



Kobelco Sustainability Day

# Kobelco Group Research and Development

September 29, 2025  
Kobe Steel, Ltd.

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# Part I

## Overview of the Technical Development Group and 21 Core Technologies

September 29, 2025



Kobe Corporate Research Laboratories  
Kobe Steel, Ltd.

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## 01

### R&D Organization, Structure, and Environment

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- Creating a Future through Technology Integration

# 01

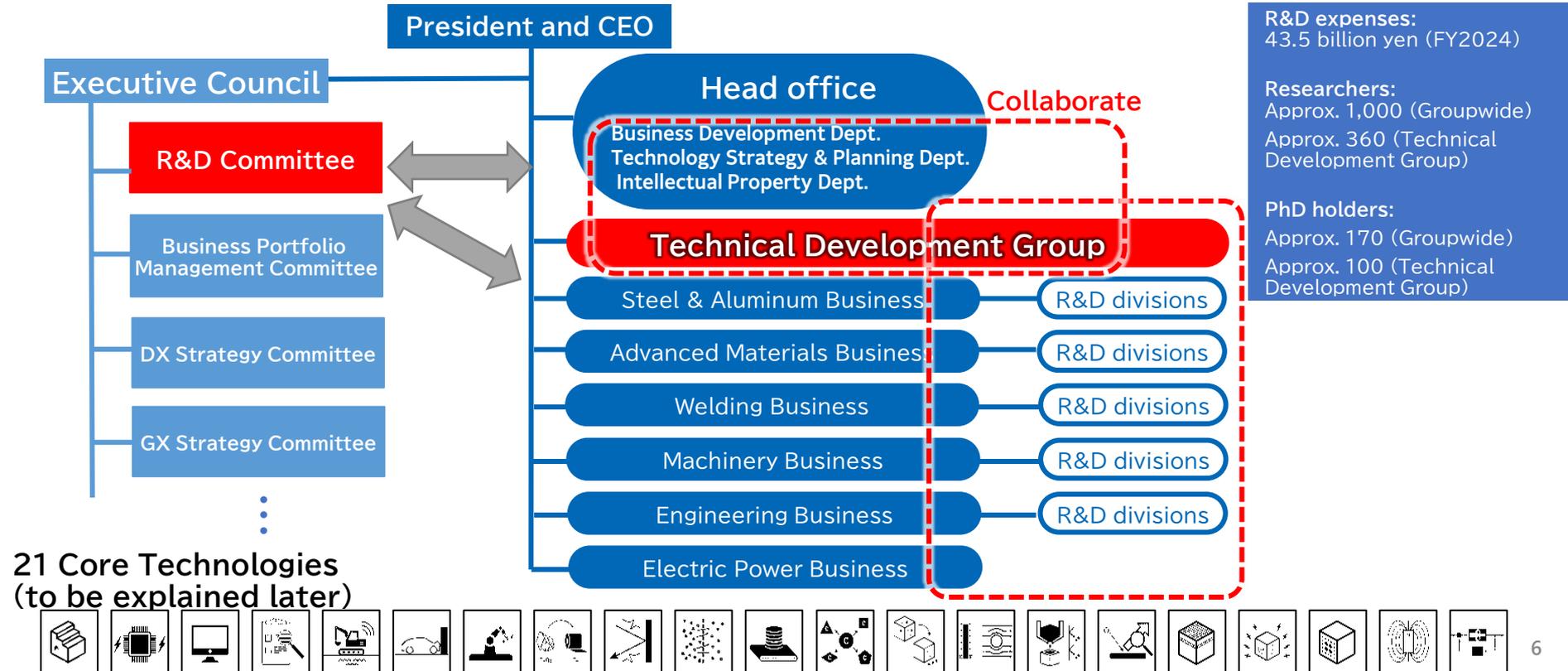
R&D

## Organization, Structure and Environment

**KOBELCO**

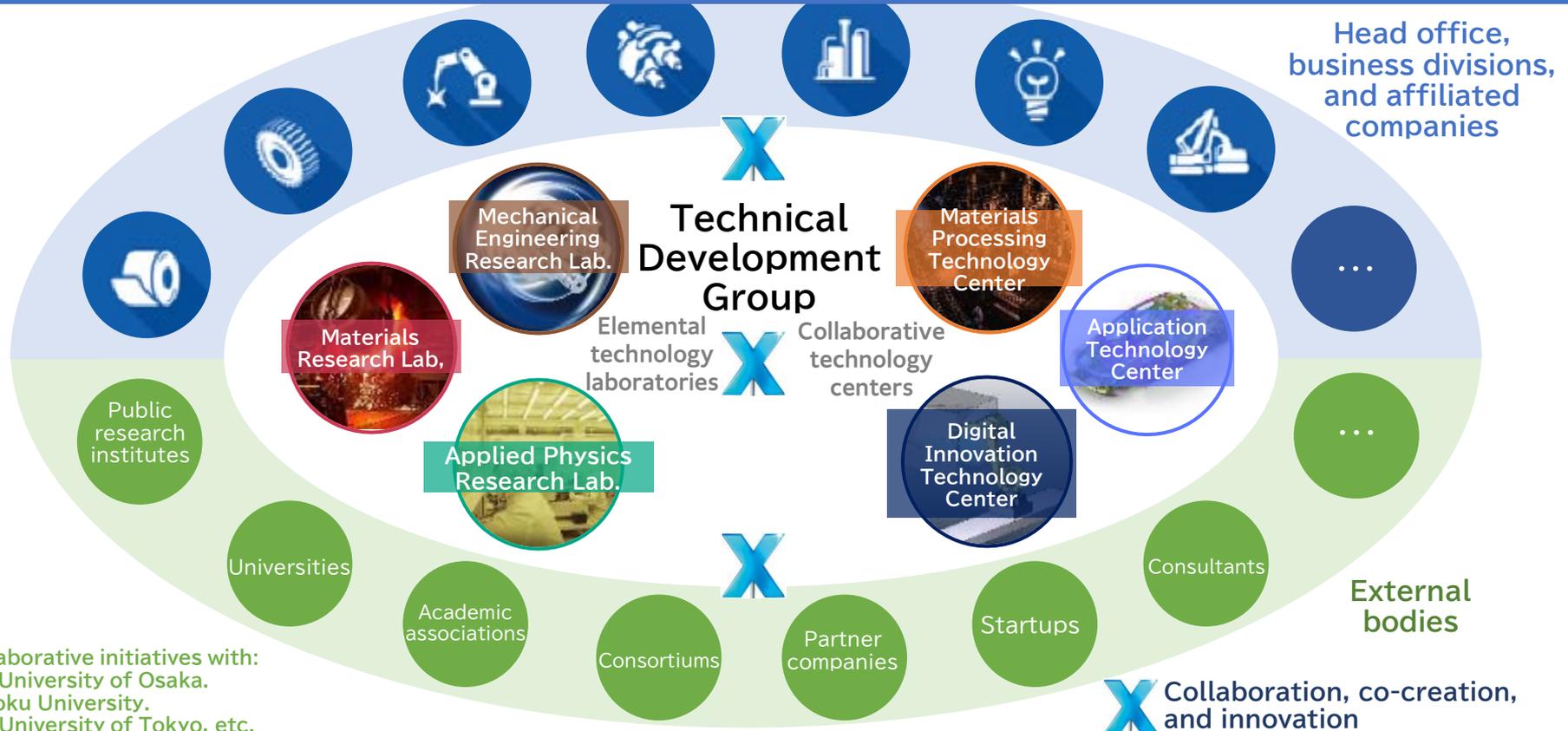
# R&D Organization

At the Kobelco Group, the Technical Development Group acts as the central hub for research and development, working in collaboration with relevant departments at the head office and business divisions to address various challenges by integrating 21 core technologies.



# Technical Development Group and Operating Structure

Effectively integrating **unique future technologies** aimed at the mid- to long-term with **technologies that support our current business strategies** while developing and promoting technology strategies that enhance our business



Collaborative initiatives with:  
The University of Osaka.  
Tohoku University.  
The University of Tokyo, etc.

**X** Collaboration, co-creation,  
and innovation

# R&D Environment

- ① Improved communication and increased interaction between departments by consolidating researchers in a single building
- ② Increased efficiency in R&D by positioning laboratory/testing buildings around research buildings
- ③ Fostering internal and external collaboration through KoCoLab, a technology showroom and co-creation space



## ② Testing buildings located nearby



## ③ KoCoLab



## ① All researchers in one location



Site area: Approx. 150,000 m<sup>2</sup>

# 02

## 21 Core Technologies

**KOBELCO**

# Kobelco Group's 21 Core Technologies

- ◆ The Kobelco Group has developed its 21 core technologies over many years of operation across diverse industries.
- ◆ These technologies serve as a common language within the company, fostering the integration of various technologies.
- ◆ We will actively utilize these technologies in collaboration with external partners for future co-creation and development.



