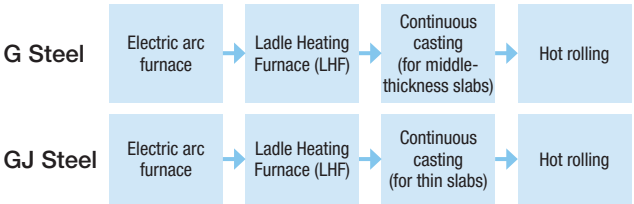
After the completion of the acquisition of G Steel and GJ Steel, Nippon Steel has sent personnel (23 as of August 2024) to the companies' major divisions such as production, sales, maintenance, planning, and finance to rebuild and strengthen their business foundation. In August 2024, we decided to make capital spending of approximately 1.5 billion baht (approximately 6 billion yen) to strengthen their ability to respond to quality and to handle cost competitiveness. Investments include the establishment of a new skin-pass mill and improvement of the scrap yard at G Steel, as well as investment in strengthening scrap management at both G Steel and GJ Steel.

Both companies will strengthen their ability to respond to quality and to handle cost competitiveness, quickly build a strong profit structure, and capture demand in the Thai market, where steady growth is expected.

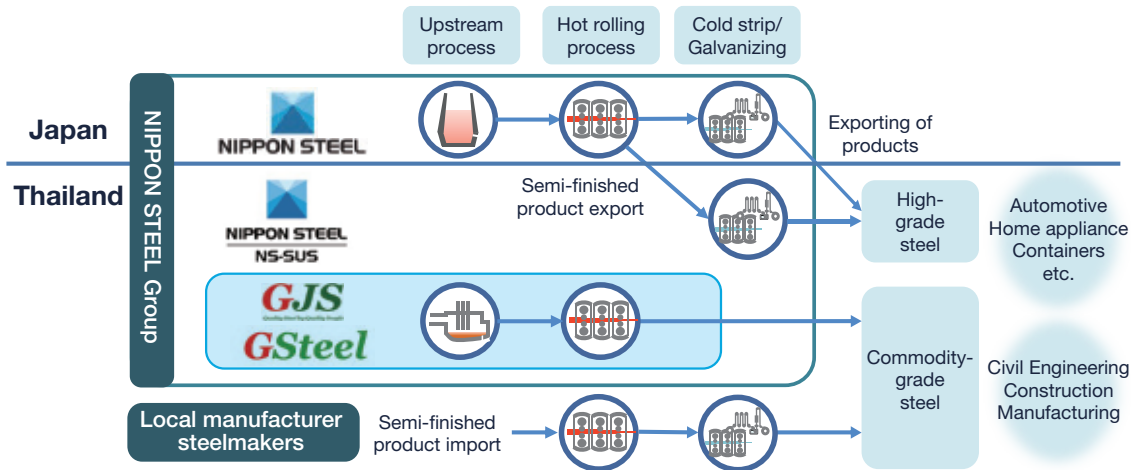
[Manufacturing bases in Thailand]



[Manufacturing process]



[Thai Market in our Global Business Strategy]



The 100 Million Tons, 1 Trillion Yen Vision

(As of the end of August 2024)

Special Feature: Acquisition of U. S. Steel Corporation

On December 18, 2023, we announced our decision to acquire United States Steel Corporation (“U. S. Steel”), an integrated blast furnace and electric arc furnace steel manufacturer. The acquisition is currently being reviewed by the relevant authorities and is expected to close in the third or fourth quarter of calendar year 2024 as soon as the approval is obtained.

By bringing together the two companies that have provided superior products and services and contributed to the development of society over their long history, we will integrate our manufacturing capabilities with world-leading technologies, provide better value to customers around the world, and move forward together as the best steelmaker with world-leading capabilities.

Overview of U. S. Steel

U. S. Steel is one of the leading integrated blast furnace and electric furnace steelmakers in the United States, and manufactures and sells steel sheets for use in automobiles, home appliances, and building materials, as well as steel pipes for use in the energy sector in the United States and Europe (Slovakia).

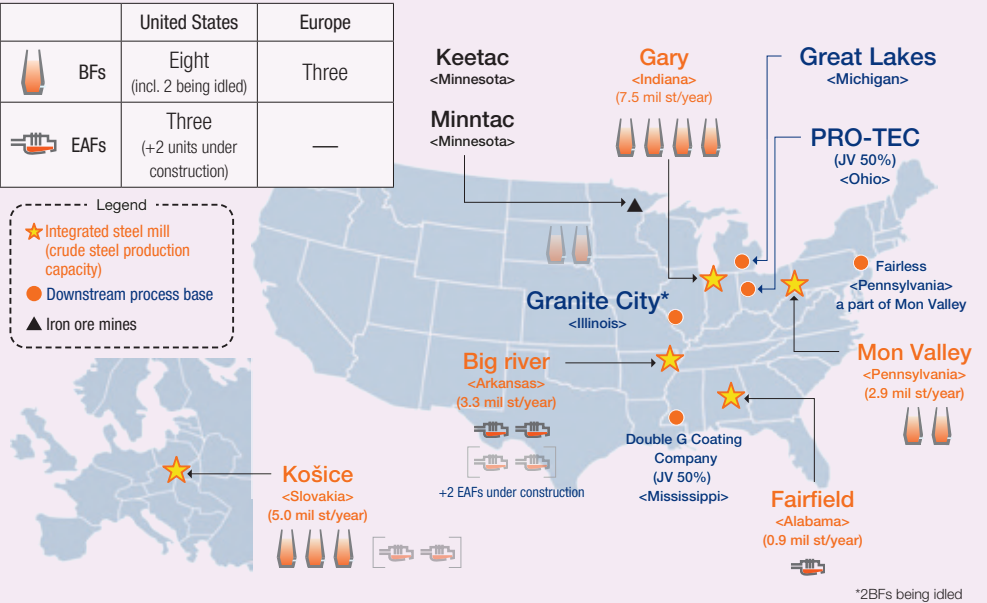
The company has a crude steel production capacity of approximately 20 million tons, and in addition to its competitive integrated blast furnace steelworks, it possesses valuable assets such as an advanced electric furnace mini-mill capable of producing high-grade steel and iron ore mines capable of self-supplying iron ore for use at its North American production sites. U. S. Steel has also invested in carbon neutrality, including the expansion of capacity of the electric arc furnace mini mills’ and installment of equipment for the production of direct reduced iron pellets to supply for electric arc furnaces.

[Overview of U. S. Steel]

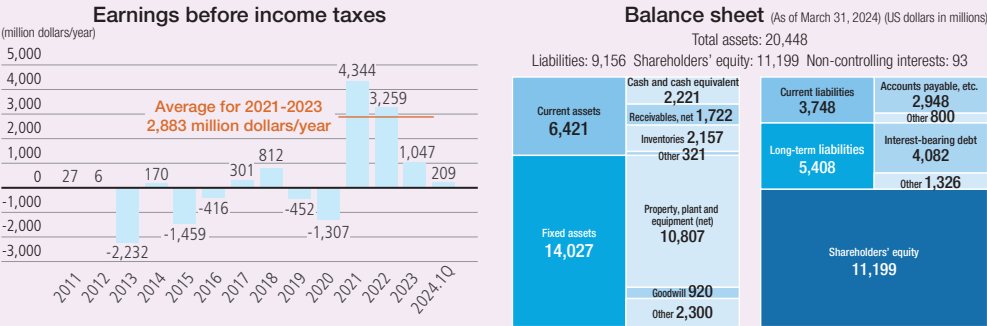
	United States	Europe	Total
Head office location	Pittsburgh, Pennsylvania, U.S.A. (Will stay at the same location after the acquisition)		
Main manufacturing base	<Steel sheet> Gary (Indiana), Mon Valley (Pennsylvania), Granite City (Illinois), Great Lakes (Michigan), PRO-TEC (Ohio) <Electric arc furnace mini mill> Big River Steel (Arkansas) <Steel pipes> Fairfield (Alabama)	Košice (Slovakia)	
Production type	Steel sheets (hot-rolled steel sheets, cold-rolled steel sheets, plated steel sheets, tin sheets, electrical steel sheets), tubular products (seamless)		
Crude steel production capacity	15.8 mil tons/year: 8 BF’s (2 of which are out of service) (17.4 mil st/year): 3 EAFs (plus 2 under construction)	4.5 mil t/year (5.0 mil st/year)	20.3 mil t/year (22.4 mil st/year)
Crude steel production volume*1	11.7 mil t/year (12.9 mil st/year, incl. EAFs of 3.0 mil st/year, 17%*) * As a percentage of total incl. Europe	4.0 mil t/year (4.4 mil st/year)	15.7 mil t/year (17.3 mil st/year)
Shipment volume of steel products*1	10.5 mil tons per year (11.6 mil st/year)	3.5 mil t/year (3.9 mil st/year)	14.1 mil t/year (15.5 mil st/year)
Iron ore mines	Minntac, Keetac (Minnesota)		
Pellet production volume	20.0 mil t/year (22.1 mil st/year) All iron ore used at steelworks in the U.S. is procured from its own mine as pellets		
Net sales*1	14,528 million dollars/year	3,525 million dollars/year	18,053 million dollars/year
Earnings before income taxes*1	1,047 million dollars/year		
Net earnings*1	895 million dollars/year		
Number of employees*2	13,995	7,808	21,803

\*1 CY2023 results, \*2 At the end of CY2023 t: metric ton, st: short ton

[Map of U. S. Steel main bases]



[U. S. Steel's financial status]



The 100 Million Tons, 1 Trillion Yen Vision

(As of the end of August 2024)

### Significance for Nippon Steel’s management strategy

Nippon Steel is moving toward 100 million tons of global crude steel capacity through expanding its integrated production framework, which enable us to create added value starting from iron/steel-making process, in “areas where demand is promisingly expected to grow” and for “sectors in which its technologies and products are appreciated.” In doing so, our basic strategy is to acquire integrated steel mills through acquisitions and capital participation (brownfield investment) and to expand the capacity of existing bases.

The U.S. steel industry is largely driven by domestic demand and U.S. steelmakers are not highly dependent on exports of products. In addition, it has been remarkable that there is a trend to bring operations back to the home U.S. market in downstream sectors such as energy and manufacturing, due to relatively low energy prices in the United States and structural changes in the world economy. We are confident that we can utilize our seasoned technologies and product lineup in the United States, since we expect a high level of demand for high-grade steel in this largest market amongst developed countries as well as sustainable growth in domestic steel demand.

We believe that this acquisition is a worthwhile investment since it is not only consistent with our overseas business strategy but also would enable us to diversify our global footprint by securing integrated steel manufacturing capabilities in the United States, adding to existing operational bases in ASEAN and India, where market volume and growth potential are significant.

Upon completion of this acquisition, the Nippon Steel Group’s global crude steel production capacity\* will increase to approximately 86 million tons per year, strengthening its reach. Nippon Steel and U. S. Steel will move forward together as the best steelmaker with world-leading capabilities, providing a range of products and services made by the technologies possessed by both companies for high-grade steel including electrical steel and automotive steel to broadly contribute to customers and society.

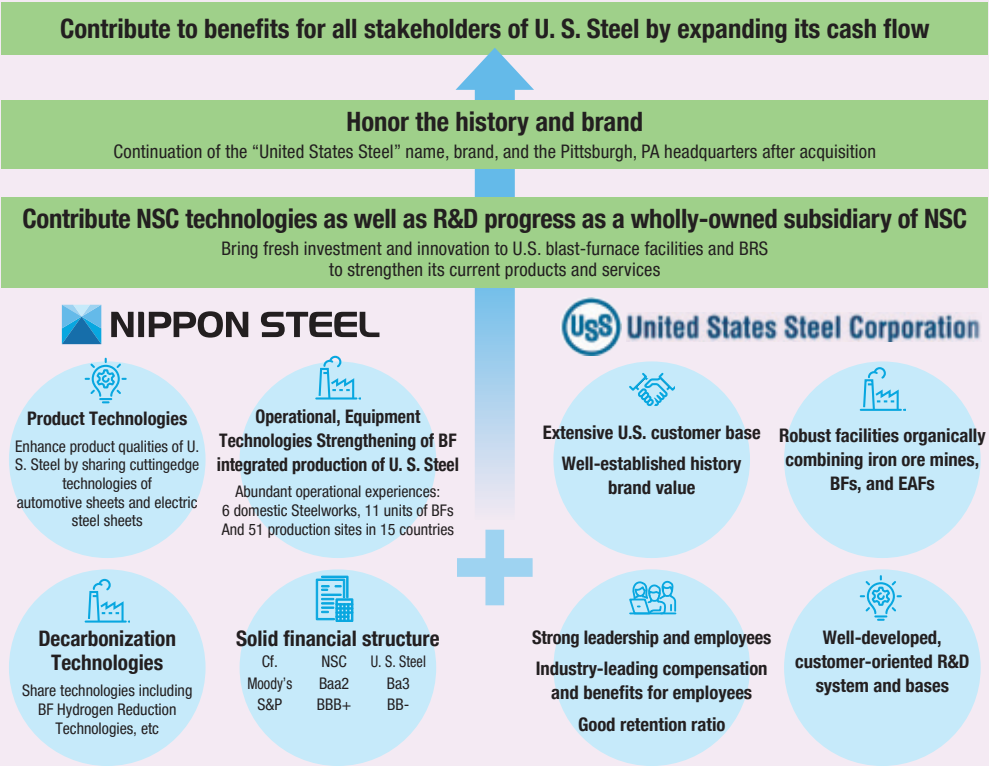
### Value creation through the acquisition, and contribution to the U.S. industry and society

Nippon Steel will continue to respect the history and brand of U. S. Steel, which will retain its iconic corporate name, brand, and headquarters in Pittsburgh. Nippon Steel North America, which will be the direct parent company, plans to relocate its headquarters from Houston to Pittsburgh.

The acquisition will not result in any new plant closures or layoffs, or any transfer of U. S. Steel production or employment overseas, protecting production and employment in the United States and bringing new investment and inovation to BF and EAF.

By making U. S. Steel a wholly owned subsidiary, we will be able to fully share our advanced technologies, including product technologies, operation and equipment technologies, and decarbonization technologies, as well as our R&D activities. By combining these with the strengths of U. S. Steel, we will expand U. S. Steel’s cash flow.

[Realizing further growth of U. S. Steel]



U. S. Steel will remain “Mined, Melted and Made in America” and will continue supplying sophisticated steel products to American industry. Nippon Steel will strongly support U. S. Steel’s sustainability, leveraging our advanced technology and formidable financial strength.

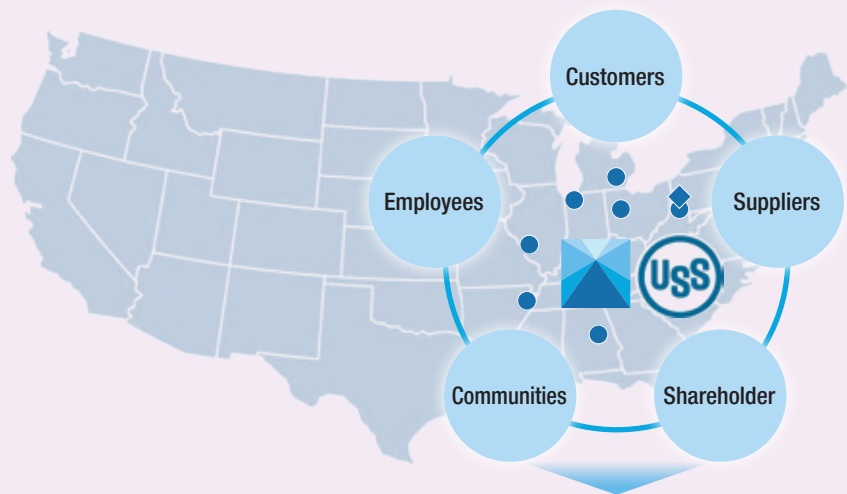
U. S. Steel's becoming a wholly owned subsidiary of Nippon Steel will contribute to the interests of all of its stakeholders, including customers, employees, suppliers, communities, and shareholders, and will bring significant benefits to the U.S. steel industry as well as U.S. industry and society as a whole.



## The 100 Million Tons, 1 Trillion Yen Vision

(As of the end of August 2024)

[Contribute to the benefit of stakeholders]



**It will bring tremendous benefits to the U.S. steel industry and the U.S. as a whole**

## Efforts to achieve carbon neutrality

Nippon Steel and U. S. Steel have been promoting research and development to achieve carbon neutrality by 2050. Each has technological strengths. Nippon Steel's strategy is to advance its three breakthrough technologies to progress towards carbon neutrality: (1) hydrogen injection into BF's; (2) hydrogen direct reduction of iron (3) high-grade steel production in large size EAFs. U. S. Steel operates one of the leading electric arc furnace mini mills, Big River Steel, and construction of Big River 2 is expected to be completed in 2024.

Going forward, by integrating the advanced technologies of both companies, the two companies will further promote efforts to achieve carbon neutrality by 2050 and contribute to the realization of a sustainable society.

