Nippon Steel’s Environmental Initiatives

Dec, 2019
Agenda

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Steel and Human Society
Steel Products and Application

Steel sheet

Automobiles

Home Appliances

Packings

Construction & Building

Ships

Construction Machinery

Bridges
Steel is an Essential Material

Abundant resource

Endless recyclability into all kinds of steel products

Recoverable reserves (bil. tons)

Iron ore 170.0

Bauxite 30.0
Copper 0.79
Zinc 0.23
Lead 0.08
Nickel 0.07

Diverse properties and further potential

Strength
Formability
Weldability
Corrosion resistance
Easy to paint/coat

Theoretical strength 10,400 MPa
Iron & steel
Theoretical strength 3,500 MPa
Aluminum
Concrete
CFRP
Carbon fiber

Eco-friendly in Life Cycle Assessment

Produce + Use + Recycle = LCA

Other materials
Steel

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C + 1/2 O_2(gas) = CO(gas)
Fe_2O_3 + 3CO(gas) = 2Fe + 3CO_2(gas)

Coke is essential material as reducing agent to produce steel.
CO₂ emissions in Japan in 2017

- Steel industry accounts for 14% of CO₂ emissions in Japan.
- CO₂ emission from industrial sector has been decreasing, while that of commercial and residential sector is increasing year by year.
Steel and SDGs

NIPPON STEEL contributes SDGs through Steelmaking

1. No Poverty
2. Zero Hunger
3. Good Health and Well-Being
4. Quality Education
5. Gender Equality
6. Clean Water and Sanitation
7. Affordable and Clean Energy
8. Decent Work and Economic Growth
9. Industry, Innovation and Infrastructure
10. Reduced Inequalities
11. Sustainable Cities and Communities
12. Responsible Consumption and Production
13. Climate Action
14. Life Below Water
15. Life on Land
16. Peace, Justice and Strong Institutions
17. Partnerships for the Goals

Paris Agreement | Factors promoting steel demand
Environmental Management
Basic Environmental Policy

Nippon Steel is a corporation whose business activities exert a large influence on the environment. For this reason, we see comprehensive “environmental management” throughout the group companies as an integral part of our mission, and we establish “Basic Environmental Policy”.

Under the principle of “Ecological Management,” Nippon Steel is committed to contributing to the creation of an environmental-preservation oriented society with lower environmental impact. For this purpose, the company will conduct business activities based on the viewpoint of environmental preservation in local communities, which includes the maintenance and improvement of good living environments and the promotion of reduction and recycling of waste. The company will also address challenges on a global scale including response to issues of global warming as well as the maintenance and improvement of biological diversity.

1. Reducing environmental impacts at every stage of operations (Eco Process)
2. Offering of environment-oriented products (Eco Products)
3. Proposing environmental preservation solutions from a global perspective (Eco Solution)
4. Development of innovative technologies
5. Development of a rich environment
6. Promotion of environmental relations activities
Our Engagement for Tackling Climate Change

Eco Process
Efficiency improvement of production process

Eco Product
Contribution from use of high-grade steel in finished products

Eco Solution
Global contribution by the transfer of energy conservation technologies and equipment

Development of innovative technologies
Three ecos to contribute to SDGs

Three ecos and innovative technology development

Raising challenges from the viewpoint of SDGs

Sustainable Development Goals (SDGs)

2020 Mid-Term Environmental Management Plan
We hold an “Environmental Management Committee” hosted by top management including 4 of 5 vice presidents every six months.

The committee manages environmental risks such as climate change and air / water / waste, etc., and reports to the Board of Directors and Management Committee.

The steel industry requires huge investments, so long-term perspectives are essential for the management. The climate change issue is one of the most important issues that is directly linked to our business performance in the long term.

Our officers and directors are 100% performance-linked.
Coping with Climate Change
Voluntary CO₂ reduction actions by Japanese industrial sector

- 60 industries including steel have pledged to the voluntary CO₂ reduction targets towards 2020 and 2030 under “Commitment to a Low-Carbon Society”
- “Commitment to a Low-Carbon Society” and “Paris Agreement” have the same framework
  ✓ Pledge to a voluntary target and enhance actions through review by third party

*Keidanren: Japan Business Federation
Sectoral Approach

The Japanese steel industry has adopted a sectoral approach to reduce CO2 emission both domestically and worldwide.

**Effectiveness of the Sectoral Approach**

- Since the Japanese steel industry has matured technically, we have been working on CO2 reduction with ambitious goals while sharing the best practice across the industry.

- On the other hand, emerging countries have great CO2 reduction potential. Since the steel making processes are basically similar, it is effective to reduce the world's CO2 emission by transferring the world's best energy-saving technology in Japan.