Carbon resource conversion and application technology



Inclusions (in metal) control technology



Melting, forging, and welding technology



Metal working process technology



Metallographic structure control technology



Metal surface control technology



Structural deformation and breakdown evaluation technology



Atomic-level analysis and evaluation technology



Functional electronic material technology



Magnetic property control technology



Machine vibration, noise, and dynamics characteristics control technology



Welding mechanism modeling technology



Thermal and fluid dynamics technology



Absorption and desorption technology



Direct reduced iron production technology



Electric control technology



Measurement technology under special conditions



Process control technology



Servicing technology



Operations research (OR) application technology



AI application technology for data-driven science



Since our founding, we have developed our thermal and fluid control technology through developments of various production processes and products. We aim to further advance this technology as a key technology for energy transition toward the realization of a green society.

**Heat exchangers**

**Plastic mixing and pelletizing systems**

**Materials manufacturing**

**Waste treatment**

**Thermal and fluid dynamics technology**

**Electric power**

Particle Traces Colored by CPM Concentration (mole/m<sup>3</sup>) (2022/11/21 10:00:00) (1/20) (Unit: 1/100, 0.001, 0.01, 0.1, 1, 10, 100, 1000, 10000, 100000)

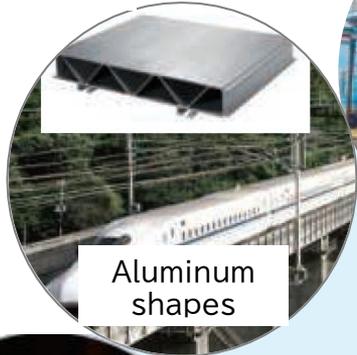
°C F

# 21 Core Technologies - Applications



Ensuring safety and security in urban development and manufacturing

Our long-established technology for controlling vibrations and noise, which inevitably occur during machinery operations, extends beyond machinery products and contributes to the realization of a safe and secure society by ensuring stable factory operations and providing solutions to the challenges faced by our customers in the materials businesses.



Aluminum shapes



Compressors



Construction machinery



Production process



Machine vibration, noise, and dynamics characteristics control technology



Weight reduction solutions

# 21 Core Technologies – Examples of Technology Integration

We developed the innovative welding solution AXELARC™ and realized **ultra-low spatter and productivity improvement by integrating our welding business's long-established technologies with the electrical control technology developed in the machinery and other businesses.**

## Customer issues and concerns

When molten metal sparks (**spatter**) stick on the item being welded, it requires extra work to scrape the surface.



Increasing the current to speed up welding **results in defects**

## Integration of 21 core technologies

Measurement technology under special conditions    Welding mechanism modeling technology    Thermal and fluid dynamics control technology

Clarify the mechanism through close observation of the welding phenomena

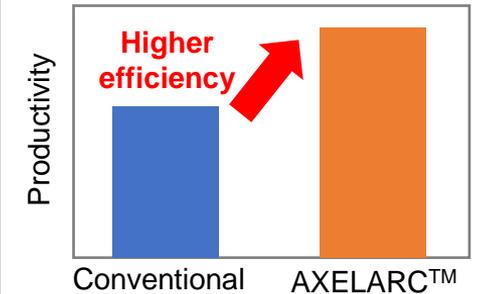
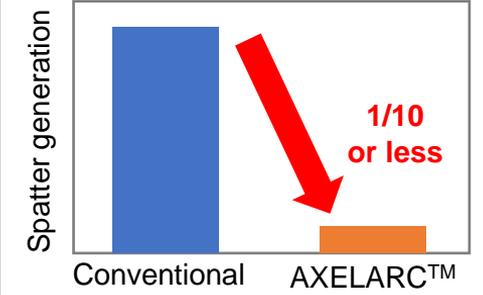
The molten material is shaken off by the wire feed's inertia as it moves forward and backward.



Electric control technology

Control large currents at the hundreds of microseconds level

## Our proposal for increased value



# 21 Core Technologies – Examples of Technology Integration



Ultra-low spatter realized



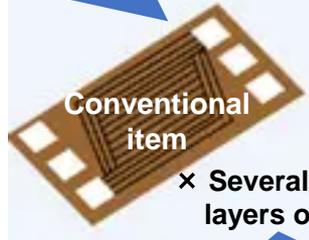
# 21 Core Technologies – Examples of Technology Integration

We developed NC Titanium, the world's first pre-coated bipolar plate material for fuel cell vehicles, through the integration of long-established technologies in the titanium business and the high-performance products business

## Customer issues and concerns

A bipolar plate requires a surface treatment to enhance its electrical conductivity, but

the surface layer tends to peel off easily, resulting in poor productivity.



× Several hundred layers or more

Each individual sheet must have surface treatment after formation, making mass production difficult.

## Combination of the 21 core technologies

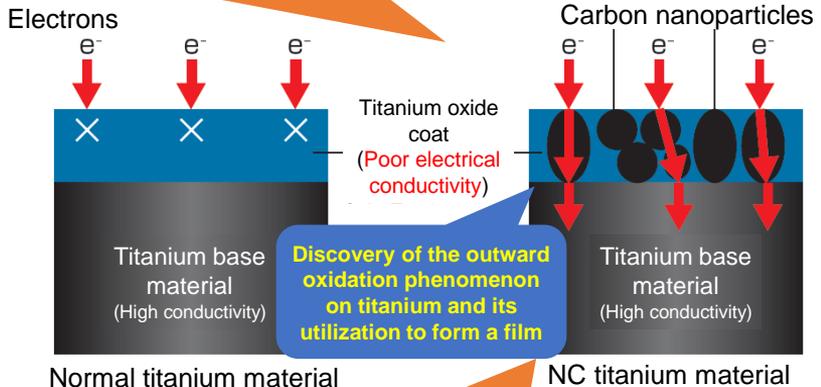


Atomic-level analysis and evaluation technology



Metal surface control technology

A newly developed coating allows electricity to pass through easily, preventing the surface layer from peeling off during the pressing process.



Discovery of the outward oxidation phenomenon on titanium and its utilization to form a film



Metal working process technology

Continuous processing technology enables mass production.

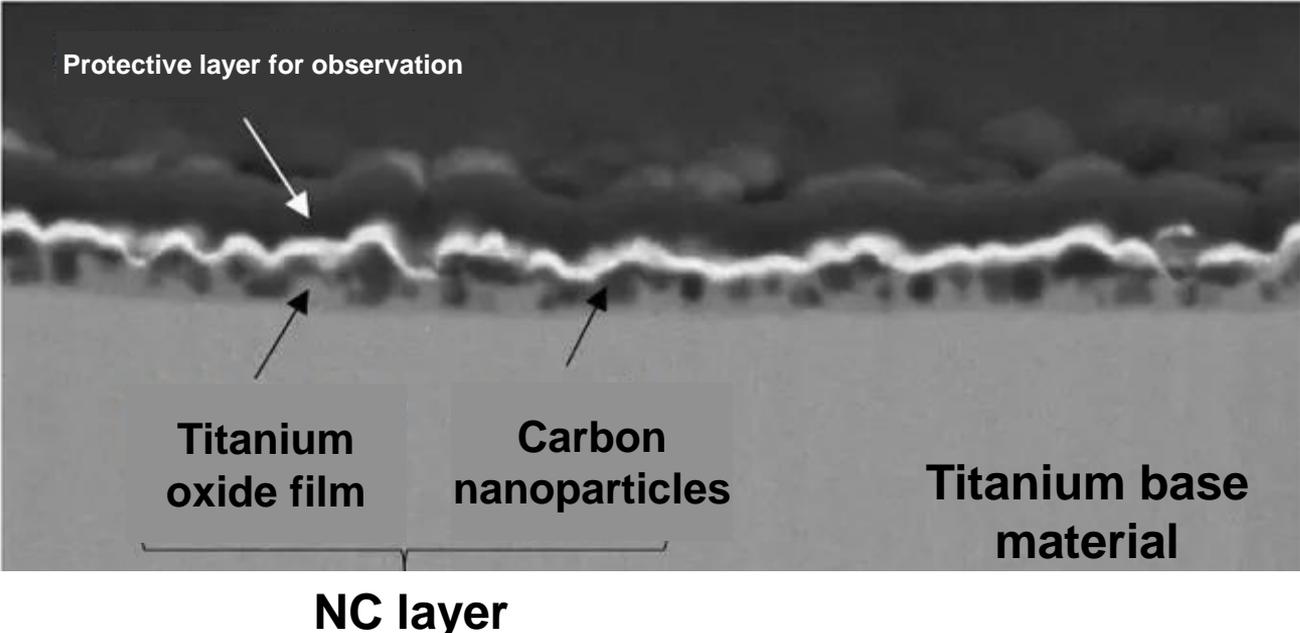
## Our proposal for increased value

We supply coils with a completed surface treatment, thereby eliminating the need for customers to perform any surface treatment process.



Received the Ichimura Prize in Industry for Excellent Achievement and many other awards

# 21 Core Technologies – Examples of Technology Integration



# 03

## Future Perspectives

**KOBELCO**

# Creating a Future through Technology Integration

By integrating 21 core technologies, we aim to increase corporate value and transform into an appealing company.