## Impact of the acquisition on Nippon Steel's consolidated financial position

At the closing of the acquisition, Nippon Steel will pay 14,126 million US dollars, or 55 US dollars per share. We have already received commitment letters from Japanese financial institutions and will use proceeds from the bridge loan for payment. If all funds for the acquisition will be procured through the bridge loan, the D/E ratio immediately after the acquisition is expected to deteriorate from the current 0.5 level to around 0.9. However, in June 2024, we already had raised part of the acquisition funds in the form of hybrid funds of 250 billion yen, 50% of which is deemed as equity by rating agencies. In addition, our existing convertible bonds of 300 billion yen issued in 2021 will be converted to equity due to the arrival of their maturity date or the exercise of the soft call. These factors are estimated to temporarily raise the post-acquisition D/E ratio to around 0.8. Further, mainly by permanent financing by optimal means, the D/E ratio is expected to recover to the 0.7 level by the end of fiscal 2024. Moreover, we will aim to swiftly restore the D/E ratio to the target level of our Medium- to Longer-term Management Plan, 0.7 or lower, with a contribution from our consolidated profit and cash flow including U. S. Steel, permanent financing by optimal means, and other measures.

U. S. Steel's assets and liabilities will be consolidated in Nippon Steel's consolidated balance sheet on or after the date of completion of payment of the consideration for the merger.

(Reference) U. S. Steel consolidated balance sheet (As of the end of March 2024)

Total Assets: 20,448 million US dollars

Liabilities: 9,156 million US dollars (including consolidated interest-bearing debt of 4,082 million US dollars)

## The 100 Million Tons, 1 Trillion Yen Vision

## (3) From procure to earn profit in raw material business

Nippon Steel has made minor investments in raw material mines operated by major resource companies in order to ensure stable procurement of quality raw materials. We used to procure approximately 20% of the iron ore and coking coal we use from our invested mines, but this proportion has increased to about 30% for coking coal after we invested in Elk Valley Resources Ltd. (EVR JV), a Canadian coking coal company.

In order to realize a carbon-neutral steelmaking process, we are developing three breakthrough technologies: Hydrogen injection into blast furnaces, high-grade steel production in large size electric arc furnaces, and hydrogen direct reduction of iron. Securing stable procurement of high-quality raw materials suitable for manufacturing processes using these ultra-innovative technologies will become an increasingly important challenge. We therefore need to secure interests in raw materials that are indispensable to our business strategy.

In recent years, raw material prices have been soaring and fluctuations in market prices have been expanding. In order to realize a consolidated profit structure that is less susceptible to external factors, we must raise the portion to be procured from our mines.

From the standpoint of stable procurement of quality raw materials that will be necessary in the future, and of realization of a consolidated profit structure that is less susceptible to fluctuations in raw material market conditions, we will expand its investment in raw material mines not only for procurement, but also to make this operation into a business, utilizing our insights on user needs and raw material utilization technology. By doing so, we want to build an integrated business structure with an extensive depth spanning from raw materials to manufacturing and distribution.

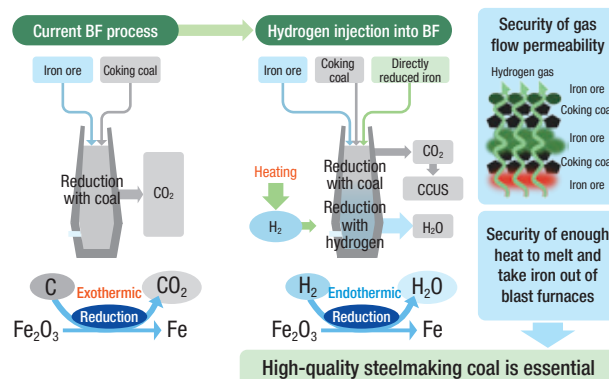
Investment in EVR JV,  
a Canadian coking coal company

In January 2024, we indirectly acquired a 20% interest (approximately 200 billion yen) in Elk Valley Resources (EVR JV), which is the coking coal business partnership sold by Teck Resources Limited, the world's second largest producer of high-quality steelmaking coal in the world.

In order to realize a carbon-neutral steel production process, we

are working on the development of "hydrogen injection into BF's" technology. In the BF hydrogen injection process, high-quality coking coal, which is used as a raw material for high-quality, high-strength coke, is required to achieve both CO<sub>2</sub> emissions reduction and the stability and efficiency of pig iron production.

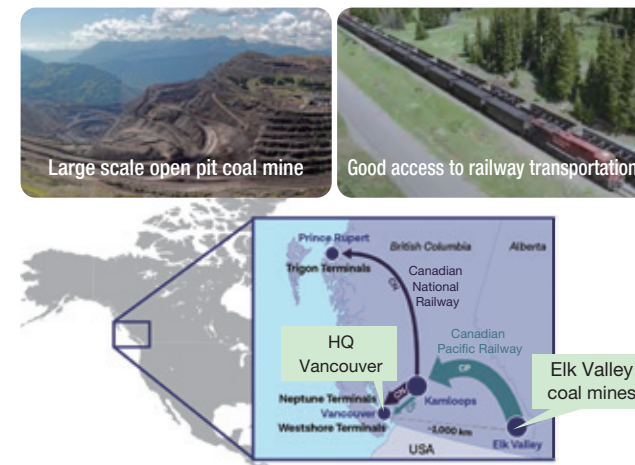
## [Necessity of securing high-quality steelmaking coal]



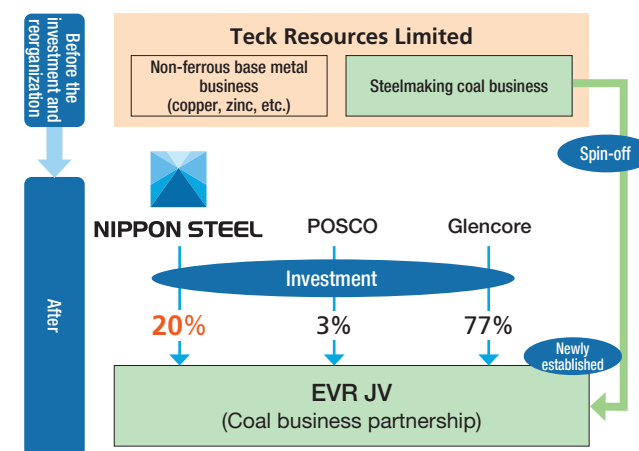
However, given the trend toward decarbonization, investment in development of coking coal for steelmaking is not expected to increase in the future, and there is growing concern that the world's capacity to supply coking coal for steelmaking will gradually decrease. In order to promote carbon neutrality in the future, we believe that we must expand investments in raw material interests by ourselves to secure stable procurement.

The coking coal produced by EVR JV is high-quality, hard coking coal and is highly competitive in terms of the cost of mining and transportation to Japan, which will greatly contribute to the realization of our carbon neutrality and the stabilization of consolidated earnings. In addition to holding a 20% stake in the company, we entered into a long-term coal offtake rights agreement that will enable long-term and stable procurement of hard coking coal. We also have a system in which we are involved in the management of the company as a business by sending one person as a member of EVR's Shareholders Committee, the highest decision-making body, to secure the right to veto decisions on important matters.

## [Outline of EVR JV]



## [Investment scheme]



The 100 Million Tons, 1 Trillion Yen Vision

(4) Incorporating distribution into the business portfolio

Changes in the environment surrounding steel distribution

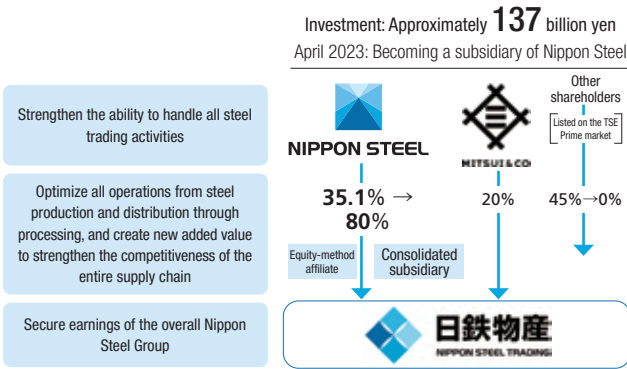
To date, in addition to direct transactions with some customers, Nippon Steel has appointed several trading companies as intermediaries and has maintained and strengthened its sales capabilities throughout the steel supply chain by utilizing their various functions such as information gathering, transaction practice, credit, investment and management in the distribution and processing businesses.

However, the environment surrounding the steel market has structurally and drastically changed in a short period of time due to a potential decline in domestic demand and expansion of local production by customers, qualitative improvement, and quantitative expansion of China and other competitors, the steel industry’s global trend of local production for local consumption, and fluctuations in resource and energy prices and exchange rates affected by economic policies in various countries to address geopolitical and inflationary risks. In order to respond swiftly and appropriately to such fluctuations, we must increase direct contact points with customers in Japan and overseas, and strengthen the ability to comprehensively carry out operations related to steel trading. Moreover, in order to securely generate the entire Group’s profit, we need to make more optimal, efficient operations that span from manufacturing to distribution and processing and to create higher added value to further improve competitiveness throughout the supply chain.

Turning Nippon Steel Trading into a subsidiary and privately held company

We have long maintained a cooperative relationship with Nippon Steel Trading, the core trading company of our Group, mainly through the sale of steel products and the exchange of personnel. However, the fact that Nippon Steel Trading is a listed company that is an equity method affiliate of Nippon Steel subjects us to certain restrictions on the mutual sharing of customer and technical information, and the storage and mutual utilization of management resources. Moreover, measures aimed at enhancing the corporate value of our Group and Nippon Steel Trading from a medium- to long-term perspective may have been viewed as conflicting with the interests of minority shareholders of Nippon Steel Trading if the measures result in a short-term deterioration in its performance or financial position.

[Changes in the investment ratios of Nippon Steel Trading]



In order to eliminate these restrictions and realize broader synergies, we transformed Nippon Steel Trading into a subsidiary and privately held company. We will create new added value by promoting many actions, listed below, from the following three viewpoints: (1) to enhance and raise the efficiency of the Group’s trading company functions, (2) to enhance the direct sales ability by making integrated use of our sales knowhow and infrastructure throughout the group, and (3) to further advance the supply chain.

[Measures under consideration or in preparation for projects involving Nippon Steel Trading]

Equity investment in Hyster, a Norwegian company engaged in the production of water electrolysis equipment for hydrogen production (January 2023: equity investment)
Expansion of a steel material service center in India (August 2023: start of operation)
Integration of NS Construction Materials Sales Co., Ltd. and SK Construction Co., Ltd. (temporary stand construction) (April 1, 2024: integrated)
NST Mechanical Tubular Products Sales Co., Ltd. acquired the automobile steel pipe cutting business from Sakaishin Co., Ltd. (April 1, 2024: acquired)
Transfer of the steel processing business of Mitsuhashi Kozai Co., Ltd. to Nippon Steel Kobelco Shearing Corp. (July 1, 2024: transferred)
Made Denkishizai Co., Ltd. a subsidiary (August 1, 2024: executed)
Merger of Nippon Steel Trading and NS Architectural Steel Services Corp. (former Nihon Teppan Co., Ltd. ) (October 1, 2024: to merge)
Construction of high-grade electrical steel sheet processing plant in Mexico (April 2025: scheduled to start operation)
Full-scale development of the portal site for linking information with business partners (NST Business Online)
Undertaking efforts to focus our sales forces on new demand areas, improve the efficiency of our commercial business operations, and strengthen cooperation at overseas bases

## Nippon Steel's Strategies

## Status of progress in the 100 Million Tons, 1 Trillion Yen Vision

## What we did so far

## Actions to be taken

## 1. Rebuilding of the domestic steel business

## Drastic improvement of breakeven point

## 1) Facility structural measures

- Implemented more than half of the planned facility shut-downs for the production facility structural measures, including 4 BF's
- Reduced annual costs by ¥100 billion by FY2023 of ¥150 billion planned in the structural measures
- Significantly reduced the scale of fixed cost due to cost reduction efforts, including structural measures
- Shut down facilities including one BF (Kashima No. 3) in accordance with the roadmap for the structural measures, and consolidate production into competitive facilities
- Steadily reduce the remaining ¥50 billion costs of the structural measures
- Absorb the increase in amortization costs, and maintain a low level of fixed costs by cost reduction efforts, including structural measures

## 2) Spread improvement in direct contract sales

- Improved direct contract pricing
- Revised the business practice of direct contract-based sales (starting with goods shipped in Apr. 2022)
- Promptly reflect the short-term rapid fluctuation of raw material market prices, increase in labor costs and transportation costs, etc. in sales prices
- Reflect the value of our products and solutions to the sales price

## 3) Shift to a more sophisticated order mix, and undertake renewal and improvement of facilities

- Relined the No. 3 BF at the Nagoya Works (Jan.–Jun. 2021)
- Decided to invest in improving capacity and quality of electrical steel sheets. Partially completed and launched in Sep. 2023
- Decided to invest in strengthening the supply system of ultra-high-tensile steel sheets (the construction of a next-generation hot strip mill in Nagoya)
- Steadily execute construction and start of the capital investment plans to improve strategic product capability and quality, increase the ratio of high-value-added products, and increase marginal profit unit price
- Develop and provide high-value-added products and solutions that meet customer needs

## 2. Deepening and expanding overseas business

- Acquired G/GJ Steel (Feb. 2022)
- Decided to invest in expanding capacities for upstream steelmaking and steel sheet capabilities at AM/NS India's Hazira steel mill in west India (Sep. 2022, Apr. 2022), and secured renewable energy power and acquired infrastructure assets (Sep. 2022).
- Announced the proposed acquisition of U. S. Steel (Dec. 2023)
- Work on deal closing of the U. S. Steel acquisition and maximize the post-acquisition business value
- Further expand capacities at AM/NS India (capacity expansion at Hazira steel mill in west India and construction of a new steel mill)
- Explore further opportunities toward establishing a 100 million-ton global steel capacity

## 3. From procure to earn profits in raw material business

- Indirectly acquired a 20% interest in Elk Valley Resources (EVR JV), which is the coking coal business partnership sold by Teck Resources Limited, the world's second largest producer of high-quality steelmaking coal in the world.
- Pursue more investments in raw material interests in order to secure stable procurement of raw materials essential to the business strategy

## 4. Incorporate steel distribution in the business portfolio

- Nippon Steel Trading became a subsidiary and a privately held company (Apr. 2023, Jun. 2023)
- Strengthened the capacity to assume responsibility for all steel trading activities
- Become more competitive throughout the supply chain by optimizing and improving efficiency in steel production, distribution and processing, and through creation of new value

# Carbon Neutral Vision

We aim to achieve CO<sub>2</sub> reduction in our supply chain by offering two values: “providing high-performance steel products and solutions that contribute to reducing CO<sub>2</sub> emissions throughout society” and “providing carbon neutral steel by decarbonizing the steelmaking process” through the realization of the “Nippon Steel Carbon Neutral Vision 2050”.

## Providing two types of values targeted by the Carbon Neutral Vision 2050



**NIPPON STEEL**

In support of the ambitious government policy to realize a carbon neutral society in 2050, we announced the Carbon Neutral Vision 2050 as a part of the Medium- to Long-Term Management Plan in March 2021.

### Providing two types of values by achieving carbon neutrality

Provision of high-performance steel products and solutions that contribute to reducing CO<sub>2</sub> emissions in society as a whole



Reduce CO<sub>2</sub> emissions at the time of production and processing by customers

Reduce CO<sub>2</sub> emissions at the time of use of our products by end customers

Provision of carbon neutral steel through decarbonization of the steelmaking process



Reduce CO<sub>2</sub> emissions in customers' supply chains

By providing high-performance steel products and solutions, and by providing carbon-neutral steel through decarbonizing steel-making process ahead of other countries in order to supply carbon neutral steel to the markets, we are determined to meet the decarbonization need of our customers (including approximately 6,000 companies in Japan) and support their international competitiveness.

## Decarbonization scenario for “Carbon Neutral Vision 2050”

We have formulated a target of reducing total CO<sub>2</sub> emissions by 30% by 2030, compared to the 2013 baseline and of achieving carbon neutrality in 2050. We are working to develop and actually implement breakthrough technologies in steelmaking process ahead of steel companies in other countries.

Our plan is ambitious compared to those of our global peers, and is intended to significantly contribute to the Japanese government's plan. With the assistance of the Green Innovation (GI) Fund\*, we are working on specific plans for the roadmap of development and practical implementation.

\* This is a project that commissions or subsidizes research and development of the New Energy and Industrial Technology Development Organization (NEDO), a national research and development corporation, to support companies and others implementing projects that aim to achieve ambitious 2030 targets (e.g., CO<sub>2</sub> reduction) in focused areas of the Green Growth Strategy Action Plan.

### [Our CO<sub>2</sub> emissions reduction scenario]

Target in 2030

**30% reduction in total CO<sub>2</sub> emissions vs. 2013**

30% reduction in total CO<sub>2</sub> emissions vs. 2013 by implementing the COURSE50\* in the existing BF and BOF process, reducing CO<sub>2</sub> emissions in existing processes, and establishing an efficient production framework.

