JFE Steel's Environmental Vision 2050

6 Feb 2024

JFE Steel Corporation

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Environmental Vision 2050

JFE Steel Corporation

Carbon Neutrality Strategy Briefing

JFE Steel's Transition to Low-carbon Processes

Environmental Vision 2050

2024 — 18% less CO_2

Transition Period — Develop ultra-innovative technologies for carbon neutrality (GI Use of funds)

Use EAFs

Expand use of DRI

2030 — 30% or more CO_2

Innovation Period — Establish & implement ultra-innovative technologies

Adopt optimal processes based on external conditions

2050 — Carbon neutrality

Carbon recycling blast furnace

Small-scale tests → Mid-scale demonstration tests +CCU → Develop large-scale furnaces → Roll out based on hydrogen supply volume ×α

Use in existing blast furnaces

- LNG injection
- HBI
- Oxygen blast furnaces

Direct reduction

High-grade HBI

EAF iron source

- Low-grade ore
- Carbon recycling technology

Transition to carbon-free hydrogen ×β

Direct-reduced iron made with blast furnace-grade ore (Fe<65%)

EAF

Upgrade Sendai EAF

Large, high-efficiency EAF (possibly in Kurashiki District)

Transition to carbon-free electricity ×γ

Use of scrap

DRP technology

Double-slag refining process

Expand use of scrap

Burnerless technology

External conditions

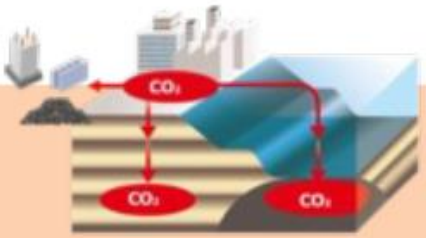
- Carbon-free electricity
- Carbon-free hydrogen
- CCUS

Green steel

Sustainable market based on actual environmental value

Carbon-free electricity

Carbon-free hydrogen



CCS

Pursue multilayered technology development, via GI Fund projects, etc., to discover the most proven technologies and then achieve carbon neutrality by deploying the most optimized configuration of green steelmaking processes.

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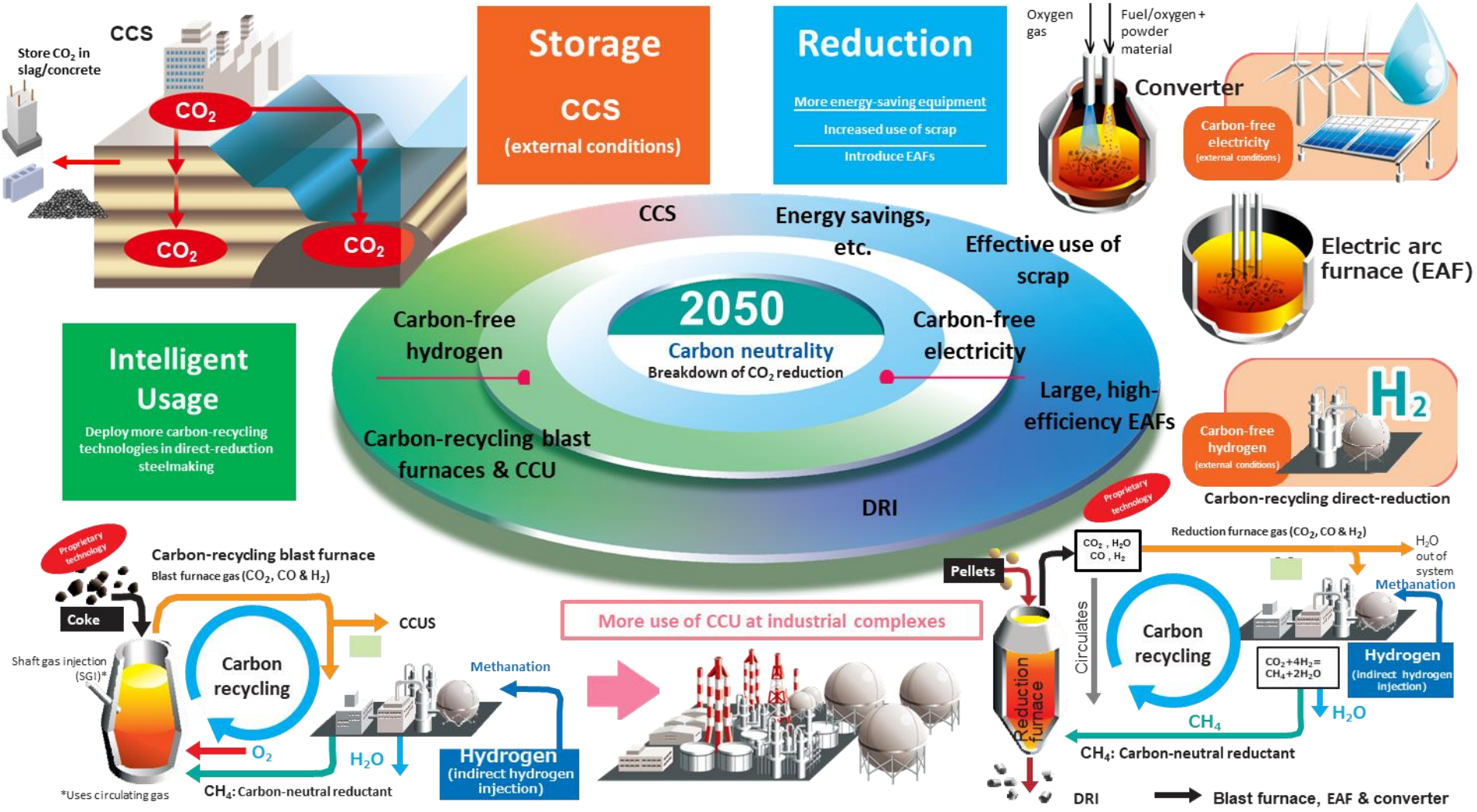
JFE Steel's Carbon Neutrality Vision 2050