## Transformation Initiative KOBELCO-X

Enhancing earning power & Pursuing growth      Two pillars of business strategy      Taking on the challenge of realizing carbon neutrality

**AX**  
Ambidexterity



**GX**  
Green transformation

**BX**  
Business transformation

**FX**  
Factory transformation

Transformation to realize our business strategy  
= Strengthening sustainability management

**CX<sup>2</sup>**  
Customer experience transformation

**DX**  
Digital transformation

**EX**  
Employee experience



**Part II**

**R&D for AX/GX**

**—Our Path toward Transformation —**

September 29, 2025



**Kobe Corporate Research Laboratories**  
**Kobe Steel, Ltd.**

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### KOBELCO-X and R&D

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- Positioning of the Current Medium-Term Management Plan
- KOBELCO-X and R&D

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### R&D for AX/GX

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- AX: Transforming Business Models (Welding Wire Additive Manufacturing Technology)
- GX: Realizing a Hydrogen Society
- BX: Transforming Materials Development with MI

## 03

### Our Path toward Transformation

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- Our Path toward Transformation

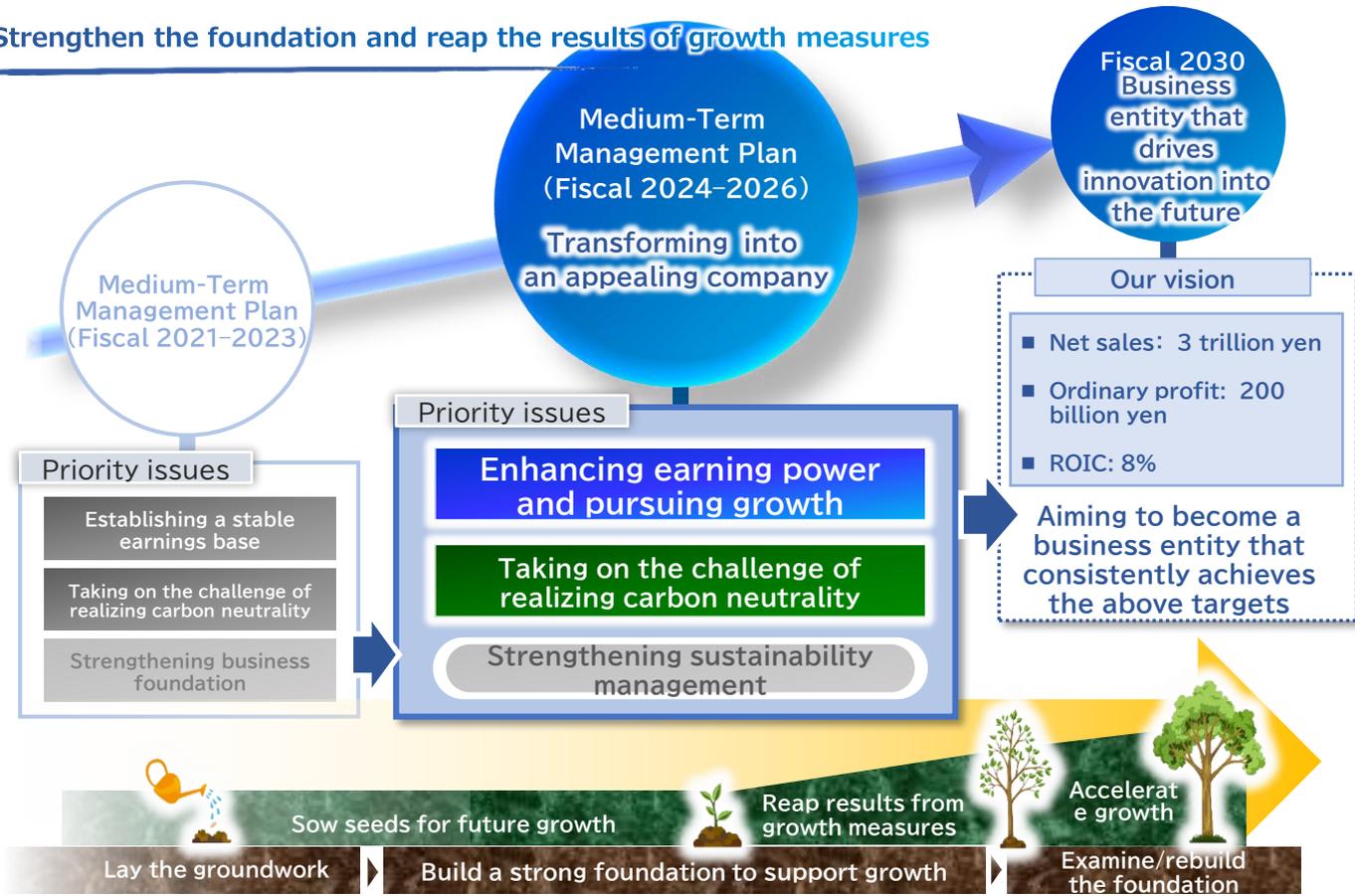
# 01

## KOBELCO-X and R&D

**KOBELCO**

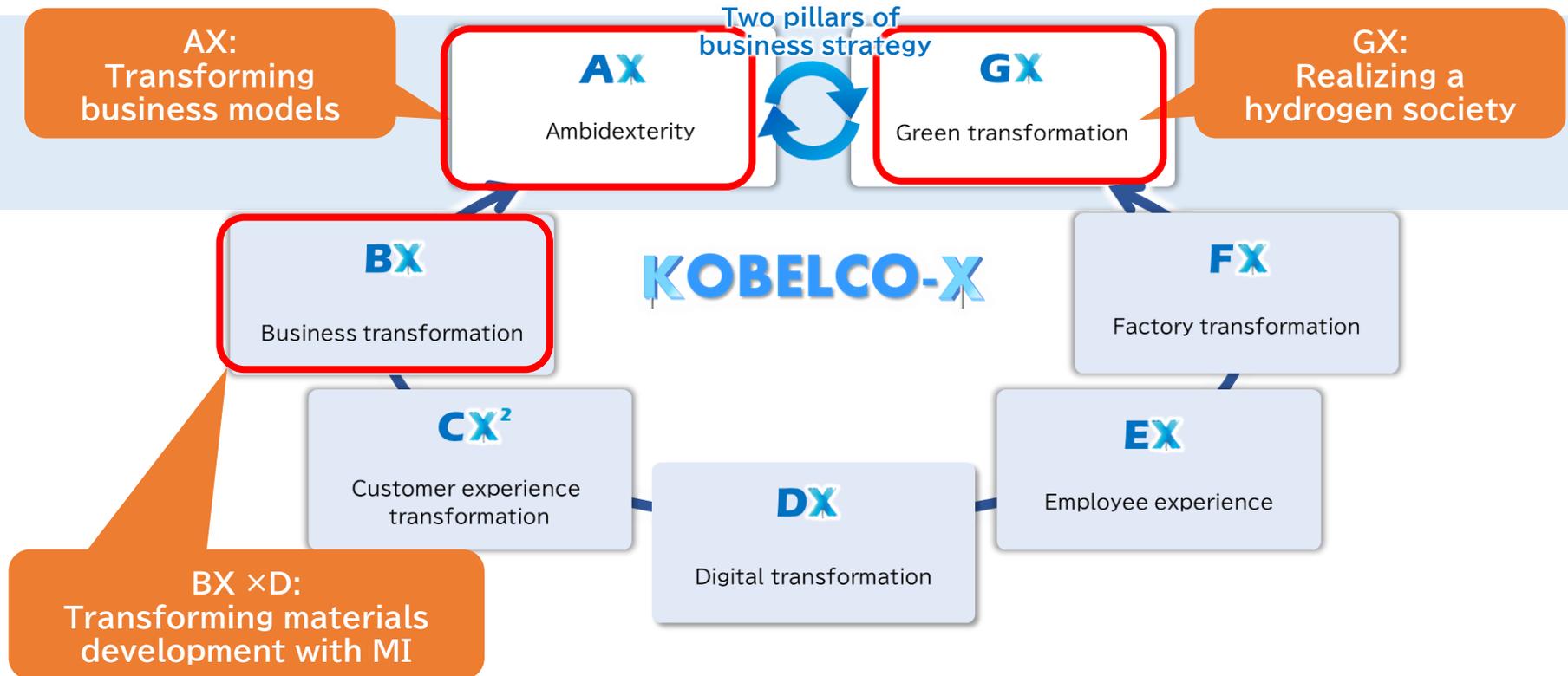
# Positioning of the Current Medium-Term Management Plan

Strengthen the foundation and reap the results of growth measures



# KOBELCO-X and R&D

We are developing **the seeds of innovation aimed at pursuing growth**, with a focus on AX/GX, which are promising drivers for our transformation into an appealing company.