\* COURSE50: Abbreviation for CO<sub>2</sub> Ultimate Reduction System for Cool Earth 50

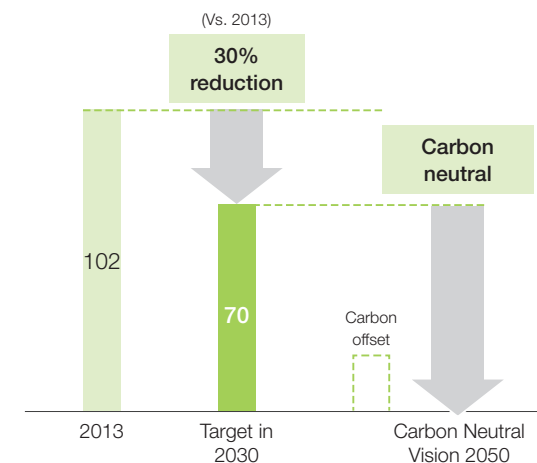
Vision for 2050

**Ambition to become carbon neutral**

Ambition to become carbon neutral by taking up the challenge to mass produce high-grade steel in large size EAFs and to realize hydrogen steelmaking (i.e., Super COURSE50 use of BFs; hydrogen direct reduction of iron), and with multi-aspect approach, including CCUS\* and other carbon offset measures.

\* Carbon Capture, Utilization and Storage

### [Total CO<sub>2</sub> emissions\* (million tons/year)]



[Scope of scenario]  
Domestic  
SCOPE 1+2 (Receipt of raw materials to product shipment + indirect emissions from purchased electricity)

\* Including Nippon Coke & Engineering Co., Ltd. and Sanso Center Co., Ltd.



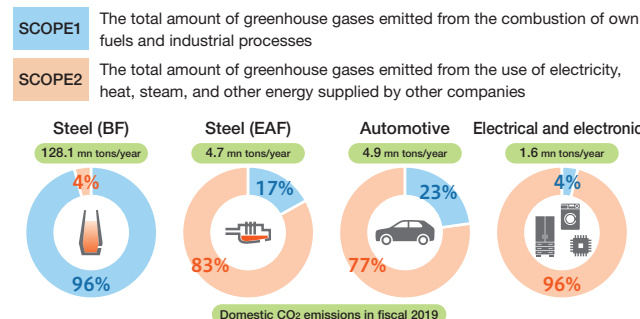
## Carbon Neutral Vision

## Three challenges to achieving carbon neutrality in the steel industry

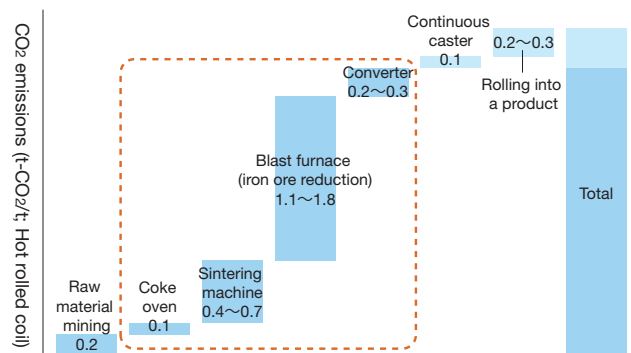
In order to achieve carbon neutrality in the steel industry, there are three unique challenges in technology development, predictability of return on investment, and infrastructure, which must be overcome simultaneously.

## Technology Development: the need for the development of breakthrough technologies

Most of the CO<sub>2</sub> emitted in the supply chain of the steel industry is from steelmaking processes (Scope 1), particularly in the upstream processes from the reduction of raw materials such as iron ore and scrap to melting and refining.

[Ratio of Scope 1 to Scope 2 CO<sub>2</sub> emissions by industry]

Source: The JISF compiled figures recorded in the General Energy Statistics for Fiscal 2019 for non-steel industries, and calculated figures for the steel sector by the Japan Iron and Steel Federation.

[CO<sub>2</sub> emissions from the steelmaking processes]

Source: Carbon Trust International Carbon Flows (2011)

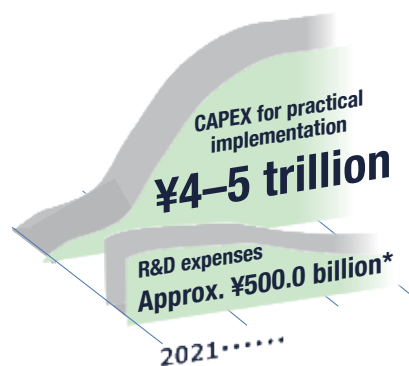
The steel industry does not have any existing technologies for drastic decarbonization, unlike renewable energy and nuclear power generation in the electric power industry, and electric vehicles in the automotive industry. The industry therefore needs to develop a super-innovative technology that uses hydrogen instead of carbon as a reducing agent for iron ore in the steelmaking process.

Nippon Steel has been striving to develop three breakthrough technologies: “Blast furnace hydrogen reduction,” “reduced iron production using hydrogen,” and “high-grade steel production in large electric arc furnaces” to solve the above-mentioned daunting technical challenges and realize a carbon-neutral steelmaking processes.

## Predictability of investment recovery

The development and commercialization of breakthrough technologies that realize carbon-neutral steel production processes require significant R&D expenses and capital investment. At present, in order to achieve carbon neutrality in our steel production processes, we anticipate that we will need to spend more than 500 billion yen in R&D and more than 4 to 5 trillion yen in capital investment on actual equipment by 2050. Operating costs will also increase compared to operating the traditional steelmaking processes.

## [Carbon Neutral required Investment Image]



\* Minimum level estimated to be required for the time being

## Three factors to increase costs

- Huge R&D expenses
- Huge CAPEX for practical implementation
- Increase in operational cost, even if inexpensive green hydrogen and green power are to be secured

Concerning R&D expenses, government support via the GI Fund has already been decided. We are making our utmost efforts to become a frontrunner in the world in developing technologies for the practical implementation of the three breakthrough technologies. We are already discovering the seeds of technology and are planning to develop technologies that will minimize significant cost increases. The test results so far have shown steady progress.

With regard to capital investment for practical implementation, predictability of investment recovery is needed in making decisions. In order to ensure predictability, 1) creation of a market for green steel products and 2) sufficient support from the government for rising capital investment and operating costs are indispensable.

## ■ Creation of a market for green steel products

Efforts to realize carbon neutrality of the steel production process require three huge increases in costs: R&D costs, equipment investment, and operating costs. Nevertheless, steel products based on the new steelmaking processes are no different from products based on conventional steelmaking processes. Because the value in use is the same, and only the environmental value (CO<sub>2</sub> reduction) is added, this environmental value needs to be converted into economic value (to be passed on to the sales price). Unlike the sale of electrified vehicles that differ from conventional vehicles and the sale of electric power, for which the market is closed in Japan, steel products are distributed internationally and are exposed to competition. To customers of steel products and also to consumers of end products, a major challenge for us is to promote the environmental value and convert it into economic value. In order to create a green steel market, it is important to establish an international standardization for green steel products, as well as a mechanism to give an incentive and support for purchasing green steel products. We are lobbying many stakeholders, including governments, various industry associations, national and international standard-setting bodies, and academics to create such a mechanism.

## Carbon Neutral Vision

## ■ Support for rising capital investment and operating costs

In other countries, government support systems have been established not only for R&D expenses to achieve carbon neutrality, but also for actual equipment investment and rising operating costs. From the standpoint of equal footing in international competition, such a support system is desired in Japan as well. The Japanese government has already launched investment promotion measures using GX Economy Transition Bonds for technologies that effectively and efficiently achieve emission reductions, particularly those that are highly effective in strengthening industrial competitiveness and economic growth, as well as tax credits corresponding to the production volume of each strategic sector.

We have lobbied government agencies to establish such a support system. Going forward, we will work to obtain such support and ensure the predictability of investment recovery.

## Infrastructure: Energy infrastructure development

Carbon-neutral steelmaking processes require a large amount of hydrogen and electric power, which must be green hydrogen and green power produced without generating CO<sub>2</sub>. CO<sub>2</sub> emissions that would still be partially generated by using Nippon Steel's three breakthrough technologies must be physically offset by CCUS (Carbon Capture, Utilization, and Storage).

We have positioned the "stable supply of low-cost green hydrogen and power" and the "social implementation of CCUS" as "external conditions that should be established by the government" necessary for carbon-neutral steelmaking processes, and are lobbying relevant government agencies.

## Policy proposals and industry activities aimed at overcoming the three challenges

As stated, steelmakers alone cannot achieve carbon neutrality in the steel industry. These are national challenges that should be addressed by the entire nation in cooperation with society, based on (1) policy packages to achieve both international competitiveness of industries and carbon neutrality as well as (2) policies for national strategies that include strong and continuous

support, including from the financial side.

To realize these policies, Nippon Steel is determined to take every opportunity to make various proposals on Japan's climate change measures and energy policies based on the Paris Agreement and to spearhead activities through economic and industry associations.

## ■ What Nippon Steel has advocated so far

- Strong and continuous support across all stages of R&D, equipment implementation, and operational cost increases for decarbonization, including the expansion of the GI Fund
- Need for a Japanese-style policy package that integrates climate change measures with maintenance and enhancement of the international competitiveness of industries
- Need to establish a mechanism for regulations and support for creating a green steel market, and standardization for a more accurate evaluation of the "actual amount of reductions"
- Request that an effective and feasible system in designing a future emissions trading system be introduced, by considering the fact that the path to carbon neutrality differs depending on the industry and the perspective of equal footing with other countries. Nippon Steel has participated in the GX League, which promotes voluntary emissions trading.
- Reform of the energy supply structure, including not only renewable energy but also the active promotion of the use of nuclear power
- Need for a stable low-cost supply of green hydrogen and green power, as well as the social implementation of CCUS

## [Efforts to surmount the 3 challenges]

Technology development	Gov't support in development planning and testing	<b>Green Innovation(GI) Fund</b> "Utilization of hydrogen in the steelmaking process" ¥193.5 bln ➡ Raised to ¥449.9 bln	...	Budgeting completed
	Gov't support for capital expenditures	<b>One-third</b> of the total investment borne by the government by use of <b>GX Economy Transition Bonds</b>	...	Institutionalization completed
Predictability of investment recovery	Gov't support for operating costs	Establishment of a <b>strategic materials and production base tax system</b> (Green Steel)	...	Institutionalization completed
	International standardization	• <b>Adoption of the mass balance method</b> at Worldsteel and <b>development of guidelines</b>	...	High-level agreement in principle
		• Lobbying for revision of ISO, GHG protocol, etc.	...	Implementing and preparing
	Creation of economic value from the environmental value (CO <sub>2</sub> reduction)	• <b>GX League</b> [Ministry of Economy, Trade and Industry] ➡ Growth-oriented carbon pricing • <b>GX Product Market Study Group</b> [Ministry of Economy, Trade and Industry] and the Government <b>GX Implementation Committee</b> • Exchange of opinions with <b>the automobile industry</b> and others	...	Start of discussion on GX market creation
Infrastructure	Energy infrastructure development	• Safe use of nuclear and other energy sources for the 7 <sup>th</sup> Strategic Energy Plan	...	Committee recommendations
		• Hydrogen and Ammonia: Revised Basic Hydrogen Strategy, <b>Hydrogen Society Promotion Law</b>	...	Bill passed
		• CCS: <b>JOGMEC/Advanced CCS Support Program</b>	...	Project participation

## Carbon Neutral Vision

## Decarbonization of steelmaking process

In the current BF-BOF and EAF processes, coal (coke) has been utilized as 1) a reducing agent, 2) a source of heat, and 3) plays a role to support the function of raw materials at high temperature in a solid form while facilitating to maintain ventilation in the furnace. However, CO<sub>2</sub> is inevitably generated during the reduction reaction.

We are therefore drastically reviewing the process. As our top management issue, we are developing and implementing the following three breakthrough technologies: 1) Reduction with hydrogen in BFs (injecting hydrogen into existing BFs for partial replacement of carbon use), 2) Hydrogen direct reduction of iron (producing solid reduced iron by hydrogen reduction in direct reduction furnaces (DRFs)), and 3) High-grade steel production in large size EAFs (improving the productivity of EAFs to manufacture high-grade steel not producible today using direct reduced iron and steel scrap). In addition, we have started to develop technologies such as high efficiency melting of direct reduced iron using an electric melting furnace.

We aim to achieve carbon neutrality by 2050 by converting the existing BFs into the EAF steelmaking process or introducing an applicable CO<sub>2</sub> reduction technology, such as reduction with hydrogen in BFs, over the next few decades.

In addition, we will continue to actively urge the government and related organizations to establish the development of social infrastructures required to achieve this carbon neutrality, including the “low cost and stable supply of green hydrogen and green electricity” and the “introduction of CCUS.”

## Technical Issues for realizing a carbon-neutral production process

<https://www.nipponsteel.com/en/csr/env/warming/future.html>

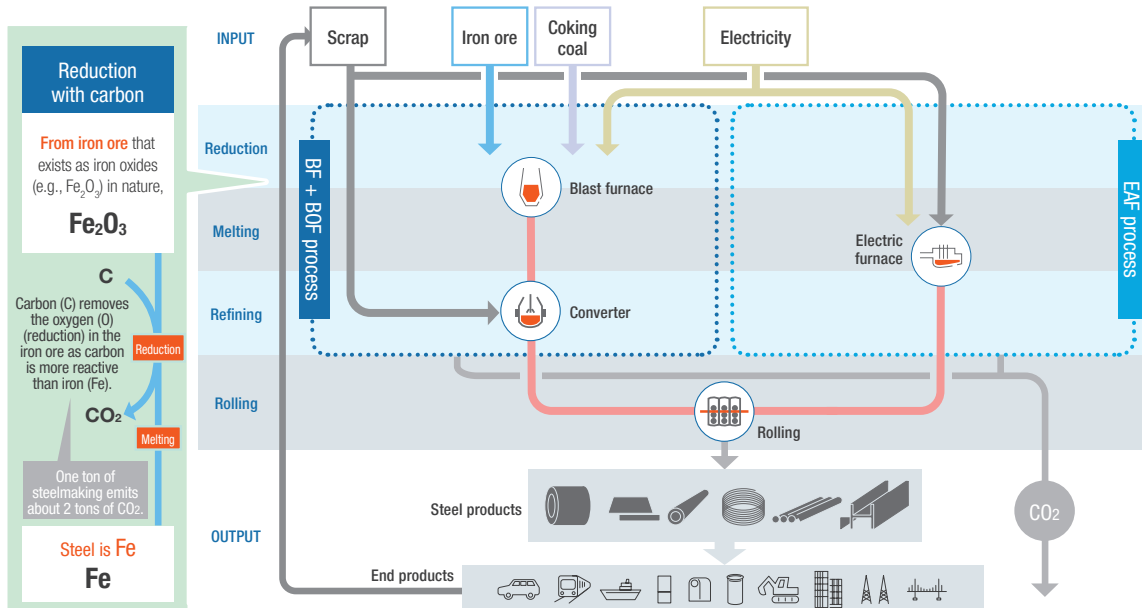
## Efforts to reduce carbon emission in power generation

We generate 89% of the electricity we use at our steelworks, 70% of which is from internally generated energy sources such as waste heat and by-product gases. We also use LNG, petroleum, and coal as external-source auxiliary fuels. Therefore, in order to reduce the carbon content of our electric power structure, we will examine and promote the following efforts:

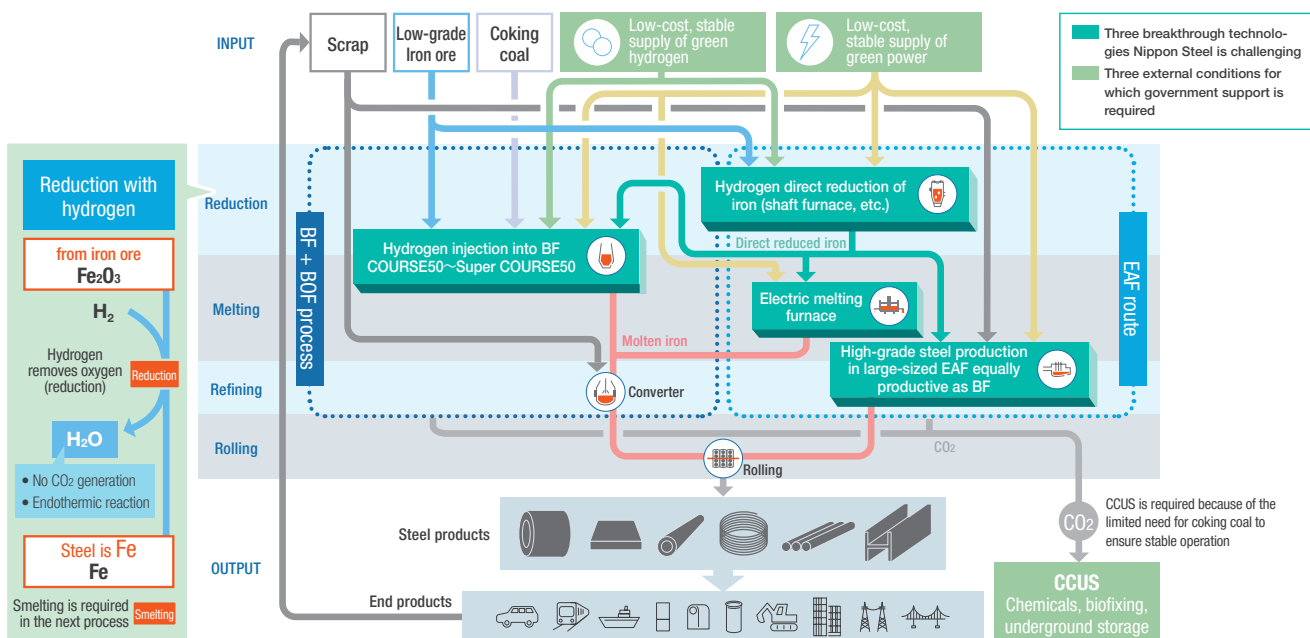
## [Issues to consider and promote reducing carbon in the electric power structure]