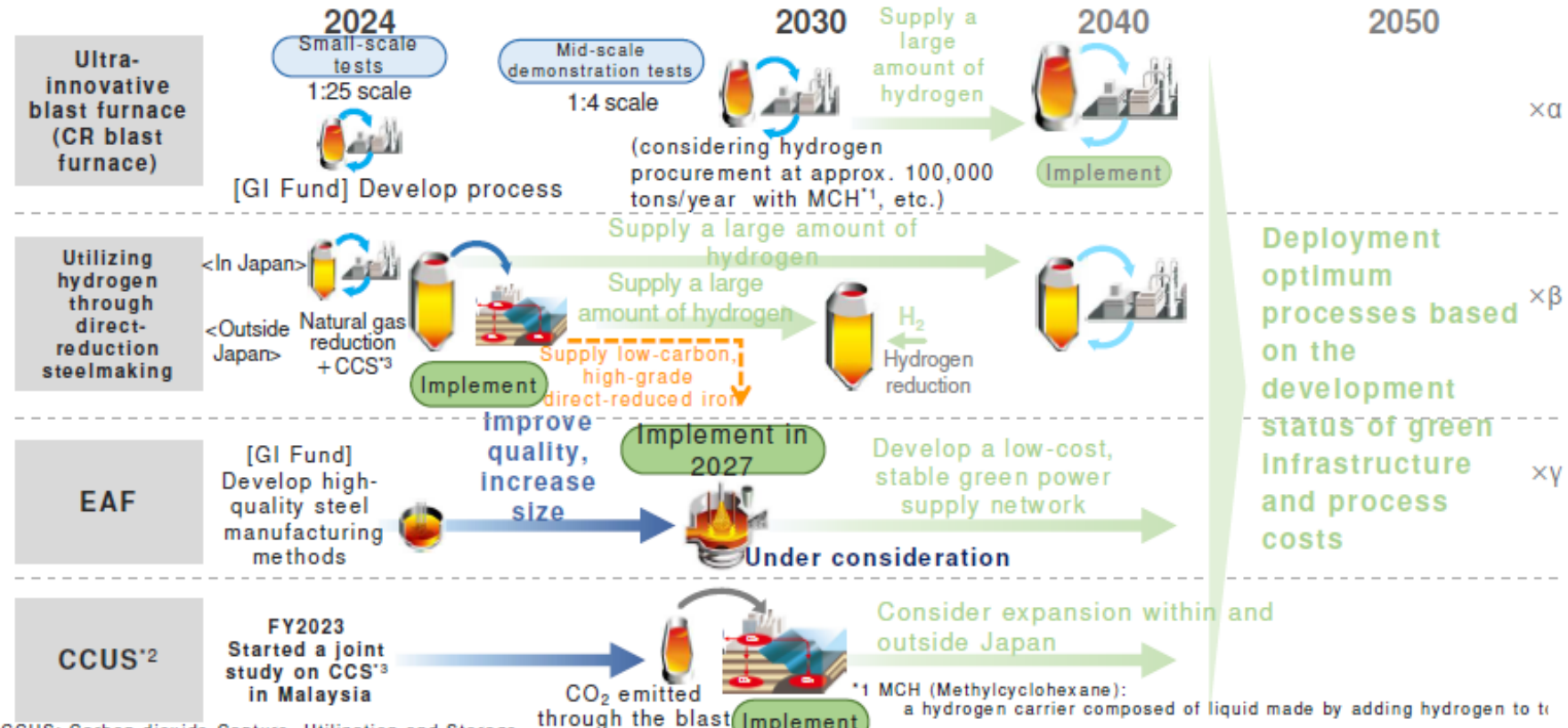


Combine reduction, intelligent usage and CO_2 storage to realize a carbon-neutral steel business by 2050

JFE Steel's Transition: Direction and Challenges

Environmental Vision 2050

- Developing technologies to produce high-quality and high-functional steel in the GI Fund project by using technologies to utilize hydrogen in the blast furnace process and direct-reduction steelmaking as well as EAFs.
- **Considering the transition of one blast furnace, which is to be refurbished in 2027, to a large, high-efficiency EAF, assuming government support. Aiming for lower CO_2 emissions and business growth.**
- Policies on the transition after 2030 will be formulated later, taking account of issues such as the development of plentiful, low-cost, and stable supply networks of hydrogen and power as well as demand for green steel.



*2 CCUS: Carbon dioxide Capture, Utilization and Storage
*3 CCS : Carbon dioxide Capture and Storage

*1 MCH (Methylcyclohexane): a hydrogen carrier composed of liquid made by adding hydrogen to t

JFE's Carbon Neutrality Action Plan

▶ JFE Steel is introducing low-carbon steel processes during its "transition period" to 2030.

▶ In its "innovation period" from 2030 to 2050, JFE Steel aims to develop and implement ultra-innovative technologies for carbon neutrality.

Transition period

- Increasingly deploy low-carbon technologies through capital investment to achieve targets such as cutting 2013-level CO_2 emissions by 30% or more by 2030
- Accelerate multitrack R&D targeting ultra-innovative technologies for innovation period
- Create markets for renewable green-steel materials based on actual environmental value
  → Create initial demand

Stimulate demand through government policy

Innovation period

- Swiftly establish and deploy ultra-innovative technologies
- Collaborate with communities and industrial complexes toward carbon neutrality
- Grow markets for sustainable green steel based on actual environmental value
  →Grow demand leading to virtuous cycles

Maintain the competitiveness of Japanese steel through plentiful, low-cost, stable supplies of carbon-free hydrogen and electricity

Behavior must be shifted on both supply and demand sides to create markets for green steel