# 02

R&D for AX/GX

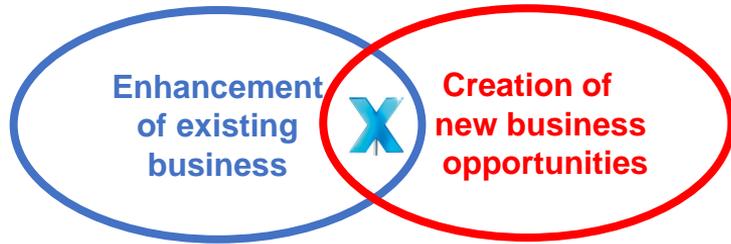
**KOBELCO**

AX

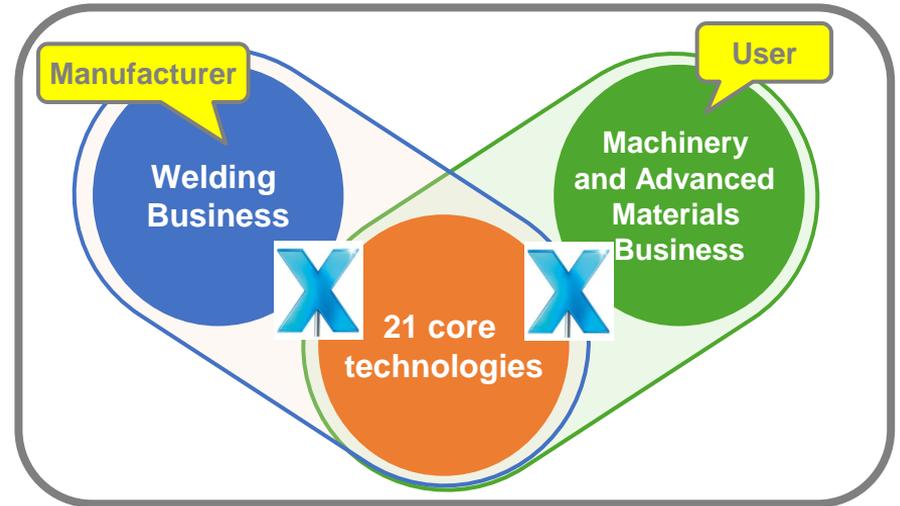


# The Concept of AX and Our Initiatives

The 21 core technologies are employed not only in existing businesses but also as foundations for creating new businesses. Here we present **an example of our Group's unique technology integration, reflecting our perspective as both a manufacturer and a user.**



AX	Materials	Machinery	Electric power
Strengthen earning power	Redevelopment of operation bases	Optimization of global production/sales systems	Stable operation of power plants
Pursuit of growth	Extension into customer experience-oriented business and solution business		
	Sales expansion for products that meet social needs, such as environmental products	Extension into new business areas such as energy transition	



**Collaboration across divisions**

Using a welding robot in the **development of welding wire additive manufacturing technology**

# Development of **Welding Wire Additive Manufacturing Technology**

Conventional casting/forging technologies present challenges in terms of lead time, design flexibility, and characteristics. Replacing current production methods with metal additive manufacturing allows for shorter transportation/cutting times and eliminating certain processes.

## Changing customer needs and business environment

- Problems with manufacturing large parts through casting/forging:
  - Low yields, **limiting productivity and performance improvements**
  - Low flexibility in shape, **making it difficult to handle complex shapes**
- **Changing customer needs and business environment**
  - Growing need for reduced lead times
  - Growing demand for higher performance and functionality in industrial machinery
  - Shortages of skilled human resources in manufacturing
  - Rise of new molding techniques such as 3D printers

**“Metal additive manufacturing technology” is attracting attention** as a promising alternative to casting/forging

## Growth potential in the metal additive manufacturing market

- **The metal additive manufacturing market is growing rapidly.** All market forecasts share the same view that **the market will continue to expand.**



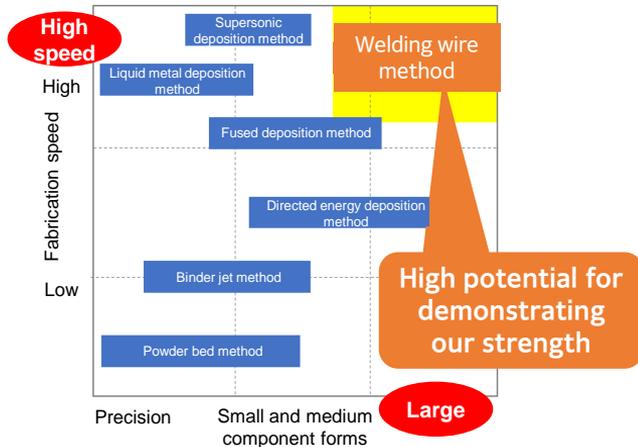
Overall trend in the metal additive manufacturing market (2024 to 2033)\*

# Development of Welding Wire Additive Manufacturing Technology

A potential market for welding wire additive manufacturing technology is the complex casting/forging parts sector. **If welding wire additive manufacturing substitutes a portion of present production methods (1 to 10%), the market could grow to tens to hundreds of billions of yen.**

## Need to focus on welding wire additive manufacturing

- The welding wire method **allows for the manufacture of large components at high speed**, while utilizing our expertise in welding and the manufacturing of large components.



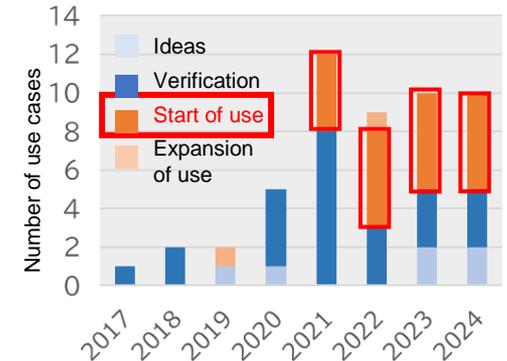
Positioning map for metal additive manufacturing

## Welding wire additive manufacturing market

- Welding wire additive manufacturing **can replace complex castings and forgings**.
- We have customers across diverse industries**, such as construction, aerospace, and energy. **Applications for actual parts** are ongoing.

Size of casting/forging market\*

Segment		Market size and growth rate
Casting	Simple	18 trillion yen in 2020 CAGR: 4-8%
	Complex	<b>2.3 trillion yen in 2022</b> <b>CAGR: 4-8%</b>
Forging	Simple	10 trillion yen in 2021 CAGR: 5.6%
	Complex	



Phase analysis of welding wire additive manufacturing use cases

\*Prepared with reference to the following documents

[Metal casting market expected to grow at CAGR of 7.6% during 2021-2026 |GII Press Release \(prtimes.jp\)](#)

[Global forged part market revenue, market size, sales volume, sales value and price analysis report 2022-2028 - ZDNET Japan](#)

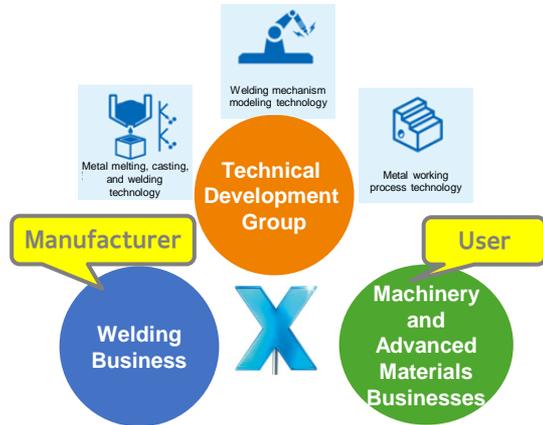
[Metal cutting tool market size and share | Growth report \[2030\] \(fortunebusinessinsights.com\)](#) \*Japanese

# Development of Welding Wire Additive Manufacturing Technology

We have successfully developed core technology for welding wire additive manufacturing. We have also achieved unattended automated manufacturing. Our results demonstrate significantly higher quality and productivity compared to conventional castings and products from other companies.

## Integration of technologies and businesses

We developed welding wire additive manufacturing technology based on the technologies and businesses unique to the Kobelco Group, operating as both a manufacturer and a user.

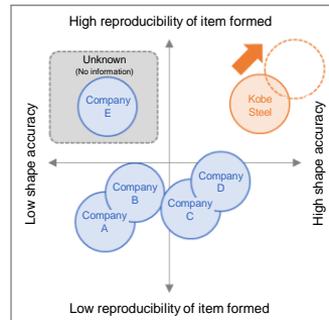


- Welding materials and welding fabrication
- Knowledge of welding systems
- Quality specifications for machine parts

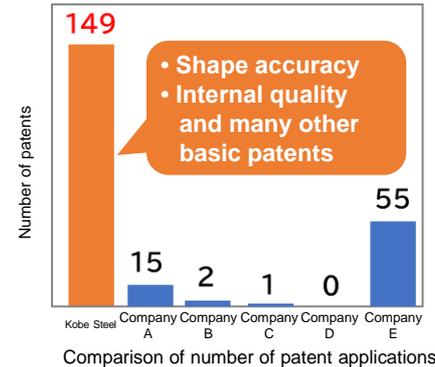
## Kobelco Group's strengths

Value provided	(1) At any time	24-hour, unattended (automated) manufacturing is possible
	(2) In any place	Producible regardless of the production site and operator's skill level
	(3) Any quantity	Any quantity of items can be produced from one set of forming data

- Outperforming competitors in terms of "high shape accuracy" and "high quality internal forming"
- Surpassing competitors with our 149 patent applications (106 registered) and maintaining our originality