- Switching to an innovative process is a huge challenge, so it is effective to create a national project with subsidies from the government and develop innovative technologies in all Japan.

As a leader in the Japanese steel sector, we are driving this activity.
Eco Process

The steel manufacturing process efficiently recycles all raw materials.

INPUT
- Iron ore 58.61Mt
- Coking coal 25.19Mt
- Fossil fuels 1,060ML
- water 0.64G m³

OUTPUT
- Crude steel production 41Mt
- Plates
- Sheets
- Wire rods
- Pipe & tubes
- shapes
- Etc.
- Slag products
- Coal chemical products

INPUT
- Scrap
- Society

OUTPUT
- End products

The steel manufacturing process efficiently recycles all raw materials.

Fuel

By-products (Slag, Tar)

Recycling rate of By-products 99%

Exhaust heat

Exhaust heat utilization rate of steam production 76%

By-product gas

Recycling rate 100%

Internally generated energy utilization rate of in-house power generation 81%

Recycled water

Recycling rate 90%

Water

Recycling rate of By-products 99%

Electric arc furnace

Exhaust torch

Electricity

Steam

Waste plastics

Chemical recycle

By-products (Slag, Tar)

Gasifier

Gasifier

Society

End products

Crude steel production 41Mt

Gallvanizing mill

Pipe mill

Continuous Caster

Rolling mill

Electric arc furnace
Japanese steel industry reduced gross consumption by process improvements. Energy recovery has been contributing to reduction of net consumption in recent years.

**Process improvements and innovation**
- Continuous casting, PCI, coal moisture control, optimization of logistics, SCOPE21
- **Byproduct gas use**
  - Gas holder, high-efficiency gas turbine combined cycle generation, hydrogen amplification, CO₂ recovery
- **Exhaust heat recovery**
  - TRT, CDQ, regenerative burners, mid-low temp. heat recovery
- **Waste material use**
  - Waste plastics and tires

Source: The Japan Iron and Steel Federation
Coke Dry Quenching (CDQ)

- Instead of water used conventionally, CDQ uses inert gas to quench hot coke and recovers the heat to generate power.
- CDQ contributes to an improvement of coke quality and reduction of environmental pollution.
- CDQ has been installed at all the working coke ovens of steel manufacturers in Japan.
Energy Efficiency in Steelmaking (BOF)

Japan has the world’s highest energy efficiency.

(source: RITE (2015))
CO2 reduction targets and results in the steel manufacturing process

- The Japan Iron and Steel Federation's “Low Carbon Society Action Plan” sets CO2 reduction targets for 2020 and 2030 in the steel manufacturing process.
- Aiming for a reduction of 3 million tons in FY2020 and 9 million tons in FY2030 as a reduction in CO2 emissions (BAU emissions) that are assumed based on FY2005 and based on certain production assumptions.

### Countermeasure menu

<table>
<thead>
<tr>
<th>Countermeasure menu</th>
<th>Phase I 2020</th>
<th>Phase II 2030</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Efficiency improvement of coke oven</td>
<td>0.9 Million t-co2</td>
<td>1.3 Million t-co2</td>
</tr>
<tr>
<td>2. Efficiency improvement of power generation facilities</td>
<td>1.1 Million t-co2</td>
<td>1.6 Million t-co2</td>
</tr>
<tr>
<td>3. Strengthen energy saving</td>
<td>1.0 Million t-co2</td>
<td>1.5 Million t-co2</td>
</tr>
<tr>
<td>4. Waste plastic recycling</td>
<td>–</td>
<td>2.0 Million t-co2</td>
</tr>
<tr>
<td>5. Development and introduction of innovative technologies</td>
<td>–</td>
<td>2.6 Million t-co2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>3.0 Million t-co2</strong> + Waste plastic recycling</td>
<td><strong>9.0 Million t-co2</strong></td>
</tr>
</tbody>
</table>

- **FY2017 CO2 reduction results:**
  - Down 2.29 million t-CO2 from BAU

**CO2 emissions** (use of electric power coefficient after reflecting credits in FY2017): **181.2 million t-CO2**

(-3.8% compared to FY2005)
We are working to save energy through effective use of energy, operational improvements in each process, replacement of aging equipment, and introduction of high-efficiency power generation facilities.

<included companies>
NIPPON STEEL  NIPPON STEEL NISSIN Osaka Steel Sanyo Special Steel NIPPON STEEL Stainless Steel OJI STEEL NIPPPON COKE & ENGINEERING 5 CO-OPERATIVE THERMAL POWER companies 2 SANSO (O2) centers etc.
Reduce CO2 emissions by improving logistics efficiency

• We are working to improve the efficiency of logistics, such as maintaining and improving the modal shift rate, improving transportation efficiency, and improving fuel efficiency.