- Total elimination of inefficient coal-fired power
- Increase efficiency in thermal power fired by by-products, utilization of CCUS, and use of non-fossil fuels for external auxiliary fuels (expanded use of zero-emission fuels such as biomass, ammonia, and hydrogen)
- Purchase of green power

## [Current BF-BOF and EAF processes]



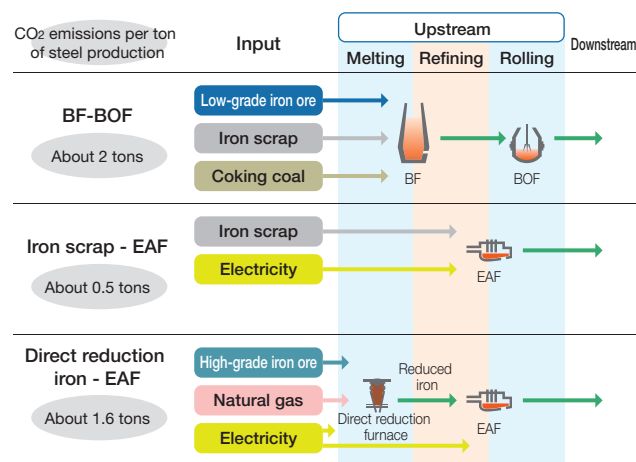
## [Carbon neutral steel production process (conceptual)]



## Carbon Neutral Vision

## The need for a multi-track approach

At present, there are two types of mass production processes for steel: The blast furnace and the basic oxygen furnace (BF-BOF) process (reduction and melting) and the electric arc furnace (EAF) process (melting). The BF-BOF process uses iron ore, while the EAF process uses steel scrap and direct-reduced iron by reducing iron ore with natural gas.



## Challenges of the BF-BOF method

The current BF-BOF process generates approximately 2 tons of CO<sub>2</sub> per ton of steel production. In order to reduce this CO<sub>2</sub>, we are developing a blast furnace hydrogen reduction technology that replaces the reducing agent from carbon (coal) to hydrogen. However, because the blast furnace is a facility for not only reduction but also melting, it still uses coal as a melting heat source, and CO<sub>2</sub> emissions will not be zero. Therefore, the combined use of CCUS offset measures is needed.

## Challenges of the EAF method

Among existing steel production processes, the EAF method of melting steel scrap in an EAF (about 0.5 tons of CO<sub>2</sub> emissions per ton of steel product) generates the least amount of CO<sub>2</sub>. However, the EAF process alone cannot realize decarbonization of the global steel industry due to the following issues, and steelmaking by reduction of iron ore will also continue to be needed.

## ■ Power supply

The EAF steelmaking process requires a large amount of electricity. In contrast, the existing BF-BOF process using carbon reduction generates electricity by using by-product gas and waste heat recovery to internally source the electricity needed for the steelmaking process and supplies surplus electricity to society. If the existing carbon reduction BF-BOF process (using a large BF of approximately 5,000m<sup>3</sup>) is replaced by the EAF process, an additional power supply of approximately 1 GW will be required.

## ■ Finite nature of scrap resources

At present, around 600 million tons of steel scrap is generated annually around the world, and its collection/recycling rate is extremely high. As steel will continue to be accumulated mainly in emerging countries, more steel scrap will be generated year by year, which, however, will not be sufficient compared to the increasing global demand for steel. This means that the current scale of steelmaking by reducing iron ore will be needed even in 2050.

## ■ Impurities in steel scrap

In the future, global steel demand is expected to shift to high-grade steel due to the need to resolve social issues such as decarbonization and national resilience.

Against this trend, current EAF steelmaking technology limits the grades of steel products that can be produced from steel scrap in EAF, making it hard to produce high-grade steel due to impurities contained in steel scrap that cannot be removed in the melting and refining process, while nitrogen in the air mixed in the steel in the EAF process affects the properties of the steel.

## Challenges of direct reduced iron

Since natural gas containing carbon is used as a reducing agent in the production of direct-reduced iron in the current direct reduction furnace, a certain amount of CO<sub>2</sub> (approximately 1.6 tons of CO<sub>2</sub> emissions per ton of steel products) is generated. This means that it is necessary to develop technology to convert the reducing agent from natural gas to hydrogen in order to achieve carbon neutrality.

## ■ Scarcity of high-grade iron ore

Since the reduction of iron ore by hydrogen is an endothermic reaction, the powdering and sticking of the raw material become an obstacle to production when the temperature drops.

In order to avoid this, it is necessary to use iron ore that is less susceptible to powdering and sticking. However, such high-grade ores represent only 5% to 10% of the world's iron ore resources.

## ■ Productivity

Both the direct reduction furnace process and the EAF process have significantly lower per-unit productivity than the BF-BOF process. While the productivity of Nippon Steel's average BF (approximately 5,000 m<sup>3</sup>) is roughly 10,000 tons/day, the productivity of the direct reduction furnace and the EAF is about half and 20-30%, respectively. Therefore, when replacing the upstream process of the existing BF steelworks with that of the EAF process, the production lot and cycle time of the remaining downstream processes must be adjusted.

## Nippon Steel's Carbon Neutral Vision approach

Nippon Steel aims to realize a carbon-neutral steel production process with an optimal composition according to economic conditions such as energy and raw materials by taking advantage of the characteristics of both the BF-BOF and EAF methods.

That is why we are working on technology development with a multi-track approach to solve the issues of the EAF method using scrap and direct reduced iron as raw materials while promoting the decarbonization development of the BF-BOF, which is superior in productivity and quality and makes use of existing infrastructure. To ensure that the 2030 CO<sub>2</sub> reduction target is met, consideration is being given to an electric kiln that can be implemented as soon as possible.

## Carbon Neutral Vision

## CCUS technology development

CCUS (Carbon Capture, Utilization, and Storage) is a technology that separates, captures, and directly uses CO<sub>2</sub> or converts it into other materials and utilizes it or stores CO<sub>2</sub> in the ground. In the carbon neutral steel production process, CCUS technology is used to process CO<sub>2</sub> still generated from the steelmaking process even after it has been minimized. Realization of this technology requires the related technology development as well as preparation

of external conditions. The required technologies include the development and installment of CO<sub>2</sub> separation and recovery technology (high-performance chemical adsorption liquid) and the development of CO<sub>2</sub>-based manufacturing technologies for chemicals and fuels. The necessary external conditions include the securing of the storage space, the establishment of the storage infrastructure for CCS, legislation, and tax incentives, the ensuring

of business profitability of chemicals and fuels manufactured by CCU (Carbon Capture and Utilization), and preferential treatment of carbon recycled products. The Nippon Steel Group is aggressively engaged in developing these technologies to help realize the social implementation of CCUS.

## [Nippon Steel Group's CCUS technology development efforts]

## Capture

CO<sub>2</sub> Separation and Recovery Technology (NEDO COURSE50 Projects)

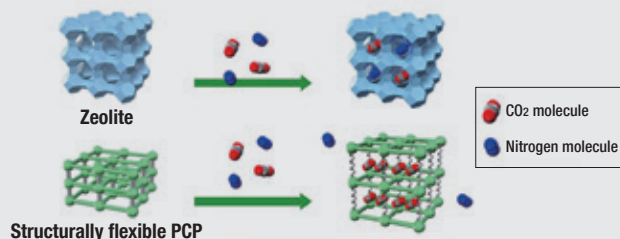
Nippon Steel Engineering Co. in the Nippon Steel Group has commercialized an energy-saving CO<sub>2</sub> chemical absorption process called ESCAP™ (Energy Saving CO<sub>2</sub> Absorption Process), which uses chemical absorption, one of the methods for CO<sub>2</sub> separation and recovery. Two units are already in operation in Japan, including the one installed in the North Nippon Works Muroran Area.

The ESCAP™ is characterized by high energy efficiency with a more than 40% reduction in heat consumption compared to general-purpose technology. In addition, its proprietary impurity removal facility enables recovery of more than 99.9% of high-purity CO<sub>2</sub> from raw material gas with high impurities.

Development of low-concentration CO<sub>2</sub> separation and capture technology (subsidized by the Green Innovation Fund)

Nippon Steel, in collaboration with Oita University, Osaka University, Kyoto University, Chiba University, Nagoya University, Hokkaido University, and Resonac Corporation, started the full-scale development of separation/capture technology for low-concentration CO<sub>2</sub> contained in industrial emission gases.

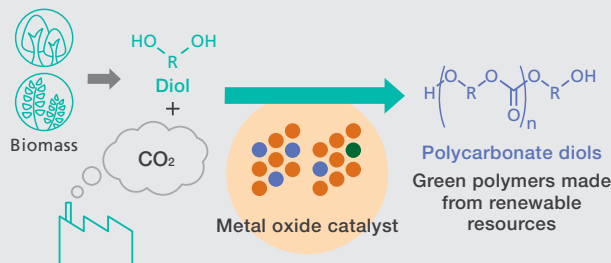
To separate/capture CO<sub>2</sub> efficiently from low-pressure, low concentration emission gases (with a CO<sub>2</sub> concentration of 10% or less at the atmospheric pressure), we are working on the development and social implementation of a new CO<sub>2</sub> separating agent (structurally flexible PCP), which has higher CO<sub>2</sub> selectivity and enables CO<sub>2</sub> adsorption and desorption with minimal levels of pressure operation.



## Utilization

Chemical product manufacturing technology using CO<sub>2</sub> as a raw material (project commissioned by NEDO)

In April 2023, Nippon Steel, Osaka Metropolitan University, Kyoto University, Tohoku University, Tokyo University, and UBE Corporation started research and development on the "development of one-step synthesis process for polycarbonate diol from CO<sub>2</sub>." Polycarbonate diol is a representative material for producing high value-added carbon compounds that do not require hydrogen. It is also a raw material for high-performance polyurethanes, widely used worldwide and whose demand is expected to grow further. However, the high environmental impact of its synthesis process has been a major issue. In contrast, this research and development aims to develop an innovative green process that effectively utilizes CO<sub>2</sub> instead of highly toxic gases such as CO and achieves high yields in one-step synthesis.



## Transportation

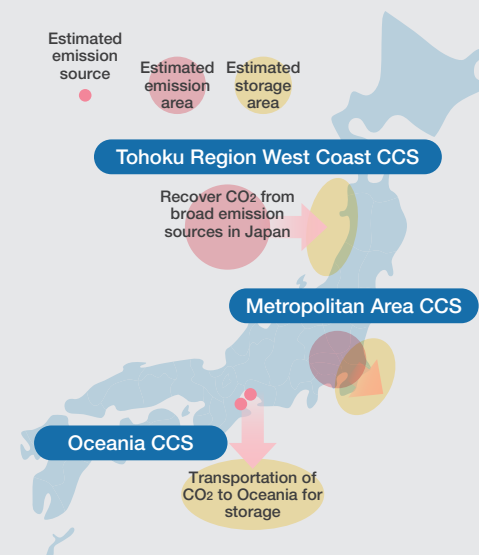
Integrated CO<sub>2</sub> ship transport technology (NEDO-commissioned project)

Jointly with Japan CCS Co., Engineering Advancement Association of Japan, and ITOCHU Corporation, and Nippon Gas Line, we have commenced the R&D and demonstration project related to a CO<sub>2</sub> transport vessel.

## Storage

CO<sub>2</sub> storage technologies

As part of the Survey on the Implementation of Japan Advanced CCS Projects that the Japan Organization for Metals and Energy Security (JOGMEC) adopted for its publicly solicited projects in fiscal 2023, Nippon Steel participates in three joint projects: the Tohoku Region West Coast CCS Project, the Metropolitan Area CCS Project, and the Oceania CCS Project. We are working jointly with each participating company to secure storage sites, develop storage infrastructure, and establish external conditions such as developing regulatory requirements. At the same time, we are taking the initiative in studies related to CO<sub>2</sub> separation/capture, liquefaction, and shipping terminals, actively promoting the early social implementation of CCS infrastructure.





## Carbon Neutral Vision

Products and technical solutions that contribute to reducing CO<sub>2</sub> emissions in various areas of society NSCarbolex™

Responding to the global climate change problem has become a major trend in the industry, and new demand has been created in the materials field through changes in the industrial structure.

Amid the increasing need for measures to cope with growth in renewable energy, decarbonization of industrial complexes, electrification of automobiles, national resilience, and intensifying disasters, we are addressing the need for new steel products and solutions by utilizing our technologies. We are also working to expand the supply of steel products that contribute to the reduction of CO<sub>2</sub> emissions in society by drawing on the Group's

collective strengths, from product development to distribution processing networks.

NSCarbolex is a brand provided by Nippon Steel to the world that collectively refers to "advanced products and solution technologies that contribute to reducing CO<sub>2</sub> emissions in society." It consists of two brands: NSCarbolex Neutral and NSCarbolex Solution.

We are committed to reducing CO<sub>2</sub> emissions in society by providing high-performance products and solutions, in addition to CO<sub>2</sub> emission reductions in our manufacturing processes.

## [NSCarbolex brand structure]

Reducing CO<sub>2</sub> emissions in steel production processes

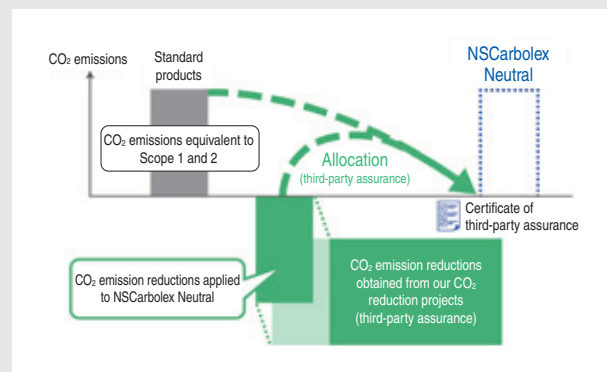
Reducing CO<sub>2</sub> emissions in the steel industry is not easy, so it is expected to take a long time to develop decarbonization technologies.

Under such a circumstance, since 2023, we began selling NSCarbolex Neutral, a steel product that uses a mass balance method to track the total amount of CO<sub>2</sub> emissions by project that we have reduced by reforming and improving our manufacturing processes and allocating it to any given steel product using the mass balance method, in order to supply customers early on with steel products with a reduced carbon footprint.

We believe that the supply of green steel using the mass balance method would enhance our customers' competitiveness amid society's rapidly increasing decarbonization needs. We will contribute to our customers' decarbonization efforts by establishing a stable supply system of NSCarbolex Neutral as soon as possible.

## [Features and mechanism of NSCarbolex Neutral]

- Feature 1** NSCarbolex Neutral products take advantage of the reduction in CO<sub>2</sub> missions that Nippon Steel actually achieved by reforming and improving its manufacturing processes.
- Feature 2** They obtain independent third-party assurance and issue certificates.
- Feature 3** They help customers reduce their Scope 3 CO<sub>2</sub> missions.
- Feature 4** The NSCarbolex Neutral brand can be applicable to all steel products manufactured by Nippon Steel.



For more information on NSCarbolex Neutral:  
<https://www.nipponsteel.com/en/product/nscarbolex/neutral/>

## TOPICS

## Efforts to create a green steel market

We are engaged in efforts to promote standardization in order to ensure that the importance of the green steel products and the actual amount of reduction that forms its basis is better known in society.

In October 2023, the Japan Iron and Steel Federation announced guidelines for the green steel products, and in March 2024, the GX Product Market Study Group (hosted by METI) advocated the creation of economic value based on the actual amount of reduction in its interim report.

Concurrently, the World Steel Association agreed on the basic principles of the green steel products in April 2024 and is currently formulating guidelines. Further, we are working to promote international standardization in the fields of ISO and GHG protocols.