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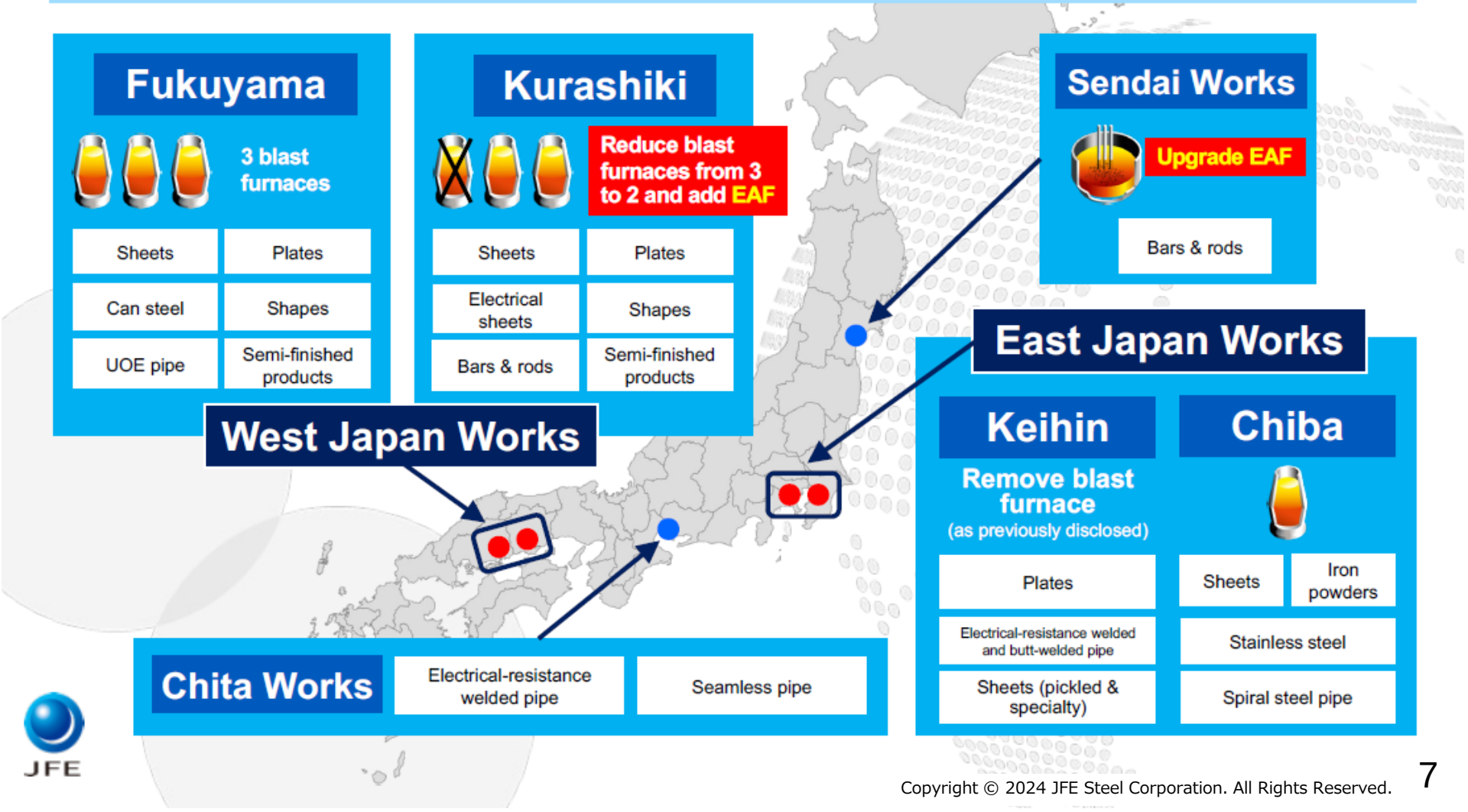
Expand Use of Scrap in EAFs (1)

- ▶ Upgrade Sendai Works' existing EAF to reduce CO_2 emissions by 30% or more by 2030
- ▶ Consider introducing large, high-efficiency EAF at West Japan Works' Kurashiki District