• In addition, we have implemented initiatives such as the introduction of Japan’s first lithium-ion battery-equipped hybrid cargo ship (launched in February 2019).

<table>
<thead>
<tr>
<th>Items of improvement</th>
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<tbody>
<tr>
<td><strong>Reduction in frequency of transportation</strong></td>
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<tr>
<td>Shift to larger transportation means</td>
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<tr>
<td>Further modal shift (from motor vehicles to vessels and railways)</td>
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<tr>
<td>Use of larger vessels and vehicles</td>
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<tr>
<td>Improvement in transportation efficiency</td>
</tr>
<tr>
<td>Improvement in load capacity</td>
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<tr>
<td>Improvement in actual loading rate</td>
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<tr>
<td>Reduction for cycle times</td>
</tr>
<tr>
<td>Reduction in transportation volume</td>
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<tr>
<td>Shortening of transportation distance</td>
</tr>
<tr>
<td><strong>Improvement in fuel efficiency</strong></td>
</tr>
<tr>
<td>Improvement in engine efficiency</td>
</tr>
<tr>
<td>Shift to fuel-efficient vessels and vehicles</td>
</tr>
<tr>
<td>Adoption of ways to improve fuel efficiency (eco-friendly tires, etc.)</td>
</tr>
<tr>
<td>Improvement in operation procedure plans</td>
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<tr>
<td>Turning off of engine when the vessel or vehicle is stopped</td>
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<tr>
<td>Promotion of economic operation (eco-friendly way of driving, etc.)</td>
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<tr>
<td>Improvement in productivity in shipment (adoption of two-hanging coil lifters, etc.)</td>
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</table>
Examples of ECO PRODUCTS™
Our high-performance steel products contribute greatly to reducing CO₂ emissions throughout the supply chain.

- **High strength steel sheet**
  Our high-strength steel sheet contributes to improving the fuel efficiency of automobiles by simultaneously improving collision safety and weight reduction of automobile bodies.

- **High strength steel plate**
  Our FCA-W plate has excellent fatigue fracture resistance in bulk and welds, contributing to improved fuel efficiency by making the LNG carrier hull thinner.

- **Steel for transformer**
  Our grain-oriented electrical steel sheet significantly reduces power loss during power conversion.

Examples of ECO PRODUCTS™
Our high-performance steel products contribute greatly to reducing CO₂ emissions throughout the supply chain.
Statistics are for the five major types of high-performance steel for which quantitative data are available (FY2017 production of 6.95 million tons, 6.6% of Japan’s total crude steel output). Use of finished products made of high-performance steel cut FY2017 CO2 emissions by 9.83 million tons for steel used in Japan and 19.90 million tons for exported steel, a total of 29.73 million tons of CO2.

### CO2 Emission Reductions: 29.73 million tons CO2 in total (6.95 million tons of high-performance steel)

**1. Domestic**
- Transformers: 215 CO2 emi. reduction 9.83Mt/y
- Rolling stocks: 27
- Automobiles: 450
- Power generation boilers: 194
- Ships: 96

**2. Export**
- Transformers: 61 CO2 emi. reduction 19.90Mt/y
- Rolling stocks: 0
- Automobiles: 849
- Power generation boilers: 430
- Ships: 651

Source: The Institute of Energy Economics, Japan
Next-generation automobile structure concept

Nippon Steel as the best partner to help materialize potentials of automobile

Mission:
Design the future of automobile

Realizing 30% weight reduction by a vehicle made of steel (equal to aluminum)

- Solutions in the ratio of high-tensile steel, structural/process designs, etc. → Achieved both less weight and collision safety

Solutions includes structural design conditions of components

- Select materials up to steel of 2.0GPa in tensile strength, on required performance ⇒ Help reduce thickness in sheet and integrate components
- Developed a structure concept using a battery made of steel for EVs, HVs, etc.
- Use of advanced electro-magnetic sheet and analysis solutions in the development of high-efficiency, small, light, quiet motors

Using the group's comprehensive power

- Delivery of materials and services with know-how in all major materials: from gasoline-vehicle parts to batteries and motors for EVs

The Nsafe™-AutoConcept is a concept of future automobile designed by Nippon Steel by using its advanced material and solution technologies and processing original products.