Comparison with competitors' technology

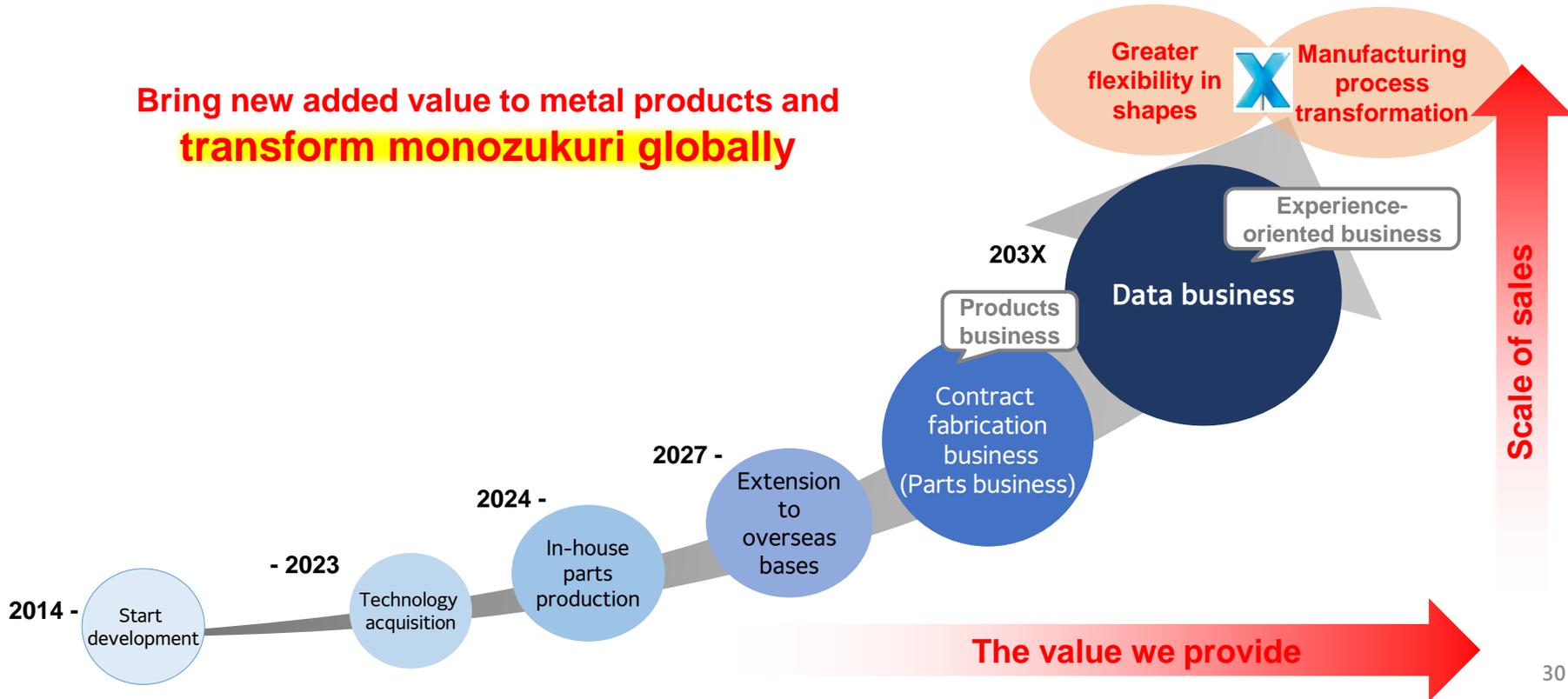


Comparison of number of patent applications

# Development of Welding Wire Additive Manufacturing Technology

By demonstrating our value in manufacturing large and complex parts **at any time, in any place, and in any quantity**, we will go beyond the current scope of competition, which focuses on replacing existing parts, **taking on the challenge of transforming monozukuri on a global scale.**

**Bring new added value to metal products and transform monozukuri globally**



**GX**



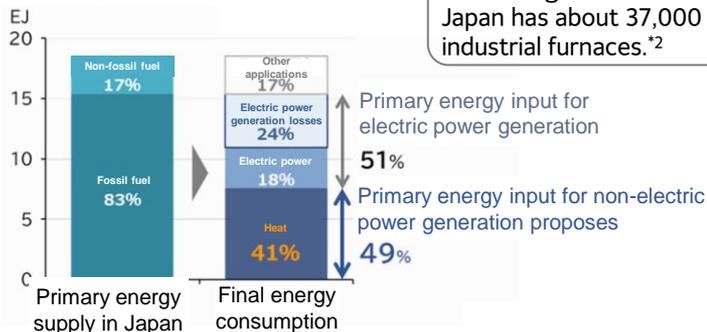
# Hydrogen Market Growth Potential and Challenges for Realization

- Hydrogen is expected to be utilized in various applications aimed at achieving carbon neutrality, including for direct reduced iron, blast furnaces, and decarbonized fuel. The market related to these areas is projected to reach approximately 160 trillion yen by 2050.
- Meanwhile, to realize a hydrogen society, we must address challenges, including (1) lowering hydrogen prices, (2) ensuring safety, etc.

## The necessity of hydrogen

- 83% of primary energy in Japan comes from fossil fuels, with about 40% of that used for heat demand involving combustion (fossil fuel demand)<sup>\*1</sup>
- The industrial sector accounts for 40% of heat demand, and CO<sub>2</sub> emissions from industrial furnaces total about 150 million tons<sup>\*2</sup> (about 10% of Japan's overall emissions)
- To realize carbon neutrality, it is essential to **transition to decarbonized fuel such as hydrogen, to meet heat demand.**

Our Group runs over 500 heat-using industrial furnaces. Japan has about 37,000 industrial furnaces.<sup>\*2</sup>

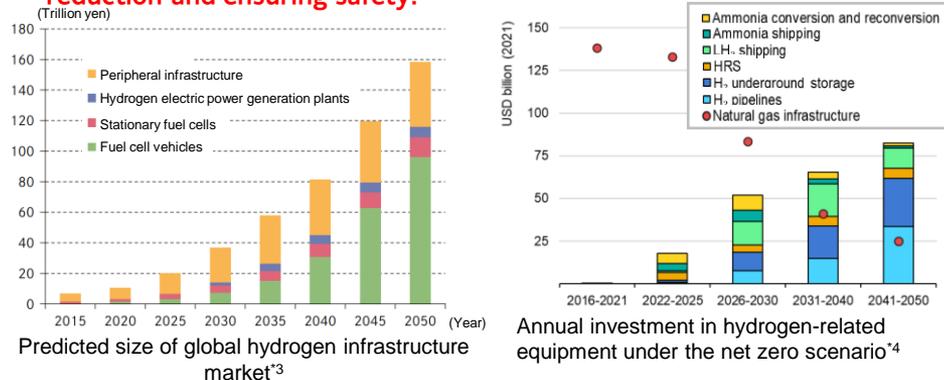


Energy demand in Japan (2021)

\*1. Source: Kobe Steel, Ltd., [NEDO hydrogen and ammonia results report meeting](#) (Japanese, July 2025)  
 \*2. Source: the Ministry of Economy, Trade and Industry, Manufacturing Industries Bureau, ["Direction of R&D and social implementation in the Decarbonization of Thermal Processes in Manufacturing Project"](#) (Japanese, February 2023)

## Hydrogen market growth potential and issues for expansion

- The hydrogen market, even when limited to infrastructure, is currently valued at about 20 trillion yen as of 2025 and is projected to reach about 160 trillion yen by 2050.
- Global investment in hydrogen-related equipment is projected to grow rapidly, reaching \$82 billion by 2050.
- The potential market, when industrial furnaces are included, is estimated to be even larger.
- However, achieving a hydrogen society presents **challenges related to cost reduction and ensuring safety.**



\*3. Source: NEDO, ["NEDO Hydrogen Energy White Paper, Chapter 4: Current Status and Prospects of the Hydrogen Energy Market"](#) (Japanese, July 2014)  
 \*4. Source: IEA, ["Energy Technology Perspectives 2023"](#) (Japanese, January 2023)

# Technology to Produce Hydrogen

## (Electrode Materials for Water Electrolysis Equipment: Cost Reduction)

Lab verification  
in progress

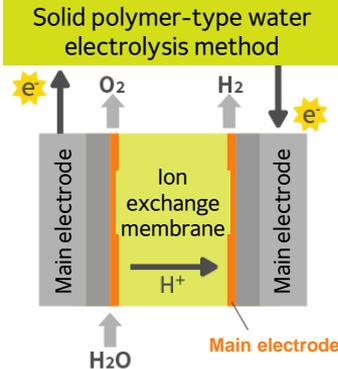
We developed a technology that reduces the use of expensive precious metals (to 1/100 or less) in electrode materials for water electrolysis equipment

Our lab testing shows that this technology achieves energy loss performance superior to conventional products.