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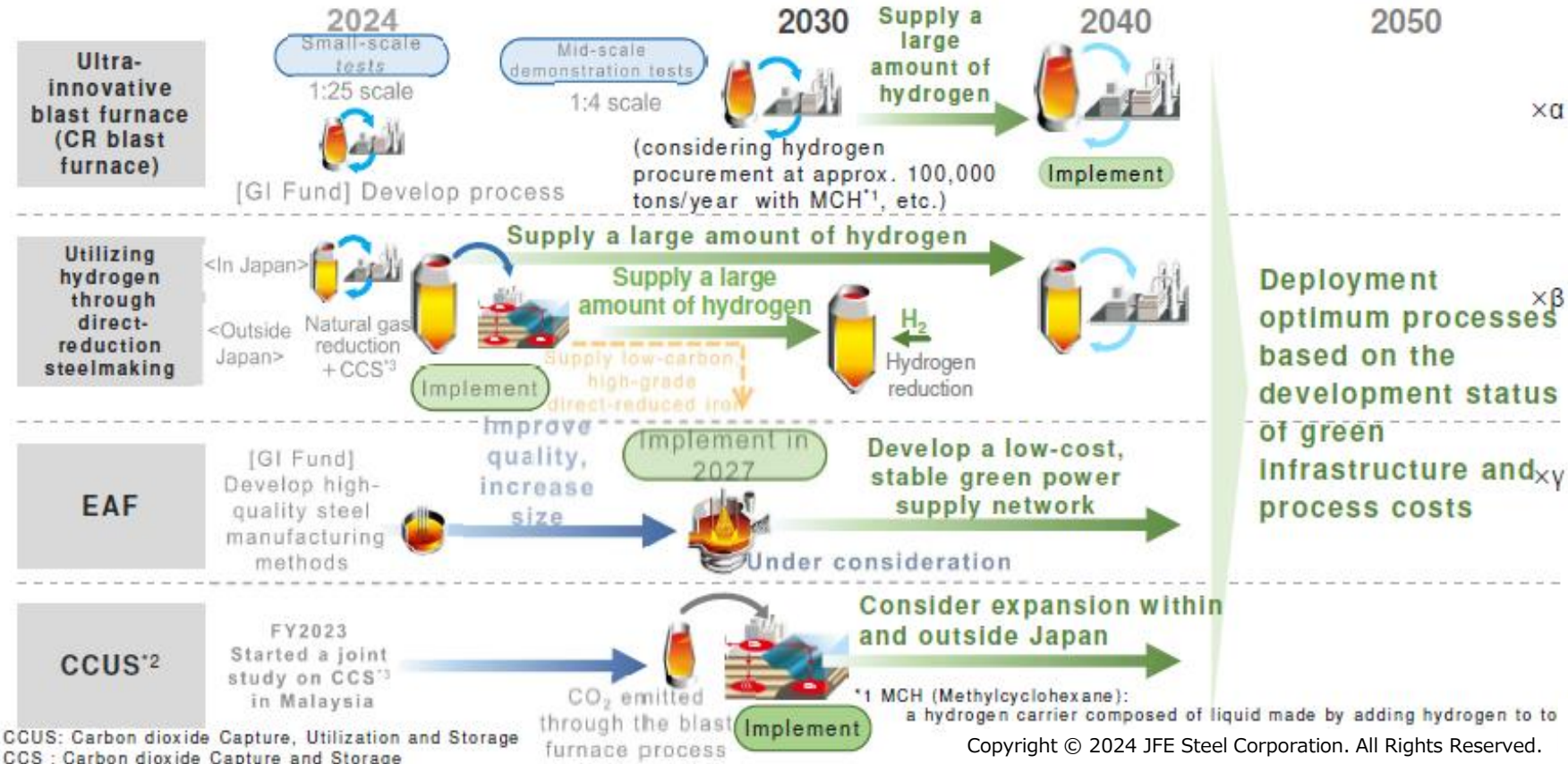

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