Breakdown of use of high-tensile steel by strength

Current vehicle

- TS≧980MPa
- TS≦780MPa
- TS≦590
- TS≦440
- TS≦390MPa

NSafe™-AutoConcept

- Stronger Safety
- More Flexible Comfort
- More Friendly Eco-friendliness
- Lighter Lightweight

Mission:
Design the future of automobile

The Nsafe™-AutoConcept is a concept of future automobile designed by Nippon Steel by using its advanced material and solution technologies and processing original products.
Importance of Increasing Eco Solution

- Technologies are the only way to minimize CO₂ emissions as demand for steel increases. Japan’s steel industry is the most energy-efficient in the world. Worldwide transfer of Japanese energy conservation technologies will become even more important as an effective means of fighting global warming.

Forecast for Global Crude Steel Production

Source: RITE
JISF’s global energy saving activities

In addition to the domestic energy saving actions, Japanese steel industry promotes contribution to global energy saving.

**China** since 2005
Japan-China Steel Industry Environmental Protection and Energy Conservation Technology Conference

**India** since 2011
The Public and Private Collaborative Meeting between Indian and Japanese steel industries

**ASEAN** since 2014
ASEAN: ASEAN-Japan Steel Initiative
ASEAN-Japan Steel Initiative since 2014

**Purpose**
- Exchange knowledge and experiences and thereby contribute to the energy saving and environmental protection in ASEAN
- Encourage technology transfer from Japan to ASEAN steel industry

**Participants**

**Public Sector**
Ministries and governmental institutions related to steel industry and energy saving in ASEAN countries and Japan

**Private Sector**
AISC, national association in ASEAN, JISF and their member companies

**Main Activities**

1. **Technologies Customized List**
2. **Steel Plant Diagnosis**
3. **Public and Private Meeting/Workshop**
Contents of Technologies Customized List

Technologies Customized List ASEAN version contains detailed information about 30 technologies and supplier information.

**Recommended 30 techs**
With energy saving effect, co-benefit etc.

**One-by-One Sheet**
Detailed technical specifications

**Supplier information**
Contact information of technology suppliers
Japanese steel industry’s energy-saving technologies are spreading globally

CDQ = Coke Dry Quenching

- **Reduction of CO2 emissions** through power generation using steam
- **Suppressing dust generation** when cooling coke
- **Improved coke quality** suitable for blast furnace use

CDQ102 unit: All are the results of NIPPON STEEL ENGINEERING

*We received orders for two large CDQs in India / Tata Steel in March 2019*
Contributing to a Circular Economy
Steel is a flexible material that can sustain resource recycling.

JISF
worldsteel: World Steel in Figures 2019
Bureau of International Recycling:
World Steel Recycling in Figures 2014–2018
Steel Recycling Research

2018 global

Steel Storage 32.4Bt

Natural resources 1.35 Bt
Scrap 0.63 Bt

DRI 0.1Bt
Loss 0.03Bt
Effective use of resources utilizing steel processes

The steel industry has the equipment and technology necessary to build a Circular Economy

Steel industry

We accept and effectively use by-products / waste generated by society and other industries

Recycling inside the steel manufacturing process

We effectively use by-products generated in the steel industry

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Recycling of waste plastics
(Chemical recycling without residues)

About 30% of the plastic containers and packaging generated in households nationwide are recycled at our steelworks.

Sorted waste plastic  →  Shredding  →  Pelletizing  →  Pyrolysis in coke oven

Oil ca. 40%
Used by chemical manufacturers in our group as raw materials for plastics

Coke ca. 20%
Used as reducing agent in blast furnace

Gas ca. 40%
Used as fuel for power generation etc. at steelworks
Material recycling of by-products produced in steel works (steel slag)

Schematic diagram of slag recycling

Application of slag produced by Nippon Steel

- Internal use: 8%
- Road/Railroad: 27%
- Civil eng./Construction: 6%
- Ground improvement: 2%
- Other: 5%
- Cement: 47%

Source: Nippon Slag Association

Use of steel slag: 18.76 million tons

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By-products and recycling (FY2018)

<table>
<thead>
<tr>
<th>By-product</th>
<th>Amount generated (wet weight – million tons)</th>
<th>Recycling application</th>
<th>Recycling rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blast furnace slag</td>
<td>12.16</td>
<td>Blast furnace cement, fine aggregate, road base, etc.</td>
<td>100%</td>
</tr>
<tr>
<td>Steelmaking slag</td>
<td>5.40</td>
<td>Road base, civil engineering materials, fertilizer, etc.</td>
<td>99%</td>
</tr>
<tr>
<td>Dust</td>
<td>3.17</td>
<td>Raw materials for use in-house and also zinc refining</td>
<td>100%</td>
</tr>
<tr>
<td>Sludge</td>
<td>0.48</td>
<td>Raw materials for in-house use</td>
<td>88%</td>
</tr>
<tr>
<td>Coal ash</td>
<td>0.50</td>
<td>Cement raw materials, construction materials</td>
<td>100%</td>
</tr>
<tr>
<td>Waste furnace materials</td>
<td>0.35</td>
<td>Reuse, road base, etc.</td>
<td>81%</td>
</tr>
<tr>
<td>Others</td>
<td>2.30</td>
<td>In-house use, others</td>
<td>99%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>24.35</strong></td>
<td><strong>Total recycling rate</strong></td>
<td><strong>99%</strong></td>
</tr>
</tbody>
</table>