## Carbon Neutral Vision

Reducing CO<sub>2</sub> emissions in our society

This brand offers high-performance products and solutions that contribute to the reduction of CO<sub>2</sub> emissions. They include "NSafe™-AutoConcept," which contributes to the reduction of CO<sub>2</sub> emissions in automobile manufacturing and driving; "High-Efficiency Electrical Steel Sheets," which contribute to the improvement of motor efficiency and the reduction of energy loss in power transmission/distribution networks; "ProStruct™," a construction material solution brand that contributes to the improvement of productivity on construction sites; and "HYDREXEL™," a stainless steel for high-pressure hydrogen environments. Through these products and solutions, we are committed to reducing CO<sub>2</sub> emissions in various scenes.

## [Value propositions through NSCarbolex Solution]

1 Reducing CO<sub>2</sub> emissions in customers' manufacturing processes

- 1) CO<sub>2</sub> emission reduction in customers' manufacturing processes
- 2) CO<sub>2</sub> emission reduction from raw materials

2 Reducing CO<sub>2</sub> emissions during the use of customers' products in society

Contribution to CO<sub>2</sub> emission reduction of the lifecycle of a customer's product by contributing to energy saving and longer maintenance cycle of the product

## 3 Contributing to energy transformation in society

Contribution to energy transformation in society by providing high-performance products and solution technology that are needed to diffusion of solar and wind power, geothermal heat and other renewable energy; realization of a hydrogen society, and expansion of other clean energy.

## [Products and solutions targeted in NSCarbolex Solution: Product and Solution Technologies Lineups]

## Automobiles and home appliances

- CO<sub>2</sub> reduction in manufacturing processes
- CO<sub>2</sub> reduction in product use, etc.

## NSafe-AutoConcept



Contribute to making lightweight vehicles by providing high-strength steel and our original processing techniques

- ▶ Contribute to CO<sub>2</sub> reduction in manufacturing process and vehicle rides

## Steel for high-strength gear



Eliminate the need for annealing treatment in secondary processes at customers. Enable vehicle body weight reductions using high-strength materials

- ▶ Contribute to CO<sub>2</sub> reduction in manufacturing process and vehicle rides

## Hairline finished electrolytic zinc-nickel alloy plated steel sheet FeLuce™



Exquisitely designed surface allows omitting additional surface treatment

- ▶ Contribute to customers in reducing CO<sub>2</sub> by cutting processes

## High-efficiency electrical steel sheets



Reduces energy loss in electric devices

- ▶ Reduces CO<sub>2</sub> emissions from use of automobiles and home appliances
- ▶ Improves power transmission efficiency

## Energy

- Contribution to energy transition in society
- Energy saving in electricity transmission, etc.

## Steel for LNG tank



Its high resistance to extreme low temperature contributes to construction of highly safe LNG tank

- ▶ Contribute to expansion of LNG use

## Stainless steel pipe for high-pressure hydrogen HYDREXEL

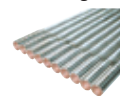


Photo by Iwatani Corporation

Its high strength and easy welding features contribute to construction of hydrogen stations

- ▶ Contribute to the realization of a hydrogen society

## High-alloy OCTG seamless pipes



Its world-class resistance to corrosion contributes to welling in high-concentrate CO<sub>2</sub> environment

- ▶ Contribute to CCS development

## Infrastructure

- CO<sub>2</sub> reduction in construction processes
- Improvement in energy efficiency in railway, etc.

## Mega-sized fixed external dimension H-section steel MEGA NSHYPER BEAM™



Simplify Hyper beam design and extend labor-saving benefits during processing to ultra-large sizes

- ▶ This product enables construction with fewer materials in a shorter period, which contributes to reducing CO<sub>2</sub> emissions.

## High-speed railway wheels and axles



Enable high-strength and lightweight high-speed railway wheels and axles

- ▶ The weight reduction contributes to reducing CO<sub>2</sub> emissions during railcar operation

## Designing titanium TranTixxii™



Aesthetic colors and design are added to the surface of corrosion resistant, strong, and lightweight titanium

- ▶ Contribute to reducing CO<sub>2</sub> emissions during construction and maintenance

## Corrosion resistant coated steel ZEXEED™



- Prevents corrosion even in severely corrosive situation
- Enables omitting of coating

- ▶ Enhances durability of solar power generation mount
- ▶ Reduces CO<sub>2</sub> emissions from customers' manufacturing maintenance processes

Our dedicated website to check the features and reduction impacts (NS estimates) of products and solutions in the NSCarbolex Solution line-up:  
<https://www.nipponsteel.com/en/product/nscarborex/solution/>

## Carbon Neutral Vision

## TOPICS

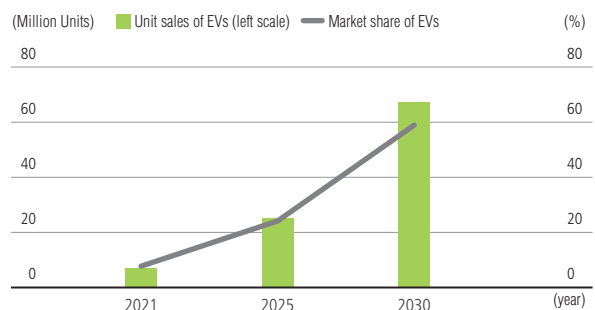
## High-efficiency electrical steel sheets that reduce energy loss in electric devices

The social needs behind the drive for attaining carbon neutrality include the reduction of energy loss in motors used in hybrid cars and EVs, as well as transformers used for power transmission. The most rational means to meet such needs is the use of high-grade electrical steel sheets, such as non-oriented (NO) electrical steel sheets used in motors and grain oriented (GO) electrical steel sheets used in transformers. The use of these products contributes to the reduction of CO<sub>2</sub> emissions when using hybrid cars, EVs, and home electric appliances, and to efficient transmission of generated power.

## Expanding production capacity of high-efficiency electrical steel sheets

In response to the increasing demand for these electrical steel sheets for EVs and other products and requests for high-grade types, we decided to implement further actions toward increasing the production capacity of non-oriented (NO) electrical steel sheets in the Setouchi Works Hanshin Area (Sakai) and the Kyushu Works Yawata Area. We also previously announced measures for electrical steel sheet manufacturing capacity and quality improvements in the Kyushu Works Yawata Area and the Setouchi Works Hirohata Area.

The total accumulated investment amount for these and other measures will be approximately 213 billion yen and they are planned to take full effect in the first half of fiscal 2027. The manufacturing capacity of non-oriented (NO) electrical steel sheets for eco-friendly cars is expected to increase by about five times from the current capacity (approximately 1.6 times versus the previously announced measures).

[World annual sales of EVs]  
(Net Zero Emissions by 2050 Scenario)

Prepared by Nippon Steel based on the IEA "Global Electric Vehicle Outlook 2022"

## TOPICS

## Response to meet needs for lightweight materials (NSafe™-AutoConcept)

Nippon Steel has contributed to reduction in body weight and improvement in the safety performance of automobiles by developing advanced materials, as well as processing technologies and evaluation technologies to realize components and their structures that maximize material performance. In 2019, we started to make proposals on the NSafe-AutoConcept (NSAC), a comprehensive solution for the development of next-generation steel vehicles to cope with the coming carbon neutral era. We are thus working with our customers to develop advanced vehicles.

Reductions in CO<sub>2</sub> emissions and enhanced collision safety are needed for automobiles and for that purpose, both bodyweight reduction and high strength are desired. Such needs can be satisfied by ultra-high-tensile steel sheets for vehicle bodies such as 2.0 GPa hot stamping materials, 1470 MPa high-tensile sheets, and 980 MPa hot-rolling high-strength steel plates for chassis. We have made these high-tensile steel lineups practical and have reduced the body weight of steel cars by 30% with our proposals on structure and processing method as well as various evaluation technologies. This has enabled steel cars to have a similar weight to that of all-aluminum cars and the provision of higher collision safety performance.

Moreover, we began proposing NSafe™-AutoConceptECO<sup>3</sup> (NSAC Eco-cubic), a new concept that has deepened the NSAC's weight reduction technologies. This has enabled us to make optimal solution proposals adapted to customers' forward-looking automaking (e.g., proposal of parts integration, using steel) from the perspectives of CO<sub>2</sub> emission reduction through weight reduction and LCA; cost reduction; and optimal production systems, to meet diverse customer needs in the midst of more innovative automaking, including rapidly advancing electrification of vehicles.



Example of a proposal on the NSAC ECO<sup>3</sup>

## Carbon Neutral Vision

## Progress of Carbon Neutral Vision 2050

The Carbon Neutral Vision 2050 aims to achieve carbon neutrality using three breakthrough technologies: “Hydrogen injection into BF,” “Hydrogen direct reduction of iron,” and “High-grade steel production in large size EAF.”

Concerning “High-grade steel production in large size EAF,” a new EAF installed in the Setouchi Works Hirohata Area started its commercial operation in October 2022, making it the world’s first integrated EAF steelmaking process that enables the production and supply of high-grade electrical steel sheets. Also, regarding the conversion from the BF-BOF process to the EAF process, we started full-scale studies at two candidate sites, the Kyushu Works Yawata Area and the Setouchi Works Hirohata Area. We began construction of a small EAF (capacity: 10 tons) in the Hasaki R&D Center to start experiments in the second half of fiscal 2024.

Concerning “Reduction with hydrogen in BFs,” Japan’s three blast furnace steelmakers, including Nippon Steel, are jointly developing the COURSE50 blast furnace, designed to replace carbon used in the BF as a reducing agent with hydrogen-rich gases generated in steelworks. This project has already established the technologies that can reduce CO<sub>2</sub> emission in a COURSE50 test furnace (12m<sup>3</sup>).

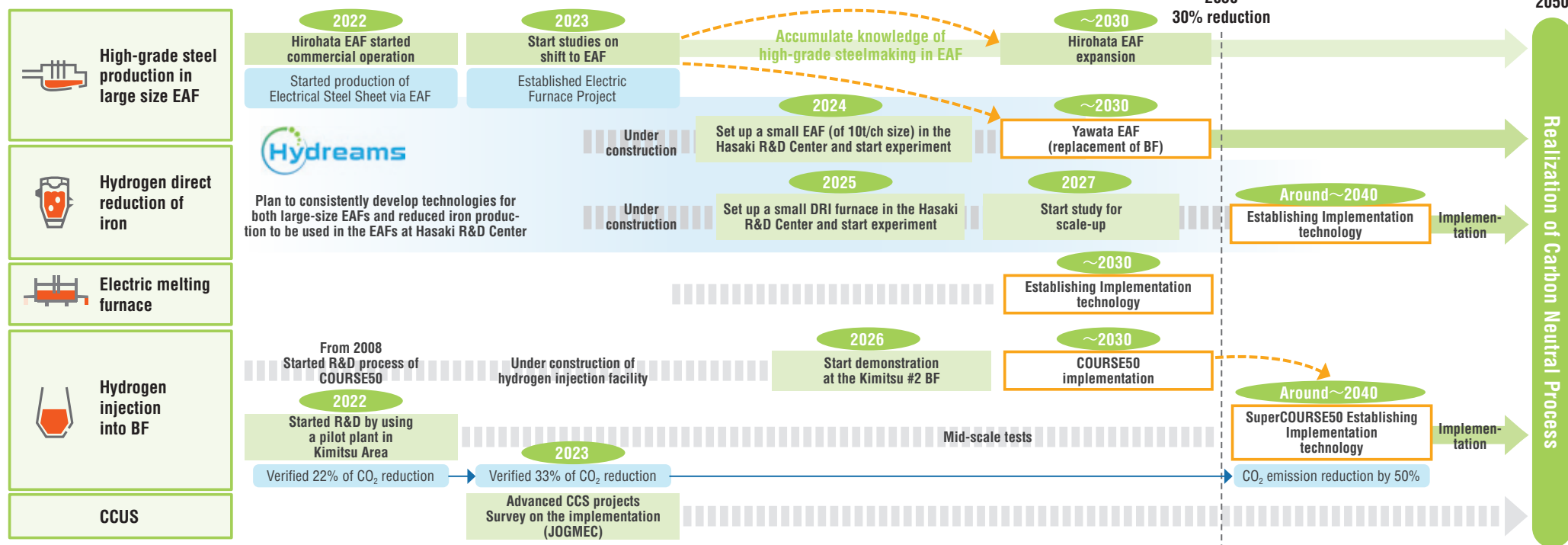
In February 2023, we decided to conduct demonstration tests at the East Nippon Works Kimitsu Area using the No. 2 BF, a large-scale BF in operation that is approximately 400 times larger than the test furnace. We are installing equipment for the demonstration tests, which are scheduled to begin in fiscal 2026. Since May 2022, we have been developing technologies with the modified COURSE50 test furnace. So far, the test in November-December 2023 has already confirmed the world’s highest 33% reduction in CO<sub>2</sub> emission in the blast furnace. We are conducting more demonstration tests to further reduce CO<sub>2</sub> emissions by 40% or more.

We are working to establish the Super COURSE50 technology in large BFs (50% or more reduction in CO<sub>2</sub> emissions).

Concerning “Hydrogen direct reduction of iron,” we started building a small test furnace in the Hasaki R&D Center to start experiments in fiscal 2025. In order to realize production efficiency that can replace the blast furnace process by using the integrated process of hydrogen direct reduction, electric melting furnace, and converter for low-grade iron ore, we are also starting to develop a technology for high efficiency melting by electric melting furnace utilizing direct reduced iron.

Based on this, by 2040, we aim to solve issues such as utilization of low-grade iron ore and conversion of reduction material from natural gas to hydrogen, and we aim to establish technology for commercializing a direct hydrogen reduction reactor using low-grade iron ore from Australia and other countries as feedstock.

## [Carbon Neutral Vision 2050]



## Carbon Neutral Vision

## TOPICS

**The COURSE50 Project\*<sup>1</sup>**  
**The Super COURSE50 Project\*<sup>2</sup>**

The COURSE50 is a technology development project that was undertaken from 2008 to 2022 with the aim of partially realizing steel production using hydrogen in the current situation where there is no infrastructure for supplying large amounts of hydrogen.

In the 12m<sup>3</sup> test blast furnace constructed in the Kimitsu Area of East Nippon Works, the testing has a target of about a 30% reduction in CO<sub>2</sub> emissions: more than 10% by hydrogen reduction using hydrogen contained in the hydrogen-based by-product gas (coke oven gas) generated in the steelworks, and a 20% offset through separation and capture of CO<sub>2</sub> from the blast furnace gas. The testing verified more than 10% by hydrogen reduction while, in the case of offset by CO<sub>2</sub> capture, we have developed an energy-saving technology using the chemical absorption method and have already put it into practical use for the industrial use of CO<sub>2</sub>.

Looking ahead to a time when the social infrastructure for an adequate hydrogen supply is in place, we are undertaking the Super COURSE50, a development project aided by the GI Fund with a technology aimed at further reduction of CO<sub>2</sub> emissions (more than 50% reduction) by heating and using hydrogen purchased from outside the steelworks, and by maintaining the thermal balance inside the blast furnace.

The testing began in May 2022, and the project has steadily advanced development, confirming the world's highest-level reduction of 22% in CO<sub>2</sub> emissions from the blast furnace itself.

The subsequent testing in November and December 2023 confirmed a 33% reduction in CO<sub>2</sub> emissions from the blast furnace itself, posting a new record for the highest reduction in the world. We are proceeding with verification testing with the goal of reducing emissions by 40% or more in fiscal 2024.



Source: NEDO "Hydrogen utilization in iron and steelmaking processes" project

\*1 Commissioned project by the New Energy and Industrial Technology Development Organization (NEDO)

\*2 The Green Innovation Fund "Hydrogen utilization in iron and steelmaking processes" project (NEDO's R&D outsourcing support and assistance project)

## TOPICS

**Development of high efficiency melting and other technologies by electric melting furnace using direct reduced iron (GI Fund)**

Nippon Steel has begun research and development on hydrogen reduction steelmaking technology using an electric melting furnace, which was selected as a new theme of the GI Fund's "Hydrogen utilization in iron and steelmaking processes" project.

The structure of the electric melting furnace enables continuous hot metal tapping by continuous operation, similar to the blast furnace, and removal of impurities by continuous discharge of slag. In an integrated process from direct hydrogen reduction to electric melting furnace and converter, this steelmaking process may enable both high quality and high productivity even when low-grade iron ore is used.

By establishing a technology for direct reduction of low-grade iron ore, we aim to reduce CO<sub>2</sub> emissions.

## TOPICS

**New Carbon Neutral R&D Center "Hydrearms™"**

In order to accelerate research and development for the realization of carbon neutrality, we are constructing a new research facility at the Hasaki Research and Development Center (located in Kamisu City, Ibaraki Prefecture).

The name of the site, Hydrearms, is derived from Hydrogen Direct Reduced Ironmaking and Electric Arc Multi-purpose Furnaces for Steelmaking.

Hydrearms is currently constructing a small test reduction furnace and a small test EAF in order to develop technologies for large EAFs and the production of reduced iron, which is the raw material for these furnaces.

The small test EAF is scheduled to start being used in the second half of fiscal 2024, and the small test reduction furnace, in fiscal 2025.