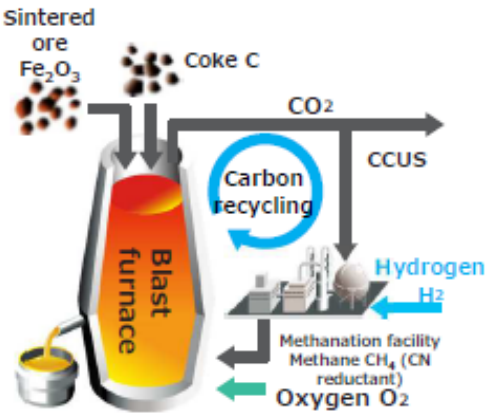
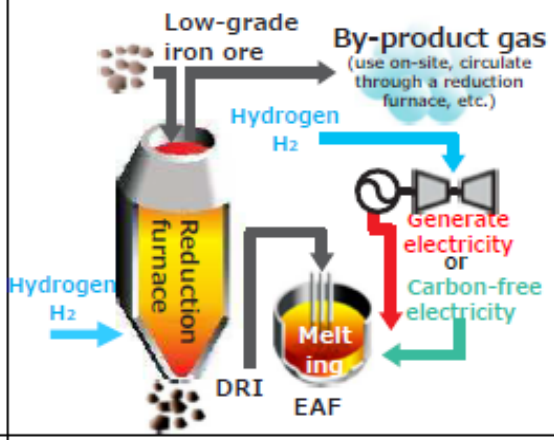
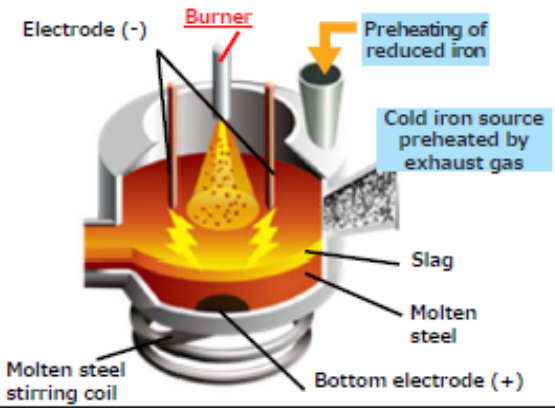
Projects Supported by the Green Innovation Fund