1. Fine dust collected with a dust collector
2. Semi-solid slurry recovered from industrial wastewater or sewage treatment

Recycling rate of by-products 99%
Promotion of Environmental Risk Management
We manage by entering into agreements with local governments at levels that are more stringent than laws and regulations.

In order to comply with the agreed levels, we set voluntary management standards and manage results.

Agreement: Gentlemen agreement between Local governments and Company

⇒ Contracts to be observed

Laws

National uniform law standards

Determined by considering regional characteristics

Local government

Concentration / Emissions etc.

Laws

Regulations

Agreements

Actual results

Local governments and Company

Signed by Local governments and Company

Voluntary management standards (Stop criteria)

Company
Introduction of environmental equipment

- Dry desulfurization denitration equipment
- Low NOx regeneration burner
- Emergency drainage cutoff facility

● From the perspective of environmental conservation in the steelworks area, we not only comply with laws and regulations, but also enter into more stringent agreements with local governments on our environmental impacts such as air and water pollution.

● Aiming to continually improve environmental conservation, PDCA is steadily implemented every year to promote environmental risk management, which is a corporate social responsibility.
Overcoming pollution

1960’s
Dirty Dokai Bay
Sky covered with smoke

Current
Revived Dokai Bay
Sky regained the blue
Initiatives on Conservation of Biodiversity
Initiatives for “Creation of Hometown Forests” at each steelworks

Muroran

Tree planting in 1972

Current

Oita

Greenery in 1973

Current

The “hometown forest” raised by NIPPON STEEL is currently about 830 hectares. Equivalent to 180 Tokyo Domes.
Humic acid

Bivalent iron (Fe$^{2+}$)

Seaweed

Bivalent Fe$^{2+}$ binds humic acid to form soluble humic acid iron salt and is supplied to seaweed through the river.

Development of divalent iron fertilization technology

Steel slag (Fe$^{2+}$)

Beverly™ Unit (Divalent iron fertilization unit)

Fermented waste wood

Insufficient supply due to deforestation and dams

Contributing to the Creation of Sea Forests

Sea desertification
Contributing to the Creation of Sea Forests

- Utilizing steel slag, a byproduct of steelmaking, contributes to the regeneration of seaweed beds
- Currently working in 38 waters near Japan
- Received 2nd Eco Pro Award for Excellence in the Beverly™ series
Blue Carbon: CO$_2$ fixation in coastal and marine ecosystem

Regeneration of coastal habitats by using steel slag materials

Demonstration Experiments in the Laboratory

SeaLab I

SeaLab II

Seaweed Growing

Material Balance

CO$_2$ Fixation & Biomass Production in the Actual Coast

Hayama in Kanagawa [CaO-improved soil]

Sea grass

Mashike in Hokkaido [Ferrous fertilizer]

Seaweed
Innovative Technology Development

The Japan Iron and Steel Federation’s “A challenge towards zero-carbon steel”
Technologies as sources of global competitiveness

**International Patent Application**
Published: CY2012-2018

- **Nippon Steel**: 1,830 Patent applications
- **Company A**: 991 Patent applications
- **Company B**: 347 Patent applications

**R&D Expenditure**
FY2018

- **Nippon Steel**: 72.0 bn¥
- **Company A**: 53.2
- **Company B**: 32.0

We received “Derwent Top 100 Global Innovators*” for 7 consecutive years (2012-18).
* IP research firm Clarivate Analytics (Thomson Reuter) selects from companies and institutions.
 Enhancing Technological Superiority

The Ichimura Prize in Industry for Distinguished Achievement

Improvement of crashworthiness for ship collision by development of highly ductile steel plates

The Commendation for Science and Technology
(Prize for Science and Technology: Development Category) by the Minister of Education, Culture, Sports, Science and Technology

Development of steelmaking process achieving minimum chromium emission (YES: Yawata Environment-friendly Smelter)

Derwent Top 100 Global Innovator 2018–19

Prized 7 consecutive years on high evaluation of constantly high patent success rate

The Ichimura Prize in Industry against Global Warming for Distinguished Achievement

Development of high strengthened stainless steel for high pressure hydrogen environment to accelerate hydrogen-based society

The Okochi Prize in Production

Development eco-friendly type steel wire for super-high-tensile strength bridge cables
Steel stock in the future

Relationship between GDP per capita and steel stock per capita

Transition of steel stock per capita


“Sustainable steel: at the core of a green economy”, World Steel Association, 2012

Steel stock saturates at about 10 t/capita in developed countries.
Steel demand and production

Steel production from iron ore is still necessary in the future.