Source: NEDO "Hydrogen utilization in iron and steelmaking processes" project



## Infrastructures that Support the Strategies

# R&D Activities — Sources of value creation and competitiveness

Nippon Steel is engaged in advancing strategic R&D, aimed at sustainable growth of the Nippon Steel Group

## One of the world's leading research resources

Our R&D resources are among the largest in the world in the steel industry, and we will contribute to the development of society through the R&D aimed at realizing our management plan. Specifically, we will (1) strengthen the development of products with high added value and technology and products that realize carbon neutrality (CN), and (2) acquire a competitive advantage by deploying products and the development technology cultivated in domestic mother mills in the actual site business, and contribute to business expansion for the global system of 100 million tons of crude steel, and (3) work to develop breakthrough steelmaking process to contribute to the realization of CN society. We will also (4) promote the digital transformation (DX) of business operations, including optimization of production plans, and automation of production facilities, by using the vast amount of technical data that we have accumulated over many years and the latest digital technology and AI.

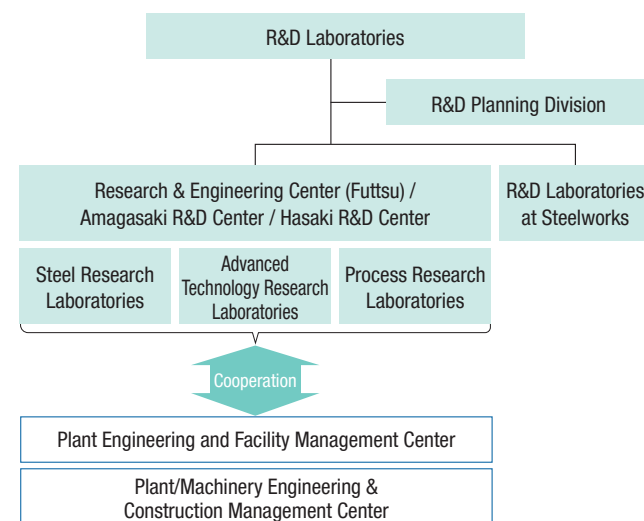
Pillars and contents of medium- to long-term management plan	Representative R&D
Rebuilding of domestic steel business • Shift to a more sophisticated order mix, renewal and improvement of facilities, and concentrated production	<ul style="list-style-type: none"> <li>Research on high-performance strategic products that contribute to society (high-tensile steel sheets, electrical steel sheets, etc.)</li> <li>Research on optimal processes and operation technologies to achieve production stability and efficiency</li> </ul>
Promoting a global strategy to deepen and expand overseas business • Building an integrated production framework in markets and sectors that are consistent with our strategy	<ul style="list-style-type: none"> <li>Stable production of steel products by suppressing the impact of differences in location and factory facilities</li> <li>Accumulation of cutting-edge research results in a form that can be used globally</li> </ul>
Challenge of carbon neutrality • Hydrogen injection into blast furnaces, Hydrogen direct reduction of iron, High-grade steel production in large size EAF, and CCUS (cooperation with outside parties)	<ul style="list-style-type: none"> <li>Research on new steelmaking processes and new products for a carbon-neutral society</li> <li>Base research through industry-academia-government collaboration that contributes to the creation of a new society</li> </ul>
Promoting digital transformation strategies • Innovation of business operations and production processes using digital technology	<ul style="list-style-type: none"> <li>Research on digitization technology that drives remote operation, automation, AI, etc.</li> <li>Practical application research on advanced algorithms</li> </ul>

Modern steelmaking in Japan began with iron ore as the raw material at the end of the Edo period and continues to progress today. In recent years, in order to develop products that utilize atomic-level observation technology and advanced calculation science and technology, and to develop manufacturing processes for stably mass-producing them at low cost, various researchers with expertise in materials, physics, chemistry, mathematics, machinery, electricity, information, civil engineering and building construction are active and are participating in a wide range of academic societies both in Japan and overseas. In the middle of the big game change in the decarbonization of society, steel is required to transform from the blast furnace method, which has extremely high production and energy efficiency. On the other hand, there is also a demand for developing products that contribute to the reduction of CO<sub>2</sub> in society as inexpensive structural materials. We will use our wide range of specialized technical capabilities and large-scale steel research resources fully for the R&D issues that are required in this era, and we will lead the Japanese industry toward the realization of a carbon-neutral society.

## R&D organization

R&D is carried out with the R&D Laboratories as a core. The Steel Research Laboratories are mainly engaged in product development; the Advanced Technology Research Laboratories in discovery of new technology seeds from basic research and R&D related to segment companies; the Process Research Laboratories in process development; and the R&D Laboratories at Steelworks in practical application research. Thus, we are dividing our organization to be in charge of R&D management that contributes to our global management. In addition, we have contributed to the early practical application of developed products and processes in cooperation with Plant Engineering and Facility Management Center, which oversees equipment engineering, and newly-established Plant/Machinery Engineering & Construction Management Center, which is engaged in the design and construction of steelmaking plant facilities. We will promote the development of products and processes for the CN society by utilizing the existing framework of the three laboratories. Furthermore, we will strengthen cooperation with universities and research institutes in the fields that require basic examination, including elemental technologies that our group does not possess.

### [R&D organization]



An organization that took over a part of the steel plant business of Nippon Steel Engineering Co., Ltd.

## R&D Activities — Sources of value creation and competitiveness

### Strengthening products with high-added value and process development

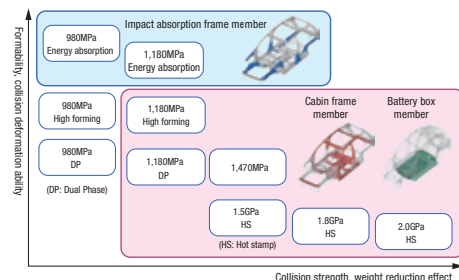
We will continue to work on maximizing the potential of steel as a material, that is, achieving our goal of “mastering steel.” Examples of the development of products with high added value include high corrosion-resistant plated steel sheets (ZEXEED™, etc.), alloyed galvanized sheets (GA), hot-dip aluminum-plated steel sheets (ALSHEET™), nickel-plated steel sheets (SUPERNICKEL™), and grain-oriented electrical steel sheets (GO), non-oriented electrical steel sheets (NO), high-alloy seamless steel pipes. We are promoting this R&D to shift to a more sophisticated order mix.

In process development, we utilize various kinds of large-scale laboratory equipment that can accurately simulate the operation of actual production facilities for each process of ironmaking, steelmaking, and rolling, as well as simulation calculation technology. Thus, we are promoting R&D of highly efficient steelmaking process that considers resources and the global environment in producing higher valued-added products.

### Next-generation automobiles

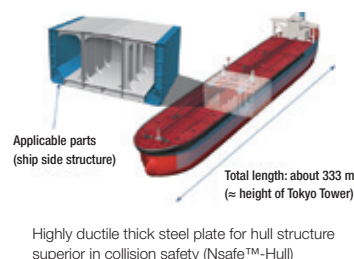
We are contributing to the reduction of environmental impact by developing and expanding the application of high-tensile steel sheets to achieve both weight reduction and collision safety of automobiles, developing high-efficiency electrical steel sheets for hybrid and electric vehicles, and improving fuel efficiency through the development of underbody products. We are proposing the NSafe™-AutoConcept ECO<sup>3</sup>, a next-generation steel automobile concept for the era of carbon neutrality. The cold-forming technology of ultra-high-strength steel sheets, which forms the core of this concept's processing technology group (NSafe-Form Series), was awarded the “Grand Prize of the Society of Technology of Plasticity” (2023) at the 58th Japan Society for Technology of Plasticity.

#### [Deepening of high-tensile steel sheets for vehicle body frames]



### Energy and resources/Shipbuilding

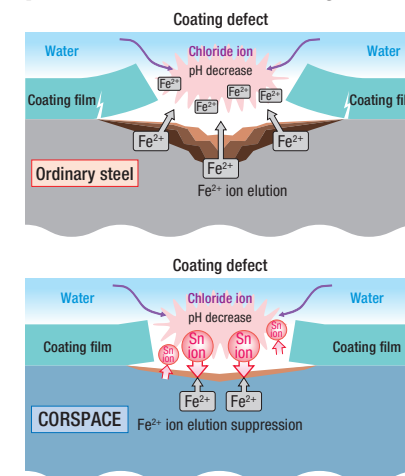
Steel materials for energy and shipbuilding require a quality that ensures long-term safety under various service conditions. We are contributing to improving the safety of final products and enhancing the productivity and competitiveness of customers by supplying high-performance products that utilizes advanced technology.



### Challenge of carbon neutrality

We accurately grasp market needs and continuously develop and supply building materials that exhibit our originality. We support social infrastructure such as construction (building pillars and beams) and civil engineering (roads/railways, rivers/harbor, building foundations). As an example of recent years, we have worked on basic research to explain the corrosion mechanism of coating defects in conventional steel materials and found that the addition of a small amount of element (Sn) to steel materials can suppress the elution of iron in a low-pH environment. We developed CORSACE™, an extended coating cycle steel with excellent LCC, which can reduce the amount of steel corrosion and coating stripped surface in coating defects to about half that of conventional products. Thus, we have received the Excellence Award of the 9th “The Japan Monodzukuri Nippon Grand Awards” (2023) and the Contribution Award of the 55th “The Ichimura Prize in Industry” (2023). The steel materials and their elemental technologies are protected by a total of 78 comprehensively acquired patents.

#### [Corrosion mechanism of coating defects]



### Challenge of carbon neutrality

We aim to achieve carbon neutrality using three breakthrough technologies. “Hydrogen injection into blast furnaces” is an effort to replace the reduction of iron oxide using carbon with hydrogen reduction, and the handling of hydrogen and the decrease in furnace temperature due to hydrogen reduction are issues. “High-grade steel production in large size EAF” is based on the existing technology of the electric furnace, but there are issues in reducing impurities and increasing the size of the equipment. “Hydrogen direct reduction of iron” is a process producing reduced iron from iron ore using a shaft furnace, etc., without using a blast furnace, and there are still issues concerning stabilization of mass production.

Through the Green Innovation (GI) Fund Project of the New Energy and Industrial Technology Development Organization (NEDO), we are tackling these challenges by undertaking demonstration tests using a test blast furnace in East Nippon Works Kimitsu Area and a new test electric furnace and a test shaft furnace at the Hasaki R&D Center (Kamisu City, Ibaraki Prefecture). In 2023, we confirmed the world's highest 33% CO<sub>2</sub> emission reduction at the test furnace, making steady progress in development toward proposing the future steelmaking process. In addition, we will conduct R&D of carbon offset measures such as “NSCarbolex™ Solution” which utilizes steel products that can reduce CO<sub>2</sub> during processing and use, and CCUS, etc. We aim for CN with a multi-aspect approach.

## Infrastructures that Support the Strategies

# Intellectual Property Activities that link strengthen management strategies through R&D results

The Nippon Steel Group respects intellectual property rights, regardless of whether they belong to us or others. We will make the most of the intellectual property rights in our business activities, and position them as one of the important factors for obtaining business revenue now and in the future.

## Policy and organization of intellectual property activities

### Policy on intellectual property activities

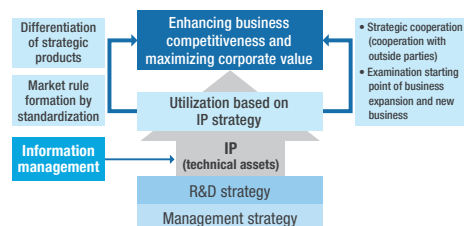
We perform intellectual property (IP) activities under the company-wide slogan, "IP is the source of our corporate activities. Maximize corporate value through enhanced protection management and active utilization." We are strengthening efforts to directly link IP created from R&D activities, which are implemented based on management strategies, to maximizing business earnings and corporate value.

Based on a specific business strategy and this slogan, we formulate and act on a flexible and effective IP strategy in accordance with all aspects (offensive and defensive) of individual products and technologies, and share the results throughout the Company in an effort to continuously strengthen our strategies.

We are also focusing on the acquisition of rights for IP generated in the development of technologies and products that realize carbon neutrality.

Moreover, we are involved in licensing IP outside the Group and in standardization to form the market rules, and uses IP in a variety of ways to advance its business. As shown in the table below, we are working to complete our Medium- to Long-term Management Plan by actively utilizing our IP.

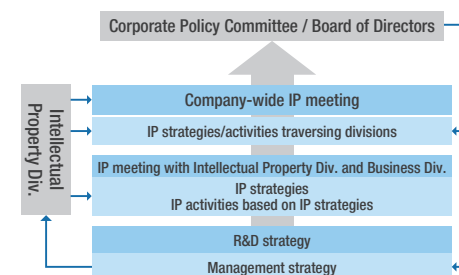
[Schematic diagram of our intellectual property]



### Promotion system of IP activities

Business divisions take the lead in making a trinity of management strategy, R&D strategy, and intellectual property strategy, and then carry out specific intellectual property activities. These activities are supported by the Intellectual Property Division. In addition, the Intellectual Property Division is actively involved in management from a traversing perspective regarding intellectual property activities that span business divisions. After discussing the progress of these activities at the company-wide meeting and determining the direction of how to proceed with intellectual property activities, the final decision is made by the Corporate Policy Committee and the Board of Directors. In addition, the results of discussion in the Corporate Policy Committee and the Board of Directors are fed back to the business divisions and people involved in the inventions to strengthen the daily intellectual property activity. Further, through continuous information management and intellectual property training, we are improving the awareness and skills of all the employees related to intellectual property.

[Schematic diagram of our intellectual property activity promotion system]



[Examples of intellectual property utilization for contribution to business to accomplish medium- to long-term management plan]

Pillars and contents of medium- to long-term management plan	Examples of representative intellectual property utilization
Rebuilding of domestic steel business • Shift to a more sophisticated order mix, renewal and improvement of facilities, and concentrated production	• Protecting strategic products (high-tensile steel sheets, electrical steel sheets, etc.) with patents for differentiation and enhancing the appealing power to customers • Stable and efficient production based on accumulated and expanded patents and technical know-how
Deepening and expansion of overseas steel business • Building an integrated production framework and a sales network in markets and sectors that are consistent with our strategy	• Strengthening the competitiveness of overseas Group companies by utilizing our patents and technology know-how • Promotion of strategic globalization considering the value of intellectual property
Challenge of carbon neutrality • Hydrogen injection into blast furnaces, Hydrogen direct reduction of iron, High-grade steel production in large size EAF, and CCUS (cooperation with outside parties)	• Promotion of development and implementation by combining patents and technological know-how of our company and third parties • Utilization of intellectual property in creating new social rules (standardization of standards)
Promoting of digital transformation strategies • Innovation of business operations and production processes using digital technology	• Protection of business and production process reforms by expanding patents • Contribution to digital society by patents and technological know-how related to DX elemental technologies

## Intellectual Property Activities that link strengthen management strategies through R&D results

### Securing creation and enhancing protection and utilization of IP

We have been focusing on enriching and accumulating our IP in terms of both quality and quantity to enhance their strategic utilization in all aspects of our business. Specifically, we thoroughly manage technical information related to research results obtained through our independent research and collaboration with universities and external research institutes, and secure and accumulate IP that can be used in our business activities.

We secure the most advanced newly created technologies and other proprietary technologies such as carbon neutral related technologies, as IP through the patent acquisition and tacit knowledge of know-how we have accumulated. We utilize them in the course of our business practices and contribution to society in line with our Medium- to Long-term Management's Plan. For three consecutive years, we have been awarded the National Commendation for Invention, which recognizes outstanding inventions aimed at contributing to the advancement of science and technology and the development of industry.

#### [Specific initiatives in intellectual property activities]

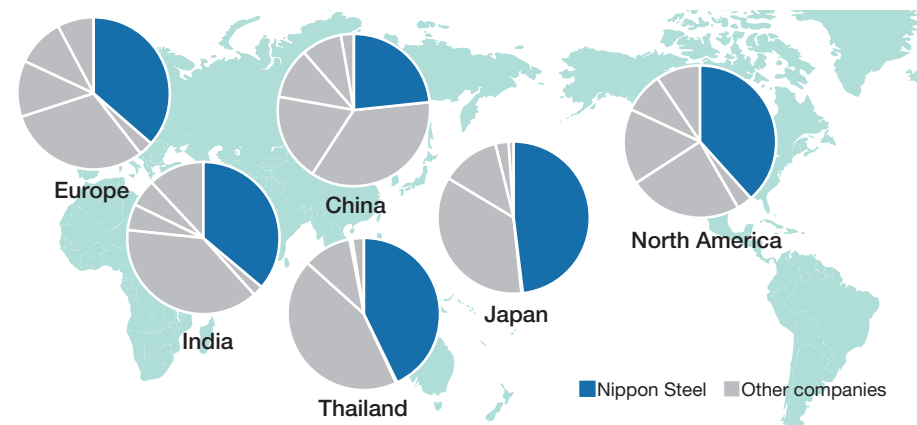
[Nippon Steel's patents in 2023] Japan approx. 15,000 /Overseas approx. 18,000 (non-consol.)