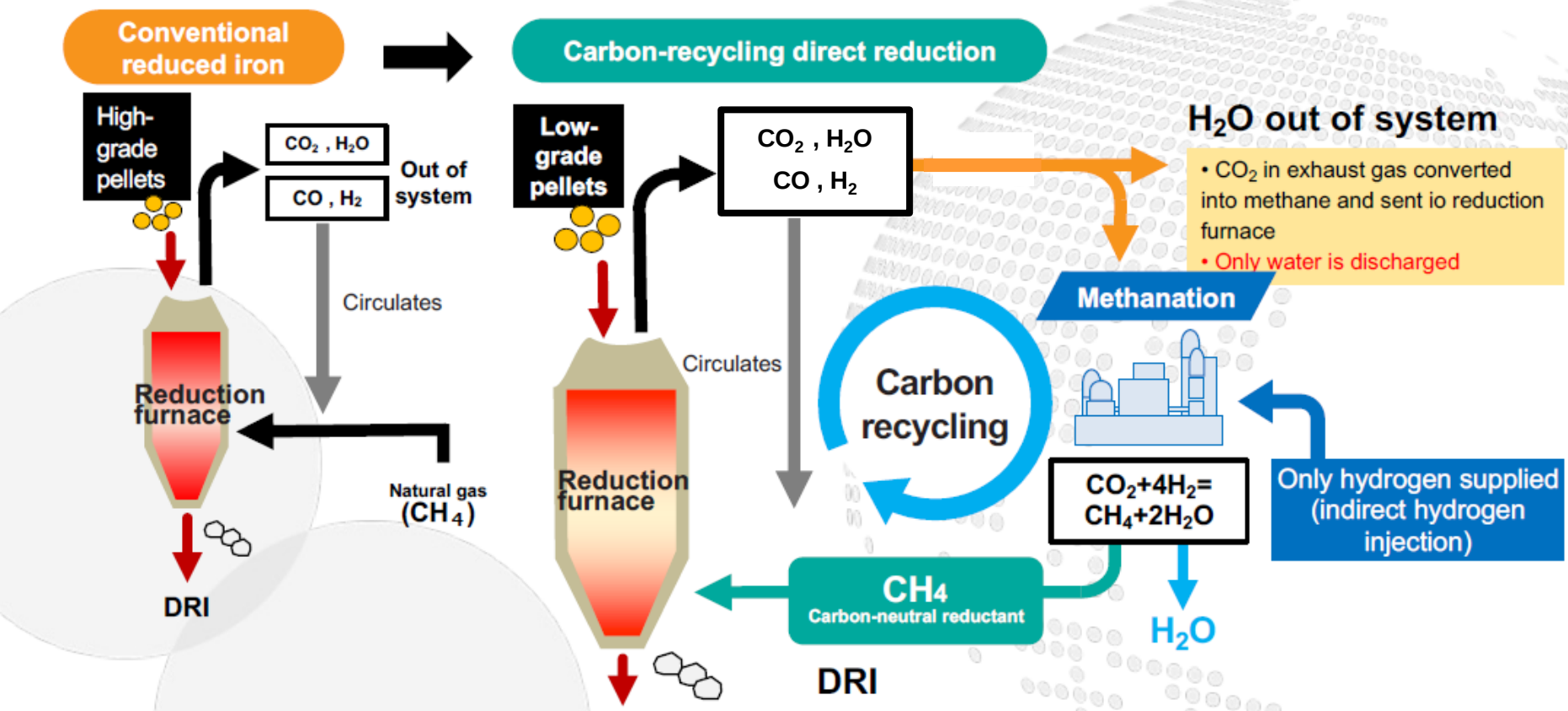
Environmental Vision 2050

- Promoting the development of ultra-innovative technologies in the NEDO project on hydrogen utilization in iron and steelmaking processes, financed by the Green Innovation (GI) Fund.
- Started building a small test blast furnace (150m^3) in Chiba District, aiming for swift implementation.