Japan Iron and Steel Federation
The First Step to the future; COURSE50

(i) Development of **reduction technology using hydrogen** in coke oven gas
(ii) Development of **CO₂ capture technology** from blast furnace gases

**Project target:** **Mitigation of CO₂ emissions from steelworks by 30%**

100%-sponsored research by NEDO (New Energy and Industrial Technology Development Organization)
JISF Long-term vision for climate change mitigation

- JISF has decided to develop super innovative technologies to realize zero-carbon steel on Nov 2018.
- Hydrogen-based steel making and CO₂ capture are main measures.
- COURSE50 is the first step to the future.
- For hydrogen-reduction, massive and stable supply of carbon-free hydrogen with rational cost is essential.

### Challenges specific in iron & steel sector

<table>
<thead>
<tr>
<th></th>
<th>2020</th>
<th>2030</th>
<th>2040</th>
<th>2050</th>
<th>2100</th>
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<tbody>
<tr>
<td>COURSE50</td>
<td></td>
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<tr>
<td>Raising ratio of H₂-reduction in blast furnace using internal H₂ (COG)</td>
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<tr>
<td>Capturing CO₂ from blast furnace gas for storage</td>
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<td>Super COURSE50</td>
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<td>Further H₂-reduction in blast furnace by adding H₂ from outside (assuming massive carbon-free H₂ supply becomes available)</td>
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<tr>
<td>H₂-reduction ironmaking</td>
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<td>Reduction with H₂</td>
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<tr>
<td>Ironmaking without using coal</td>
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### Challenges common in social fundamental

<table>
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<tr>
<th></th>
<th>2020</th>
<th>2030</th>
<th>2040</th>
<th>2050</th>
<th>2100</th>
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</thead>
<tbody>
<tr>
<td>Carbon-free H₂</td>
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<tr>
<td>Technical development of low cost and massive amount of hydrogen production, transfer and storage</td>
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<tr>
<td>CCS/CCU</td>
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<tr>
<td>Technical development on CO₂ capture and storage/usage Solving social issues (location, PA, etc.)</td>
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Response to Leading Research for “Zero Carbon Steel”

- In November 2018, the Japan Iron and Steel Federation announced the “Challenge to Zero Carbon Steel” (hereinafter referred to as the JISF Long-Term Vision). In order to reach the long-term target level sought by the Paris Agreement, it is necessary to use “super-innovation technology” that goes beyond the innovative steelmaking technology currently being developed. Based on the knowledge gained from the COURSE50 currently being developed, etc. Clarified that we will challenge to develop zero carbon steel.

- In June 2019, the government decided on the “Long-term strategy as a growth strategy based on the Paris Agreement” that reflects the JISF long-term vision. In response to this, the Ministry of Economy, Trade and Industry is scheduled to start an open call for research for leading zero carbon steel in January 2020 through the New Energy and Industrial Technology Development Organization (NEDO).

- In response to this situation, the JISF will set up the “Zero Carbon Steel Liaison Committee” and prepare for the commissioned lead research.
Disclosure under TCFD
(Task Force on Climate-related Financial Disclosures)
Status of TCFD support

- In May 2019, Nippon Steel signed a support of the information disclosure recommendations compiled by TCFD.

- Chairman Shindo was on stage at the TCFD Summit held in October this year.

- We participated in the creation of “TCFD guidance for companies (announced in October 2018)” and “TCFD guidance for investors (announced in October 2019)” and actively exchanged opinions with domestic companies and investors.

- We will continue to participate as a member of the TCFD Consortium Planning Committee.

- In the Sustainability Report 2019 and Integrated Report 2019, information is disclosed according to the TCFD disclosure recommendations.