### Customer issues and problems

Conventional materials for water electrolysis equipment

- Low performance (high running costs)
- High material cost (high initial cost)
- **Reducing costs** is key to widespread use of hydrogen

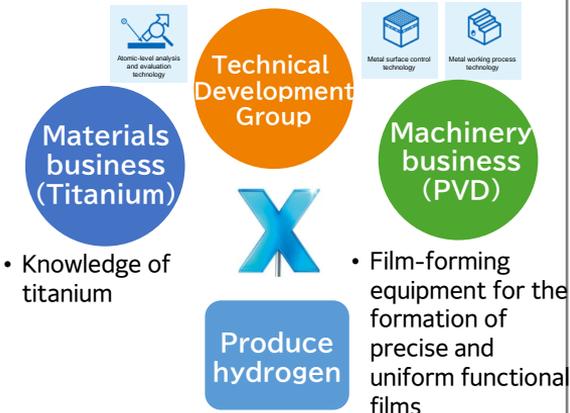


Source: NEDO Feature Article "[Two large-scale projects to make hydrogen energy accessible](#)" (Japanese, May 2023)

### KOBELCO's strengths

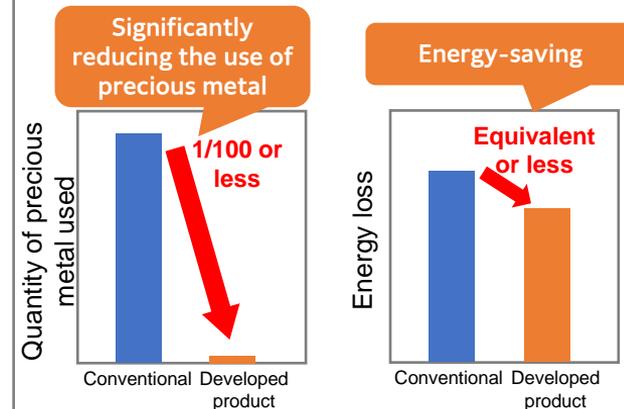
We developed our original technology, **leveraging the advantage of operating both materials and machinery businesses.**

- Processing technology, established through the development of NC titanium, improving the adhesion between functional films and materials



### Future development

We developed materials that effectively lowers hydrogen prices. Lab verification is underway for practical use.



We aim to **cut the cost** of electrolysis stack on water electrolysis equipment (the heart of the equipment) **by 50%**.

# Technology to Transport and Store Hydrogen (Materials for Liquid Hydrogen Storage Tanks: Ensuring Safety)

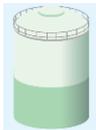
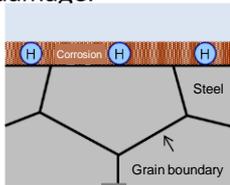
Lab verification  
in progress

## We developed evaluation/analysis technologies that reproduce actual environments

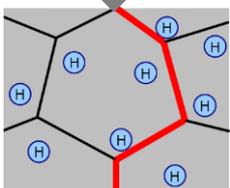
Aim to develop materials that can be used safely and securely in a liquid hydrogen environment.

### Customer issues and concerns

Hydrogen permeates materials and leads to brittleness  
→ Safe hydrogen storage necessitates the use of materials that resist hydrogen-induced damage.



Long-term use



### KOBELCO's strengths

World class!!

#### Automotive Bolt Development

Published in the most prestigious international journal in the field of corrosion (Impact Factor=8.3)

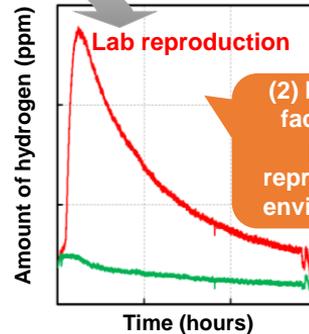
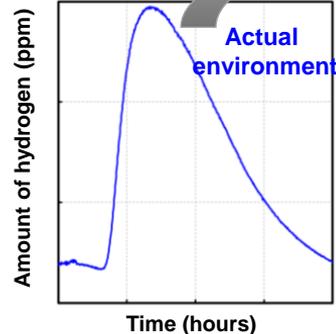
(1) Understanding of the actual environment

(2) Lab evaluation based on the actual environment

Design of materials resistant to hydrogen embrittlement

First in the world!

(1) Successful acquisition of long-term data on the amount of hydrogen in harsh environments



(2) Identification of the factors for hydrogen permeation and reproduction of the real environments in the lab

← Conventional reproduction technology

### Integration of technologies



Metallographic structure control technology



Atomic-level analysis and evaluation technology



Metal surface control technology



Store and transport hydrogen

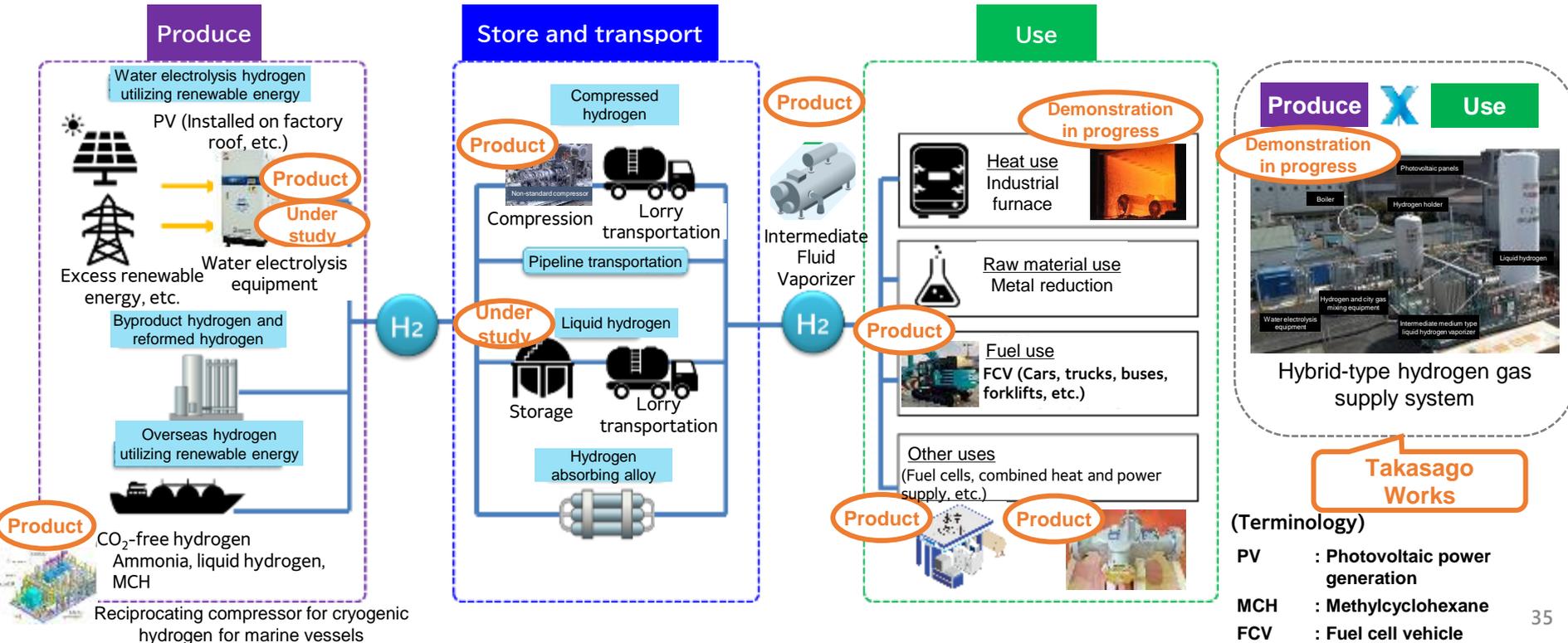
We are advancing R&D on liquefied hydrogen tanks for transportation and storage through a social collaboration program led by the University of Tokyo, along with various national projects.



# Supply Chain Initiatives for the Realization of a **Hydrogen** Society

We are promoting the development and demonstration of products and services that contribute to the societal reduction of CO<sub>2</sub> emissions

aiming to realize a hydrogen society and exploring our roles within it.