	Ultra-innovative blast furnace (Carbon-recycling blast furnace)	Direct-reduction steelmaking	Large, high-efficiency EAF
Development project			
Target	Reduce CO_2 emissions by 50% or more (compared to conventional blast furnaces)	Reduce CO_2 emissions by 50% or more (compared to conventional blast furnaces)	Establish high-quality and high-efficiency melting technologies
Description	• Technology to inject a large amount of oxygen and methane • Developing technology for seamless operations between the blast furnace and the methanation facility	• Heat compensation for hydrogen reduction (injection of high-temperature hydrogen and recycled methane) • Optimizing conditions for injecting reduced gas according to the grade of the raw material	• Improving steel quality by facilitating the denitrification with hydrogen gas and dephosphorization with suppress reoxidation • High-efficiency melting through burner lance, preheating of reduced iron, and molten steel stirring
Period	Test scheduled for FY2025-2026	Test scheduled for FY2024-2026	Test scheduled for FY2024-2025

GI Fund Project for Direct Hydrogen Reduction

- ▶Build a small bench-test furnace in East Japan Works' Chiba District and start testing in 2024.
- ▶JFE Steel will handle direct carbon recycling (indirect hydrogen injection), which utilizes methanation, traps carbon in the process for recirculation, and overcomes heat absorption in hydrogen reduction.



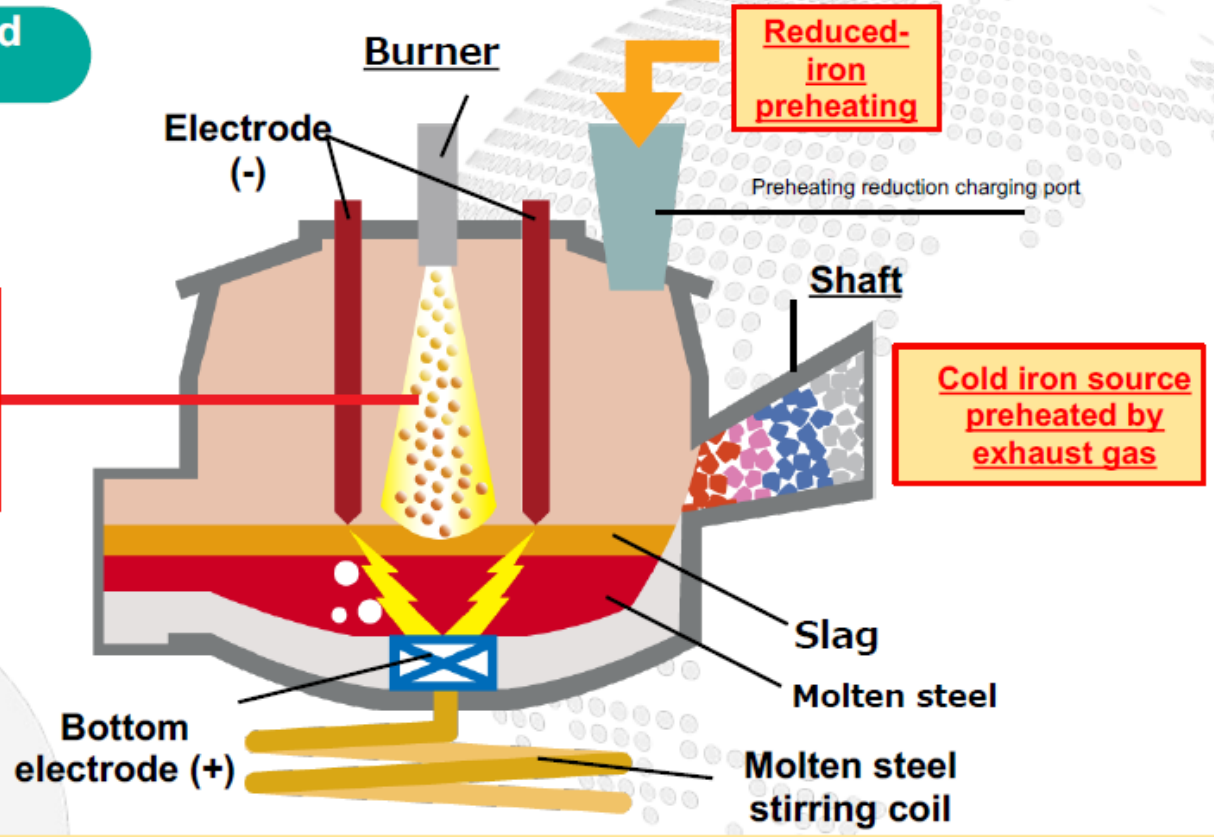
Path to implementation*: Conduct technology validation at a larger plant and then consider conducting demonstration tests, or actual implementation, of a full-scale furnace at an early stage.

*Post-stage gate plans TBD

GI Fund Project for Large, High-efficiency EAFs

- ▶ Build a small test EAF (10 tons) in the East Japan Works' Chiba District and start testing in FY2024.
- ▶ Combine reduced-iron-preheating, heating-burner and molten-steel-agitation technologies in a process aimed at reducing EAF-melting power consumption and enabling high-speed melting of cold iron sources (scrap & reduced iron).