  ⇒ This year's TCFD disclosure is the first stage. We will work on improving the level.
## TCFD scenario analysis (1)

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Factor</th>
<th>Events</th>
<th>Impact to Nippon Steel</th>
<th>Nippon Steel’s strategy</th>
</tr>
</thead>
<tbody>
<tr>
<td>$2^\circ C$</td>
<td>Transition factor 1</td>
<td>Advance in electric vehicles (EVs); decline in powertrain-related steel demand</td>
<td>Estimates for 20501 EVs: 342mn units (17% of total) Internal combustion engine vehicles (ICEVs): 1656mn units (83%)</td>
<td>■ Potential decline in the ratio of powertrain-related steel demand, but potential increase in demand for the global cumulative number of vehicles (ICEVs incl. HVs, PHVs). ■ Increase in demand for high-performance steel for EVs.</td>
</tr>
<tr>
<td></td>
<td>Transition factor 2</td>
<td>Shift to other lightweight materials, prompted by tighter fuel efficiency regulations, etc. (multi materials)</td>
<td>Shift to other lightweight materials, prompted by tighter fuel efficiency regulations, etc.</td>
<td>■ Switch to other lightweight materials is possible but should not be significant as steel remains superior in environmental impact from the LCA viewpoint. ■ Increase in demand for high-strength steel, carbon fiber reinforced plastics (CFRP), titanium steel, etc.</td>
</tr>
<tr>
<td></td>
<td>Transition factor 3</td>
<td>Shift to the electric arc furnace (EAF) route</td>
<td>Progress in shift from the blast furnace (BF) route to the EAF route, which has lower environmental impact in manufacturing</td>
<td>■ Increase in the ratio of use of scrap (25% to 47%), due to more accumulation and generation of scrap; an increase in blast furnace steel production to continue up to 2050 to satisfy steel demand not satisfied by steel made of scrap</td>
</tr>
</tbody>
</table>

*For data on EV vehicles, see IEA ETP2017. EV cars are only BEV without internal combustion engine. Vehicles equipped with internal combustion engines include PHV.*
### TCFD scenario analysis (2)

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Factor</th>
<th>Events</th>
<th>Impact to Nippon Steel</th>
<th>Nippon Steel’s strategy</th>
</tr>
</thead>
<tbody>
<tr>
<td>2°C</td>
<td>Transition factor 4</td>
<td>Increase in operating cost caused by adoption of carbon pricing</td>
<td>Adoption of carbon pricing</td>
<td><strong>■</strong> Significant impact for steel being an international product if carbon pricing is adopted. <strong>■</strong> Hydrogen reduction steelmaking and use of scrap to reduce CO2 emission <strong>■</strong> Carbon pricing impact to be alleviated by securing pricing advantages, realized by our higher value-added product strategy, based on our technological strength and solution proposals <strong>■</strong> Need to discuss with customers on passing cost increase on product price</td>
</tr>
<tr>
<td></td>
<td>Transition factor 5</td>
<td>Heightened needs for products and solutions associated with a hydrogen-oriented society</td>
<td>Increase in demand for hydrogen-related infrastructure and facilities</td>
<td><strong>■</strong> Profit growth by provision of the Group’s products and solutions that support a hydrogen-oriented society [Ex] Stainless steel for high-pressurehydrogen (HRX19™); hydrogen station (Nippon Steel Engineering) <strong>■</strong> Enhancement of the Group’s product menu and expanding sales in Japan and overseas</td>
</tr>
<tr>
<td></td>
<td>Transition factor 6</td>
<td>Higher needs for energy-efficient products and technology in the world</td>
<td>Eco-friendly technology solution to boost demand</td>
<td><strong>■</strong> Profit growth, driven by our Group’s long-proven technology solutions [Ex] Dissemination of CDQs, all of which are handled by Nippon Steel Engineering, into emerging countries <strong>■</strong> Expansion in provision of Eco Products in the world Government-private cooperation; Technologies customized list; and steel plant diagnosis to provide energy-saving technologies to emerging countries (contribution to the global value chain)</td>
</tr>
</tbody>
</table>
## TCFD scenario analysis (3)

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Factor</th>
<th>Events</th>
<th>Impact to Nippon Steel</th>
<th>Nippon Steel’s strategy</th>
</tr>
</thead>
</table>
| 4°C      | Physical factor 1       | Difficulty to procure raw materials, caused by abnormal weather        | Limited impact by taking measures on risk of suspended operation by raw material suppliers | ■ Continual procurement from multiple sources  
■ Appropriate days of inventory; risk management |
|          |                         |                                                                        | Limited assumed risk in securing stable procurement of raw materials by taking the following measures, despite some possibility in temporary procurement cost increase caused by a deterioration in supply/demand balance  
■ Material sourcing from multiple regions in the world  
■ Keeping raw material inventories in steelworks and ships |
|          | Physical factor 2       | Difficulty in operation caused by a natural disaster                   | BCP measures have been adopted. Limited risks in production disruption caused by natural disaster. Excessively abnormal weather may result in suspension of operation, etc. | ■ Continual implementation of adaptation measures, with consideration of long-term trends: Measures against typhoons and heavy rain; measures to prevent crane overturns; measures against earthquakes and tsunami (securing emergency evacuation places, embankment reinforcement, etc.) |
|          |                         |                                                                        | Opportunities in demand growth of steel for national land resilience                     | ■ Enhancement of the Group’s product menu and expanding sales in Japan and overseas |
|          | Physical factor 3       | Natural disaster caused by abnormal weather                           | Profit growth by providing products and solutions for National Resilience against earth-quakes, tsunamis, heavy rain, typhoons, etc. | ■ Enhancement of the Group’s product menu and expanding sales in Japan and overseas |
LCA : Life Cycle Assessment
It is important to consider the environmental impact not only during product use, but also throughout the product life cycle, including disposal and recycling.
**CO₂ emission in production**