1. Support the creation of new IP	<ul style="list-style-type: none"> <li>Plan IP strategy that contributes to the business strategy</li> <li>Build and evaluate the IP portfolio</li> <li>Enrich the function of establishing rights for inventions, discoveries, and IP</li> </ul>
2. Enhance the protection and utilization of IP	<ul style="list-style-type: none"> <li>Globally protect and actively use IP as a means to differentiate strategic products</li> <li>Actively use IP in strategic alliance with collaborating partners</li> <li>Thoroughly control technical information including business secrets</li> <li>Establish brand strategies with the aim of enhancing corporate value and product value</li> <li>Strictly deal with counterfeit products as well as any violation and illegal use of our IP</li> </ul>
3. National Commendation for Invention award	<ul style="list-style-type: none"> <li>2023 Invention Award "Invention of the chrome resource recycling and environment-friendly stainless steelmaking process"</li> </ul>

### Value of our patents

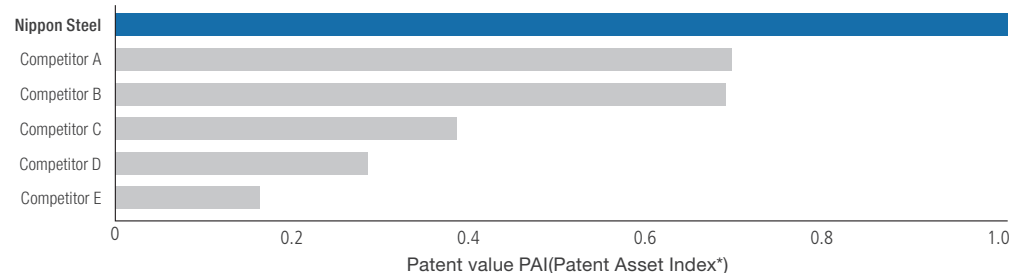
The Nippon Steel Group holds a high share of patents in major global markets compared to its competitors in Japan and overseas.

#### [Comparison of shares of patents held by Nippon Steel and its competitors in major global markets]



LexisNexis "PatentSight™" provides a patent value index PAI (Patent Asset Index™) based on the technical value and market value of patents. The PAI data in 2023 shows that Nippon Steel has a relatively higher value than our domestic and overseas competitors. We carefully evaluate domestic and international patent applications in line with our management strategy. At the same time, we continue to expand and accumulate important patents in terms of both quality and quantity, thereby increasing our valuable patent portfolio in Japan and overseas, which not only supports our business revenues in the world but also contributes to social, economic and industrial developments.

#### [Relative comparison of patent value PAI with domestic and overseas competitors (2023)]



\* Calculated using PatentSight™, a patent analysis tool of LexisNexis.  
Comprehensive evaluation index of patent calculated by multiplying "technical value" calculated based on the number of citations of patents and "market value" calculated based on the country of application for patents with valid legal status (patents pending and granted).

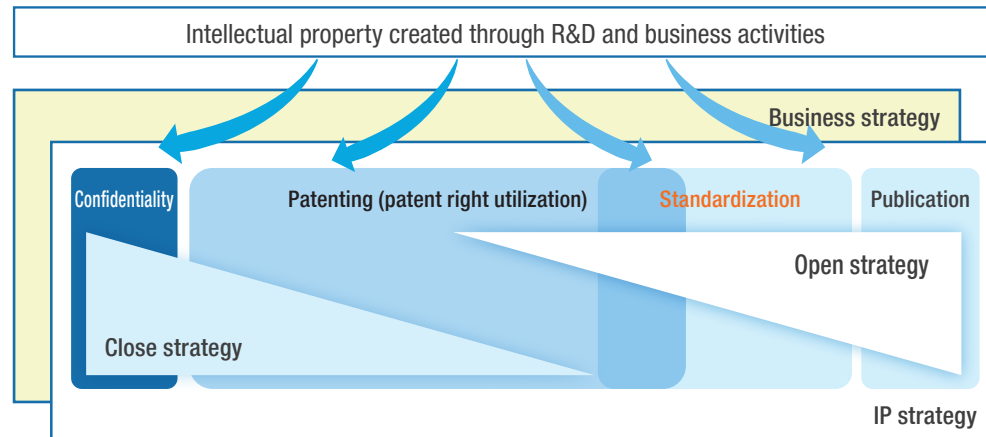
## Intellectual Property Activities that link strengthen management strategies through R&D results

### Initiatives for standardization

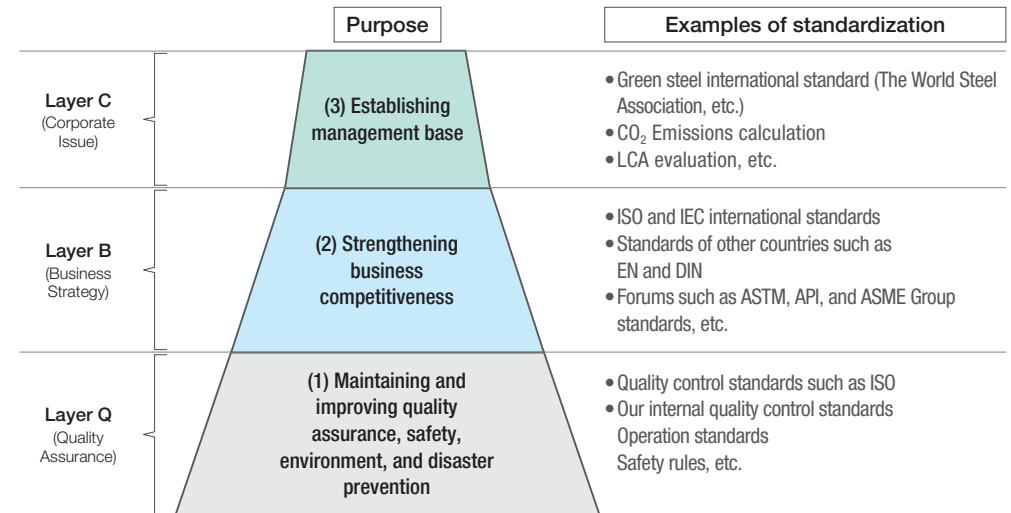
Based on our IP strategy, we utilize IP created through R&D and business activities by combining confidentiality, patenting, standardization, and publication.

Regarding the standardization, we participate in internal activities related to quality assurance, safety, environment, and disaster prevention, as well as external activities related to JIS, ISO, API, etc., and actively standardize steel materials and material testing methods. We have established sustainability standards for steelmaking and rules for the markets for products of our company and our competitors. We seek to make our efforts lead to sales expansion of our new products, thereby contributing to management, and to form and expand markets targeted by the steel industry. In the automotive steel sheet and materials field, our employee has been appointed as the Chair of the Ductility Testing Committee ISO/TC 164/SC 2, leading the standards activities. In the field of steel products for oil and gas development and production environments, our employees promoted standardization of OCTGs and received the 2024 AMPP Fellow Honor Award from the American Association for Materials Protection and Performance (AMPP) in recognition of their achievements.

#### [Intellectual property created through R&D and business activities]



#### [Our activities related to standardization]





## Infrastructures that Support the Strategies

# Promoting of Digital Transformation Strategies

Nippon Steel is strongly promoting digital transformation (DX).

With the aim of becoming a digitally advanced company in the steel industry, we will work to innovate production and business processes by making full use of data and digital technology, and promote measures that will help speed up decision-making and fundamentally strengthen our problem-solving capabilities.

## Nippon Steel's DX Initiatives and Vision

Nippon Steel will promote Nippon Steel DX to innovate all steel business processes.

Specifically, we are working swiftly on various measures to realize “innovative evolution of manufacturing capabilities by developing smarter manufacturing,” “strengthening of customer relations by reinforcing the flexible and optimal supply system,” and “global management support by enhancing business intelligence.”

### Innovative evolution of strength in manufacturing based on smarter manufacturing (Production process innovation)

- Develop smarter manufacturing (Cyber Physical Production) through the advanced use of AI, IoT and other digital technologies
- Improvement of labor productivity through the use of automation and predictive detection, etc., and production stabilization and quality improvement through the advancement of production technology
- Ensuring the same level of operations and quality at overseas sites as in Japan

### Strengthen customer responsiveness by enhancing flexible and optimal supply system (Business process innovation)

- Establishment of an integrated production planning platform from order to production to delivery (shortening of lead time, flexible response to changes)
- Linkage with supply chain information, etc., and efforts to contribute to customers and create new value
- Optimization of raw material transportation from the mine to steel mills and enhancement of responsiveness to changes in the procurement environment

### Global management support through enhancement of business intelligence

- Construction of integrated data platform (NS-Lib) that enables the linking and advanced utilization of vast amounts of data
- Building an integrated data platform that enables real-time understanding of management information and KPIs for optimal action
- Accelerate decision-making and improve problem-solving capabilities from the management level to the front line

## Reform initiatives that make full use of data and digital technology

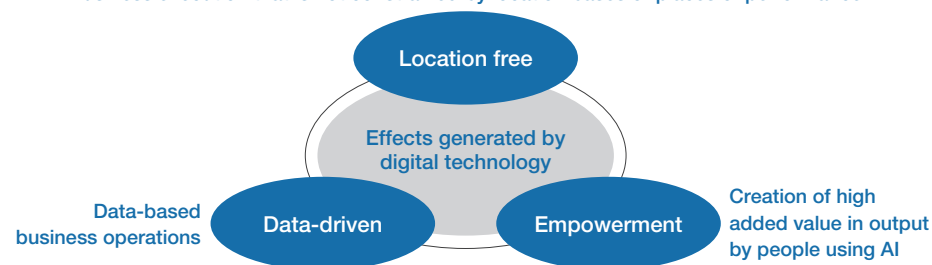
Specifically, by displaying the three effects of digital technology — “location-free,” “data-driven,” and “empowerment” — we will innovate traditional workstyles and strive to significantly increase productivity, speed up decision-making, and improve problem-solving capabilities.

In addition, rather than simply applying new digital technologies, we aim to review our business operations and production processes based on data, and thereby enhance decisions that tend to be partial optimizations to optimal decisions from a broader perspective, transcending organizational barriers and hierarchies.

AI alone is not sufficient to create value. Even in the midst of the ever-evolving landscape of digital technology, it is still the individual who conceives and carries out reform. We believe that it is crucial that people start the process by charting a course for forward-looking reform with a sense of mission, and use digital technology as a means to execute the reform.

In addition, we believe that there is significant value to be gained from expanding and advancing reforms based on the knowledge and resources made available through the use of digital technology.

Business execution that is not constrained by location bases or places of performance



## Promoting of Digital Transformation Strategies

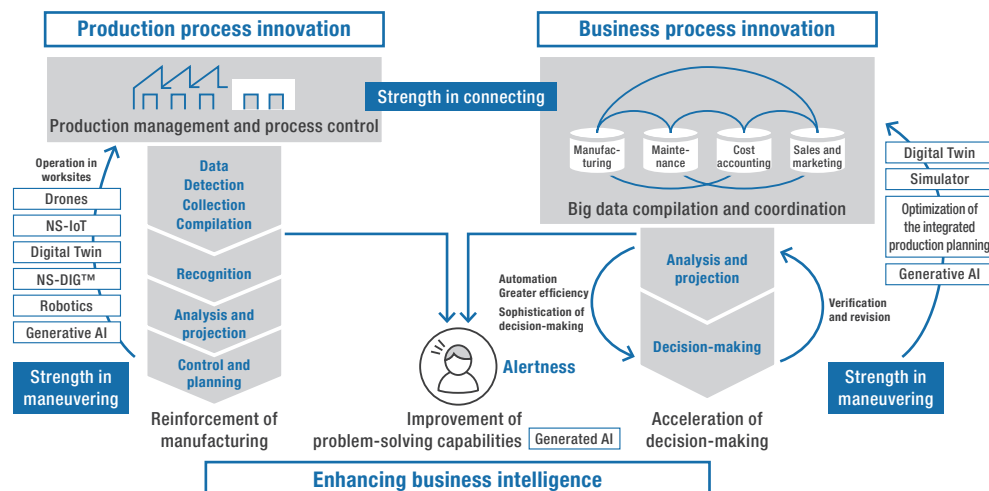
### Strength in connecting and strength in maneuvering Production process innovation and business process innovation

Nippon Steel has been proactively adopting ICT since the 1960s in a variety of fields, including production, sales, logistics, maintenance, purchasing, and profit management, and one of its major strengths is the large number of business systems it has developed and the vast amount of high-quality data it has accumulated.

We will enhance our “strength in maneuvering,” which will enable formidable process control and automation, by bolstering and making advanced use of our “strength in connecting,” which will entail organically linking valuable data assets that are dispersed in individual departments and factories by utilizing advanced information technology and the latest digital technology.

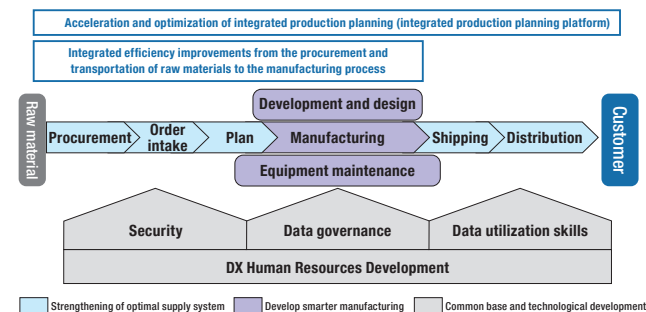
These efforts will be applied to both production and business process reform. By setting ambitious goals, we will increase the overall output of solutions and innovations to achieve these goals, advance manufacturing practices, accelerate decision-making, and drastically enhance our problem-solving ability.

We believe that these strengths will contribute not only to business process innovation and production process innovation, but also to the provision of new value to stakeholders through synergies with measures to enhance our strength in manufacturing and strength in sales and marketing.



### Innovation of all steel business processes

Nippon Steel's DX involves a series of comprehensive reforms across the entire spectrum of the steel business process. This includes the supply chain, from raw material procurement to customer relations, as well as aspects such as development, design, manufacturing and equipment maintenance. To achieve these goals, we are actively building a common infrastructure and driving technology development.

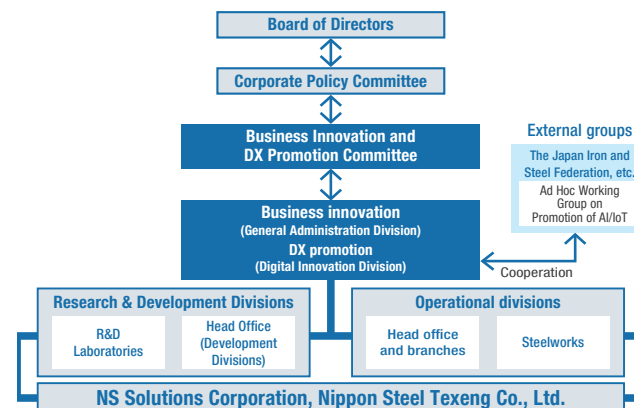


### DX promotion framework

With the Digital Innovation Division at the core, the operational divisions and the research and development divisions will work together to strengthen business competitiveness by promoting DX mainly through integrated responses to company-wide cross-sectional issues and data management.

Furthermore, we will continue to take on the challenge of advanced initiatives in cooperation with external organizations and with the collective strength of the Nippon Steel Group, including NS Solutions Corporation and Nippon Steel Texeng Co., Ltd.

We have established the Business Innovation and DX Promotion Committee, chaired by the Executive Vice President in charge of business innovation and DX promotion. It is discussing companywide policies and strategies and promoting related activities based on both the business innovations we have been working on and the promotion of DX.



## Promoting of Digital Transformation Strategies

### Nippon Steel DX Specific Initiatives

#### New ways of working with digital technology and data

Nippon Steel's wireless Internet of Things (IoT) sensor-utilization platform NS-IoT for efficient collection of operational and facility data from steelworks sites has been adopted on a full scale. Data have also been accumulated on our integrated data utilization platform NS-Lib and data-driven operations have become widespread, in combination with efforts to raise the efficiency of OA work with RPAs and Microsoft 365, and to make the work more visible with business intelligence (BI) tools such as Tableau.

The integrated AI data analysis platform NS-DIG™ and the edge computing platform AIRON-EDGE™ have made it easy for us to build and implement AI models.

By continuing these efforts and utilizing fast-evolving generative AI in the right places, we are being empowered with the increased value of our time and establishing a new way of working.