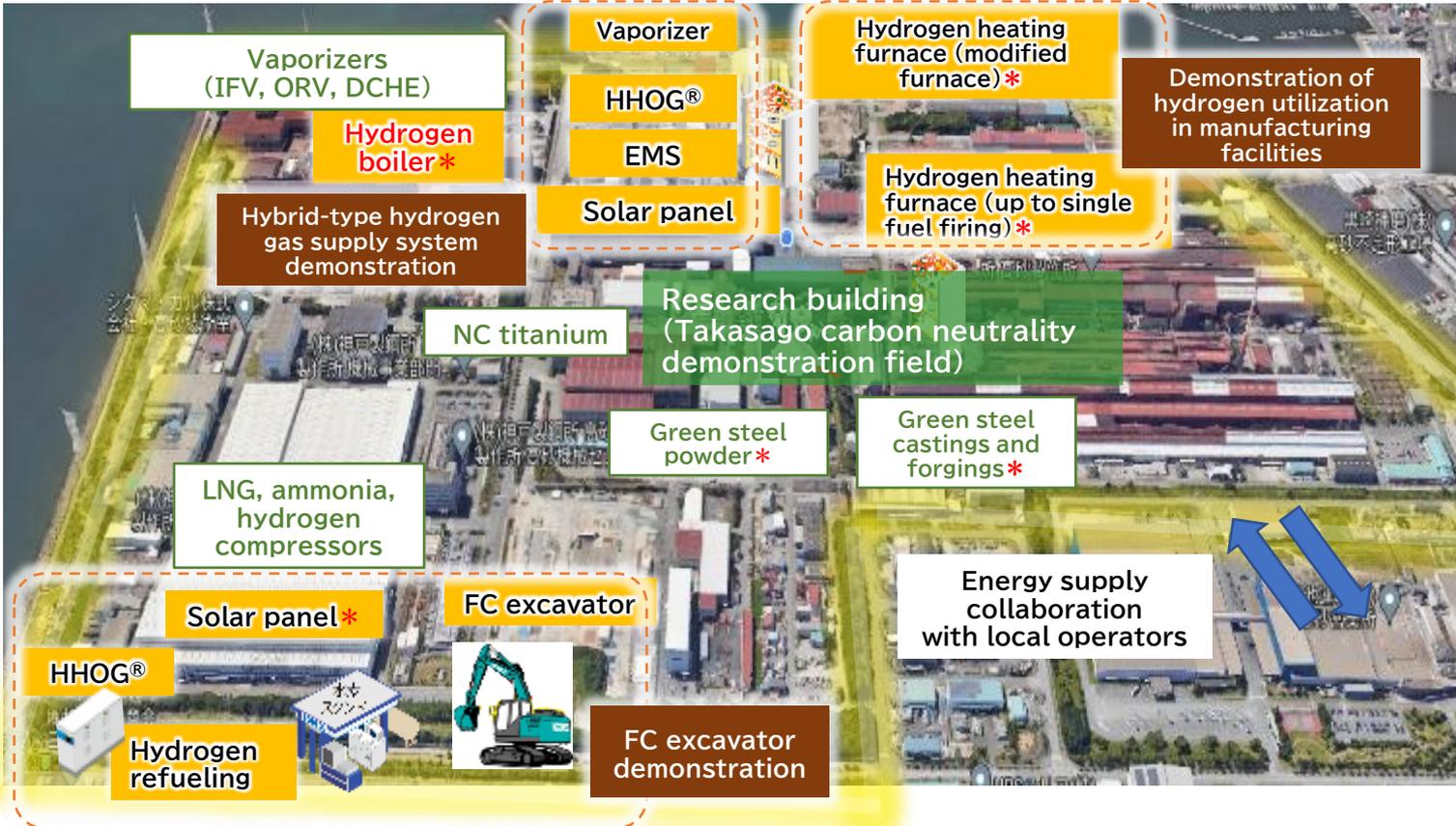
## Supply Chain Initiatives for the Realization of a **Hydrogen** Society

At Takasago Works, we are conducting demonstration tests of a technology for the production, transportation, storage, and use of hydrogen, aiming for its practical application.



- The Takasago GX Try Field is utilized as a demonstration site for taking on the challenge of realizing carbon neutrality.
- We will aim to collaborate with external parties (including startups) as well.
- We will utilize the demonstration results not only within the Group but also to support efforts toward carbon neutrality in the local community and society at large.

# GX Initiatives Demonstration Facilities



Relevant technologies (demonstration facilities)

Green products

\*Includes items under consideration or not yet implemented

- ### Acronyms
- EMS : Energy Management System
  - HHOG® : High-purity Hydrogen Oxygen Generator
  - IFV : Intermediate Fluid Vaporizer
  - ORV : Open Rack Vaporizer
  - DCHE : Diffusion-bonded Compact Heat Exchanger (DCHE)
  - FC : Fuel cell
  - NC : Nano-Carbon composite-coated

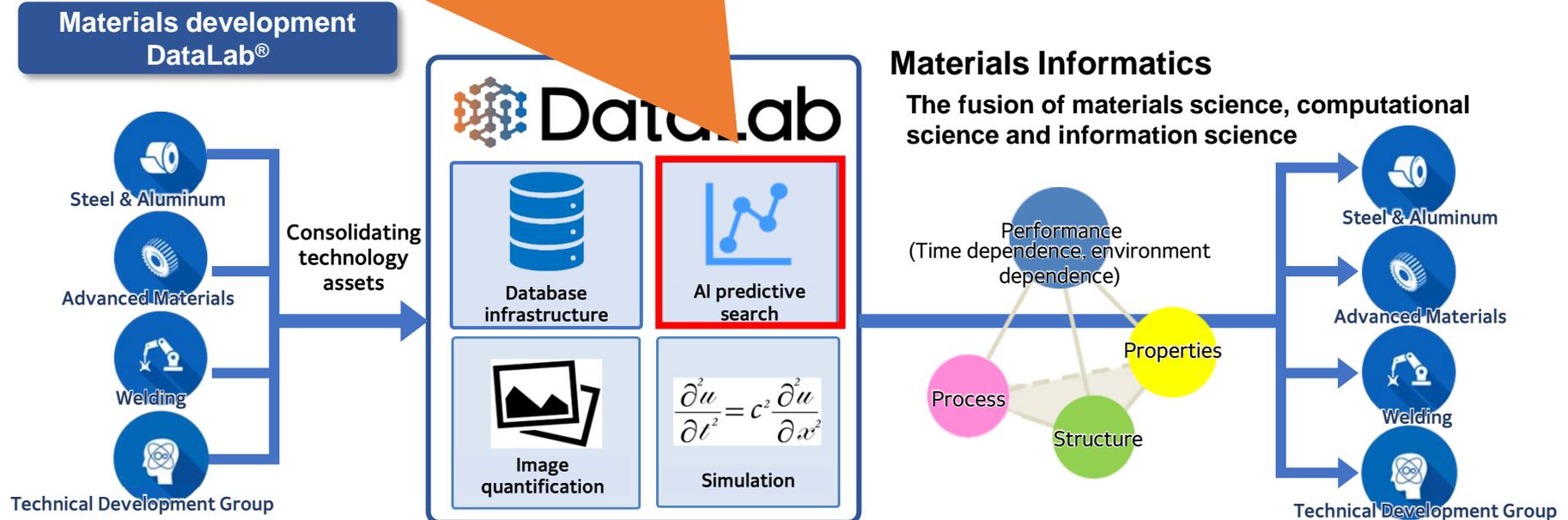
**BX**



# BX Initiatives

We are promoting efficiency improvements through digitalization in our R&D and production sites. We strive to improve the efficiency of materials development by integrating our Group's unique insights and data from its diverse business domains.

**Hybrid predictive search technology** is a key strength of Kobelco Group's Materials Informatics and serves as a core tool of DataLab®.



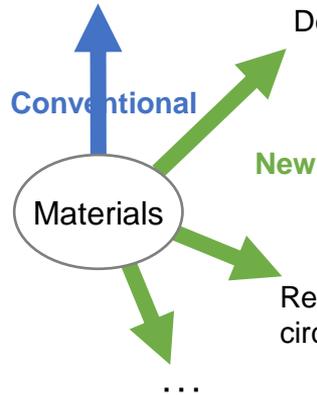
# BX Case Example (Materials Informatics)

Amid the growing diversity in material needs, we aim to address the future shortage of development personnel and enhance development efficiency by developing **our original new materials development technology (MI technology)** that combines our extensive material-related technology assets with AI technology.

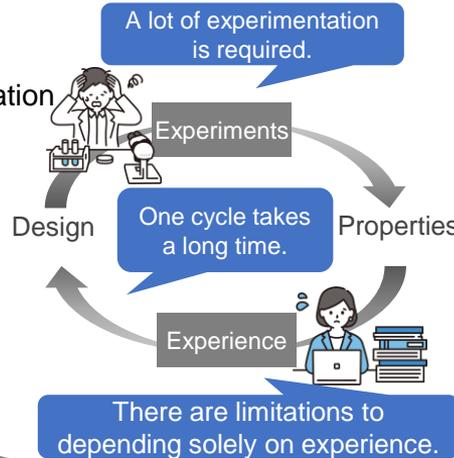
## Environmental changes and internal issues

- Diversification in material needs
- Improvement of development efficiency

Light and durable



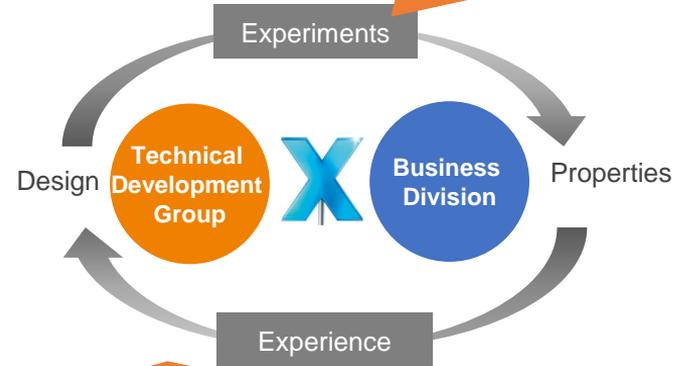
Decarbonization



- Shortage of human resources for future development to address the above issues.

## KOBELCO's strengths

We possess extensive materials knowledge and experimental data on various metals, developed through our materials businesses.