Large, high-efficiency and high-quality EAF



Powder-heating burner
Heating powder (refining agent & carbon material) with a burner while adding it to the furnace results in highly efficient heating.

Note: JFE Steel also built a 3-ton smelting furnace in Fukuyama District to develop a high-quality steel production method using scrap and reduced iron in an EAF.

Path to implementation*: Deploy technology from above GI Fund Project to construction JFE Steel's EAF

*Post-stage gate plans TBD

Contributing to CO_2 Reduction Through Green Steel JGreeX™

Environmental Vision 2050

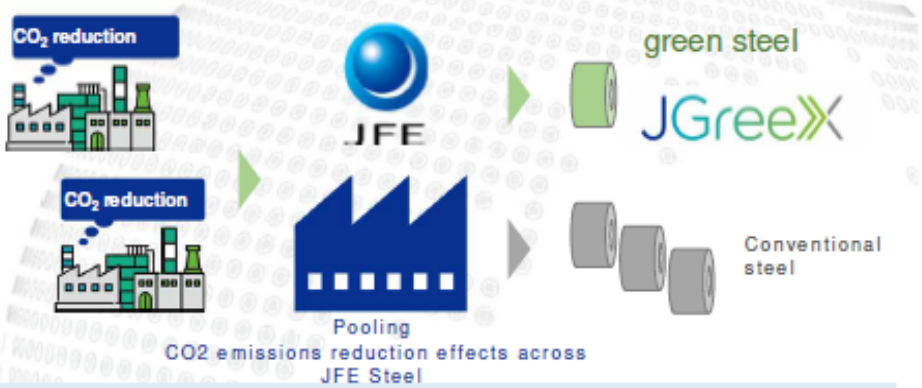
- Started supplying green steel JGreeX™, which emits significantly less CO_2 than conventional products, in 1H of FY2023.
- The steel mass balance approach is applied to JGreeX™ to calculate CO_2 intensity and reduction level of steel product based on ISO standard, ensuring additionality and transparency with third-party certifications.

■ Overview of green steel JGreeX™

JGreeX (JFE + Green + GX)

Supply start	First half of FY2023
Supply capacity	Approx. 200,000 tons (FY2023)
Target products	All steel products produced by JFE Steel
Certification body	Nippon Kaiji Kyokai (ClassNK)

■ Overview of the steel mass balance approach



STEP.1
Calculate the emissions intensity of any steel product to apply this approach

STEP.2
Identify emissions reduction projects and determine their emissions reduction levels

STEP.3
Issue a reduction certificate based on the determined reduction level, grant the certificate, and supply steel materials.

※ In addition to blast furnace companies in Japan, ArcelorMittal, Thyssenkrupp, and POSCO have also developed products as green steel brands based on the mass balance approach, and started selling them in some areas.

Business Growth Strategy through the Supply of Green Steel

- Increasing the mix of highly value-added products such as high tensile steel sheets and electrical steel sheets to 50+%, shifting the focus from Quantity to Quality, and aiming for business growth by shifting from high-quality steel to green steel.
- Expanding the supply capacity of green steel is critical for maintaining and expanding the international competitiveness of not only the domestic steel industry but also consumer industries, including automobiles and electronics.

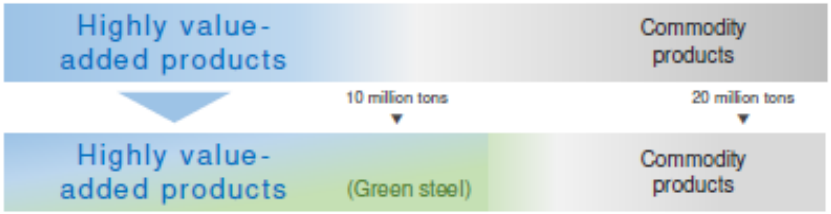
■ Medium-term business growth strategy

Expand margins and achieve stable profit by shifting the focus from Quantity to Quality

Increase the mix of highly value-added products* to 50+%

* Products that offer technological advantages, are recognized by customers for their value-added, and have greater earnings power than commodity products

FY2022 non-consolidated steel shipments: 21.74 million tons



<Highly value-added products: main examples>


High grade electrical steel sheets


High tensile steel for automobiles


Steel for offshore wind power

■ Green steel supply: Image