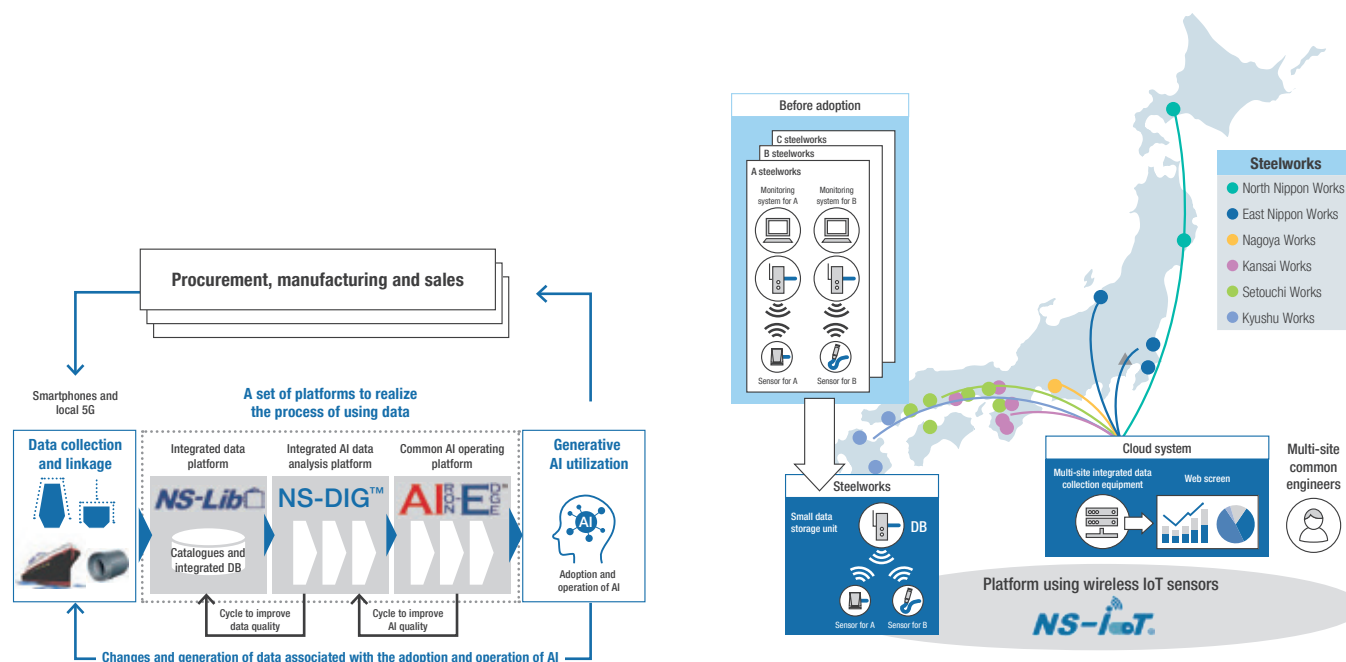
#### Advanced utilization of operational and facility data using wireless IoT sensors (NS-IoT)

We have built a wireless Internet of Things (IoT) sensor-utilization platform NS-IoT for centralized management of data from each steelworks site by using LPWA (low power wide area wireless communication) and cloud technology.

By centralizing the management of data and vehicle location information from sensors and leveraging integrated data from multiple locations for “facility status detection” and trend monitoring, the use and application of data in the production process have been expanded.

The system will be extended to the entire company and Group companies, starting with East Nippon Works Kimitsu Area and Kashima Area, with a view to expanding the system as a package to other manufacturing industries, etc.

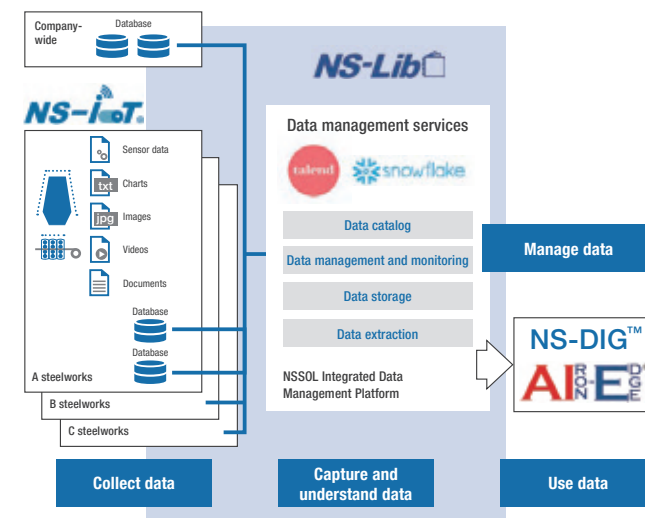
This platform will be used to stabilize production and further enhance quality by improving labor productivity through the use of automation and predictive detection, and by advancing production technology.



#### Integrated Data Platform (NS-Lib)

NS-Lib is an integrated data utilization platform built by Nippon Steel and NS Solutions by combining TALEND™, a data management function, and SNOWFLAKE™, a data storage and linking function. The platform was put into operation in April 2022. Then, in December 2023, DENODO™, a data virtualization platform, was launched, enabling databases located in different locations to be accessible across the company. We use data for orders, production plans, instructions, and manufacturing by “cataloging” them as a database in the “NS-Lib” (strength in connecting). This enables rapid and advanced decision-making and problem solving based on the same data from the management level to the front line.

By incorporating the knowledge gained by Nippon Steel, NS Solutions has launched services on an integrated data management platform aimed at outside parties under the name “DATAOPTERYX™.”



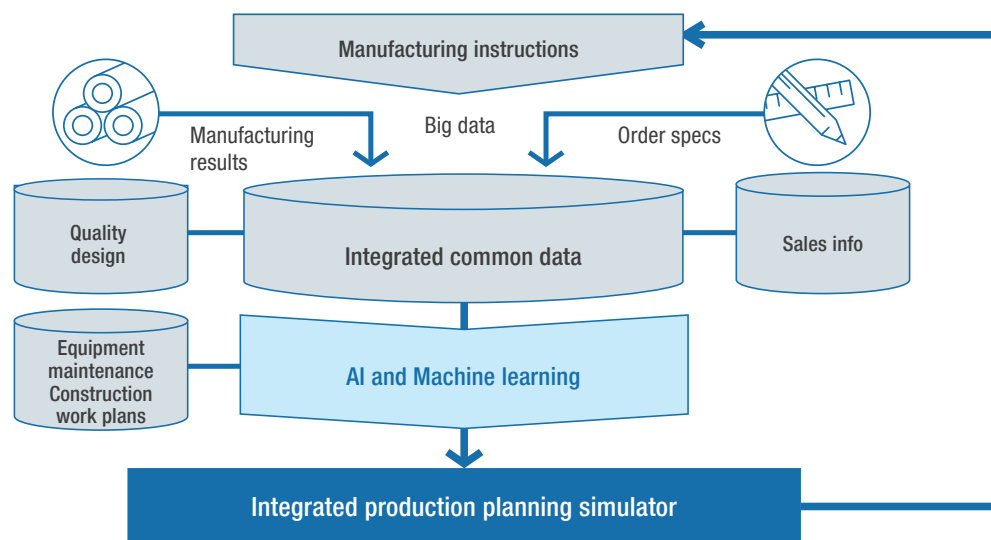
## Promoting of Digital Transformation Strategies

### Acceleration and optimization of integrated production planning

The steel industry uses a variety of raw materials, such as iron ore, coal, and scrap metal, to produce diverse steel products for automobiles, ships, bridges, and household appliances. Of these, approximately 70,000 different sheet steel products are produced, and approximately 40,000 orders are handled each month. The production plan is a complex combination of multiple processes, ranging from crude steel production to rolling to surface treatment.

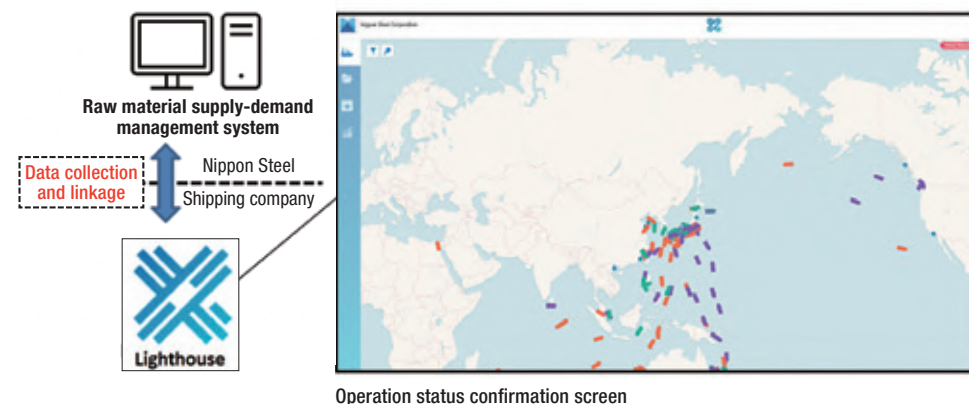
Based on the latest sales information and big data collected by each steel mill on the manufacturing process efficiency and detailed order specifications, we quickly create optimized production plans and build an “integrated production planning platform” that is shared throughout the Company. We will use this platform to unify company-wide information and introduce an integrated production planning simulator that can accurately respond to customer orders and changes in the raw material procurement environment. By applying advanced mathematical optimization technology, this production planning simulator enables rapid selection of the optimal plan from a large number of planning patterns consisting of a huge amount of data. With this initiative, we aim to significantly reduce the workload at each steel works through the sophistication of production planning operations and strengthen optimal production control throughout the Company. For example, in the East Nippon Works Kimitsu Area, we have developed and introduced a new production planning system to efficiently produce “slabs” (steel pieces) in the steelmaking process. This has resulted in about a 70% reduction in the time required to create a production plan that is equal to or greater than the level of quality created by skilled workers and enables multiple plans to be simultaneously created.

#### [Integrated production planning platform]



### Integrated efficiency improvements from the procurement and transportation of raw materials to the manufacturing process

Since we are entirely dependent on imports for iron ore and coal, efficient transportation from mines and coal pits to our steel mills translates directly into cost competitiveness. For the transportation of more than 200 brands of iron ore and coal, we use algorithms to formulate optimal transportation plans from  $10^{760}$  (10 to the 760<sup>th</sup> power) complex combinations. In addition, because the transportation environment for imported goods varies greatly due to economic, meteorological and geopolitical factors, ship allocation management is required to respond flexibly and quickly to these factors. In response to this need, we have linked Mitsui OSK's “Lighthouse” real-time operation information platform with Nippon Steel's raw material supply-demand management system, thereby streamlining the supply chain from raw material procurement and transportation to production.

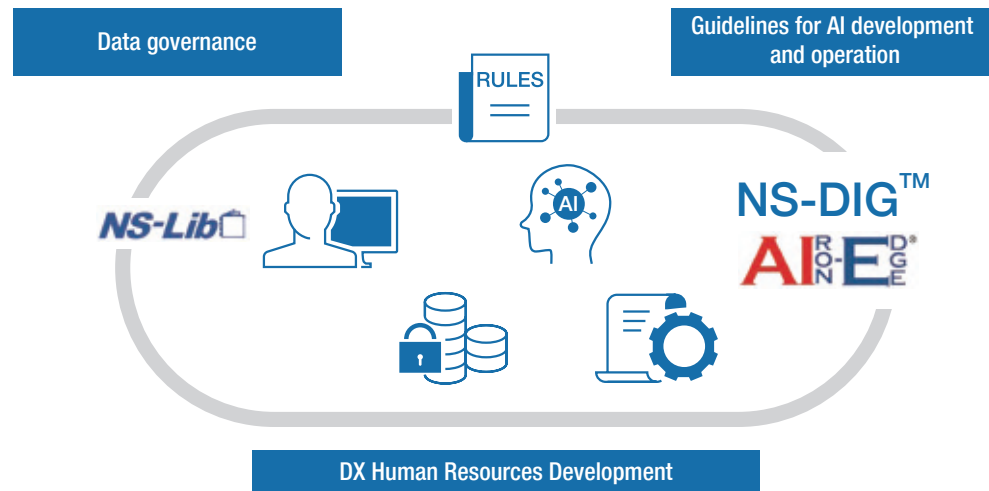


## Promoting of Digital Transformation Strategies

### Data governance, and guidelines for AI development and operation

Use of data requires good control, quality, and security. We have supplemented our existing information management rules in order to define the rule of data management, such as to create, store, use, release, and dispose, and to strengthen our ongoing data governance. In February 2022, we set up guidelines for AI development and operation, which compiles various points to consider in using and creating AI. In July 2023, we established guidelines on how to use generated AI and points to keep in mind because of the emergence of new social risks that were not previously seen in AI, such as infringement of intellectual property rights and generation of false or misleading information. Since then, the guidelines have been revised in response to changes in the environment.

Through the establishment of rules and human resource development, we aim to create an internal culture in which our employees become actively involved in DX and keep growing.



### Cybersecurity

Cybersecurity is becoming ever more important in the new workstyle with ICT as data utilization becomes more active: Information is exchanged in all different forms, in all kinds of situations and fields. Furthermore, in recent years, the increasing sophistication of cyber-attacks and attacks on operational technology (OT) or systems have forced some companies to shut down their production lines. In addition, cyber-attacks sometimes extend beyond individual companies, penetrating supply chain networks and affecting multiple entities. This underscores the need to strengthen overall security measures not only at the enterprise level, but also at the level of its affiliates and supply chain partners. Against this backdrop, we remain committed to strengthening various safety measures and providing safety education, both in Japan and in other countries. Specifically, we are working actively to improve the IT literacy (information security awareness) of every employee who uses our systems by providing security education through e-learning and conducting targeted e-mail training. In addition, we have established an organization and system dedicated to OT security and collaboration with the IT security unit, and implemented measures to bolster security through network multi-layered defense, etc.

Furthermore, with a focus on ensuring business continuity, we require our subcontract firms and suppliers in our supply chain to improve their security. In particular, we have established a "Group Companies' Cybersecurity Security Council" with Group companies with whom we closely share security strategies, so that we can work together to raise our security standards. Lastly, the NSG CSIRT, made up of our Group companies, conducts incident response to computer-related incidents.



- Proactive detection of incidents, response to incidents, and implementation of reactive measures
- Sending of the procedures to collect, analyze, and respond to incident-related information within the Company and to the Group companies



## Promoting of Digital Transformation Strategies

### DX human resources development

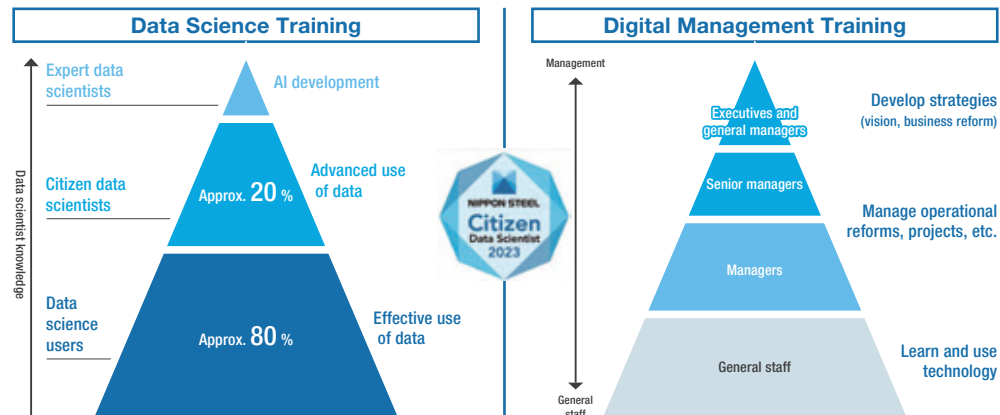
Nippon Steel defines “those who can extract and solve business problems based on data” as DX human resources, and aims to make all office staff and engineers DX human resources. Skills in three areas of business, data science, and data engineering are required to drive data-driven operations.

The strength of our Group is that we have a large number of people who are well versed in operations and have skills in business and data engineering, including people in NS Solutions. Our business competitiveness will be further enhanced by improvement of our data science skills.

We have defined data science knowledge in three levels: Expert data scientists, citizen data scientists, and data science users. In July 2021, we launched data science education programs with the goal of turning all office staff and engineers into data science users by March 2024. In addition, by 2030, we want 20% of all office staff and engineers to be citizen data scientists in every place of work. All office staff and engineers have completed the program to become data science users. By March 2024, approximately 6% of all the office staff and engineers had been certified as citizen data scientists, and by 2025, we expect this ratio to reach 10%.

To motivate employees to improve their knowledge and skills, those certified as citizen data scientists receive Open Badges. In December 2021, we also launched a new digital management education program with components for different levels or types of managers. By September 2023, all officers, from executives to managers, had completed the program.

We intend to promote education both in data science and digital management, and accelerate our production and business process reform, using data and digital technology.



### TOPICS

## Certified Citizen Data Scientist in action: Create a system that allows viewers to make decisions and take action

We faced the challenge that the management tools for shipment progress and transit points were still under development. In our business, sales production planning and process management are said to be the “key for shipment.”

Therefore, we are building a platform to visualize progress and quickly move from identifying issues to action. We believe that “visualization” is not just about creating graphs, but also “creating a system that allows the viewer to make decisions and take action.” After investigating and subdividing the business flow, we designed and created the necessary databases and dashboards.

Going forward, we aim to further improve the level of risk prediction by expanding the system to areas other than sales departments and using predictive models based on machine learning.



**Takeaki Fukunaga**

Sales Planning & Coordination Section  
Sales Coordination Department  
Marketing Administration & Planning  
Division Nippon Steel Corporation