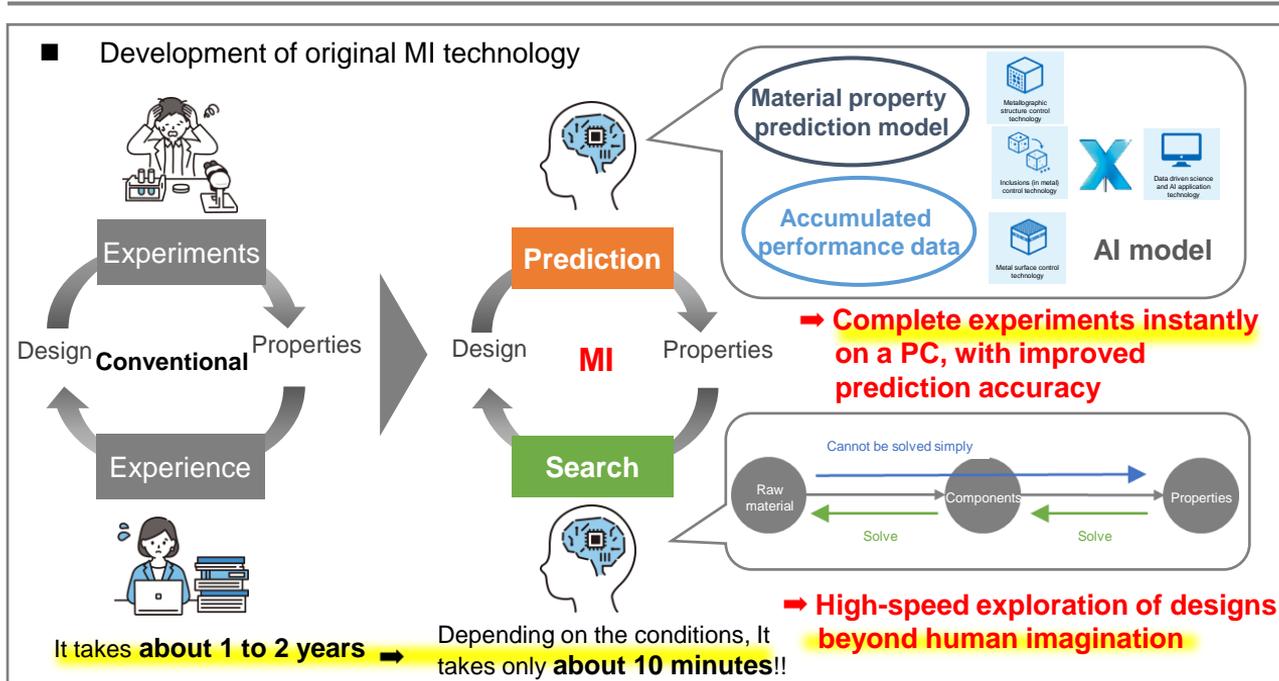
Materials experts and AI experts are nearby.

# BX Case Example (Materials Informatics)

Utilizing our proprietary MI technology, we will realize more efficient materials development, while also enabling the prediction of properties for unknown materials.

We will also leverage this technology to drive the development of exceptional innovative materials.

## Combination of technologies



## Future development

- Build a foundation (platform) of the technologies and data, and **raise the overall level of materials development capabilities**
- Incorporate the data accumulated and the related knowledge into a model to contribute to **skills transfer**



- Discover material compounds beyond human conception and **provide exceptional innovative materials**

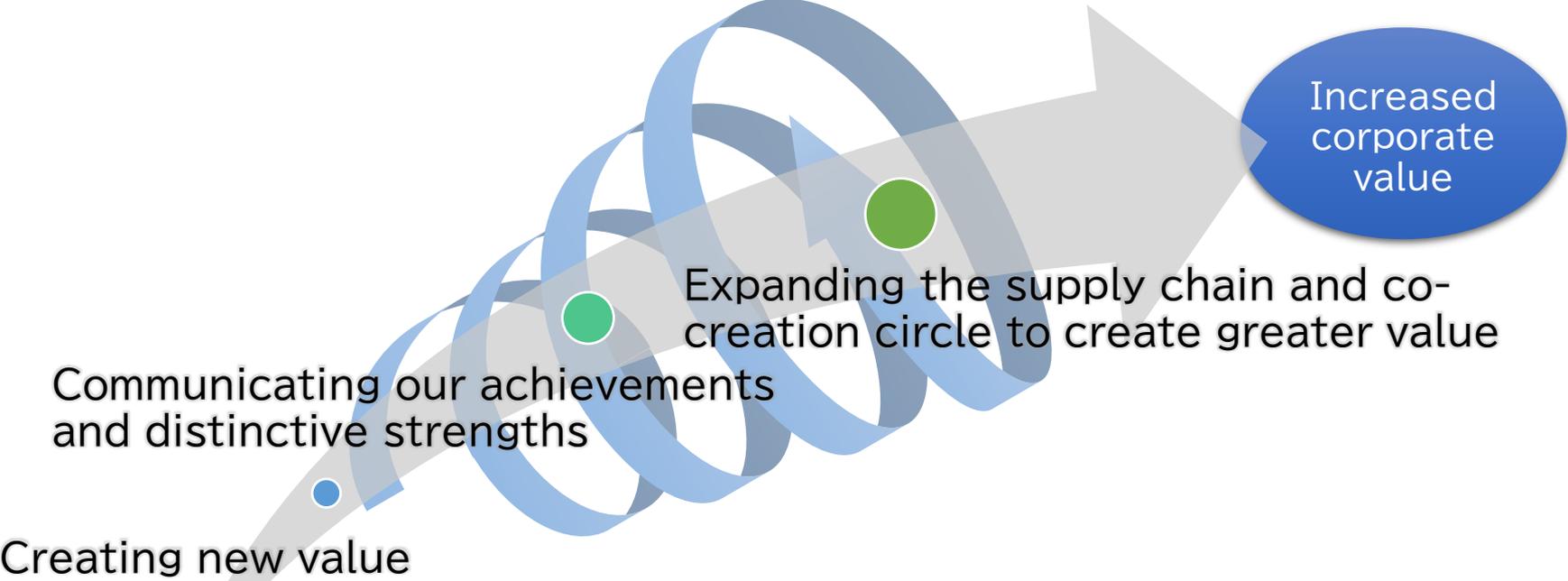
# 03

## Our Path toward Transformation

**KOBELCO**

# Our Path toward Transformation

We create synergy by leveraging the integration of Kobelco Group's unique characteristics, such as our diverse business domains and 21 core technologies. We will accelerate our R&D initiatives related to KOBELCO-X, as we strive to transform into an appealing company.



# Group Corporate Philosophy

<b>KOBELCO's View of the Future</b>	<p>Our view of a society and future to be attained as we carry out KOBELCO's mission</p> <p><b>We envision a world in which people, now and in the future, can fulfill their hopes and dreams while enjoying safe, secure, and prosperous lives.</b></p>
<b>KOBELCO's Mission</b>	<p>Our mission and the social significance of the KOBELCO Group that we must fulfill</p> <p><b>Our mission is to provide solutions to the needs of society, by making the best use of the talents of our employees and our technologies.</b></p>
<b>Core Values of KOBELCO</b>	<p>The commitments of the KOBELCO Group to society and the values shared by the entire KOBELCO Group</p> <ol style="list-style-type: none"><li>1. We provide technologies, products and services that win the trust and confidence of our customers we serve and the society in which we live.</li><li>2. We value, and support the growth of, each employee on an individual basis, while creating a cooperative and harmonious environment.</li><li>3. Through continuous and innovative changes, we create new values for the society of which we are a member.</li></ol>
<b>Six Pledges of KOBELCO</b>	<p>Code of Conduct for all Group employees to follow to fulfill the Core Values of KOBELCO and the Quality Charter</p> <ol style="list-style-type: none"><li>1. Uphold the Highest Sense of Ethics and Professionalism</li><li>2. Contribute to the Society by Providing Superior Products and Services <a href="#">Quality Charter</a></li><li>3. Establish a Comfortable but Challenging Work Environment</li><li>4. Live in Harmony with the Local Community</li><li>5. Contribute to a Sustainable Environment</li><li>6. Respect Each Stakeholder</li></ol>

# Disclaimer Regarding Forward-Looking Statements

- ◆ This document contains forward-looking statements about the Company's forecasts, beliefs, expectations, aims, and strategies. These statements are based on the Company's judgements and assumptions using currently available information and may differ substantially from actual results due to uncertainties within its judgements and assumptions and a variety of factors that may change over time, such as future business operations and changes in internal and external circumstances. Kobe Steel assumes no responsibility for revising these statements or other contents in this presentation.
- ◆ Below is a list of factors of uncertainties and changes. This include but is not limited to:
  - Changes in economic conditions, demand, and prices in major markets
  - Political situations and trade and other regulations in major markets
  - Fluctuations in foreign exchange rates
  - Availability and prices of raw materials
  - Products and services of competitors, price strategies, alliances, and other business developments such as M&A
  - Changes in strategies of the Company's alliance partners

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