- **Mild Steel**: 230 kg-CO₂ eq / autopart
- **Advanced High Strength Steel**: 173 kg-CO₂ eq / autopart
- **Aluminium**: 757 kg-CO₂ eq / autopart
- **Carbon Fiber (CFRP)**: 990 kg-CO₂ eq / autopart

**CO₂ emission in production per same performance component is low in steel compared to other light-weight materials.**
Recyclability of steel

Most of the recycling is open-loop, degrading its property. Steel is recycled “closed-loop”, fully substitutional to the primary steel.

<table>
<thead>
<tr>
<th></th>
<th>Steel</th>
<th>Aluminum</th>
<th>Polymer</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Easy sorting</td>
<td>Good</td>
<td>Fair</td>
<td>Fair</td>
</tr>
<tr>
<td>2. Low environmental impact in recycling process</td>
<td>Good</td>
<td>Average</td>
<td>Good</td>
</tr>
<tr>
<td>3. Existence of economical recycling system</td>
<td>Good</td>
<td>Good</td>
<td>Average</td>
</tr>
<tr>
<td>4. Refinable in recycling</td>
<td>Good</td>
<td>Average</td>
<td>Fair</td>
</tr>
</tbody>
</table>
Emission in multiple recycling converges to a value.
In closed-loop recycling, there is no difference CO2 emission between BF-BOF and EAF steels.

This methodology was published as ISO 20915 on Nov. 2018.
Attempting to use scrap forcibly in Japan leading to a CO2 emissions increase in global

If we try to promote the use of electric furnace steel forcibly in the region, it will cause adverse effects.
(1) There is a limit to the demand for electric furnace steel (almost construction materials).
(2) Increased CO2 in other areas.

Scrap is a finite resource.

Japan’s blast furnace is the most efficient in the world.

Distorted promotion of EAF steel may create global CO2 increase
ESG Topics
(Contributing to SDGs)
ESG Topics

**NSSMC & Mazda Co-Develops World’s First Cold-Stamped Parts Using 1,310 MPa-Class High-Strength Steel**  
(Jan. 2019)

- By de-bottlenecking the formability and dimensional accuracy problems after processing, application of 1,310 MPa-Class High-Strength Steel has been expanded to car structural parts with more complexed configuration.
- This results in a lighter and strong vehicle body that ensures improved fuel economy and crash safety performance.

**ECO・VC Gold Award from Panasonic for 9 consecutive years**  
(Jan. 2019)

“Development of new Electrical steel series for better motor performance”

→ Realized significant CO2 emission reduction.

**Expanded 24-hour in-house nurseries in Hirohata Works**  
(Feb. 2019)

The 5th nursery openend in Apr. 2019.
Oita, Kimitsu, Yawata, Nagoya and Hirohata (New open)
**ESG Topics**

**Gyro-Press Method™ (Rotary Cutting Press-in Method), Co-development of GIKEN Ltd. & Nippon Steel, Has Been Adopted in Construction of Sea Embankment against Large-scale Tsunami**

~Gyro-Press Method™, GIKEN LTD. and our joint development method~

**<Advantages of Gyro-Press Method™>**

- Clean emission: Restricted soil displacement
- Ultra low noise: Reduced skin friction
- Minimum affect on surrounding traffic: Compact operation in sites with narrow access or overhead obstructions
- Realize eco-friendliness, cost reduction & work efficiency
- Many achievements in various different infrastructure project such as river bulkhead & road retaining structure reinforcement since 2004
- Contribution for disaster prevention/reduction & early recovery

**New order for two large-scale CDQ systems from Tata Steel**

< Benefits of CDQ = Coke Dry Quenching >

CDQ systems use an inert gas inside a cooling tower to cool red-hot coke that has been dry distilled in a coke oven. The sensible heat of red-hot coke, which previously has been dissipated, is recovered as steam with a boiler.

1) Reduced CO2 emissions through power generation by steam
2) Less amount of dust generated when cooling coke
3) Improved quality of coke suited to use in blast furnace
thank you for your attention