Decarbonization Strategies and Policies in the Railway Sector in Japan

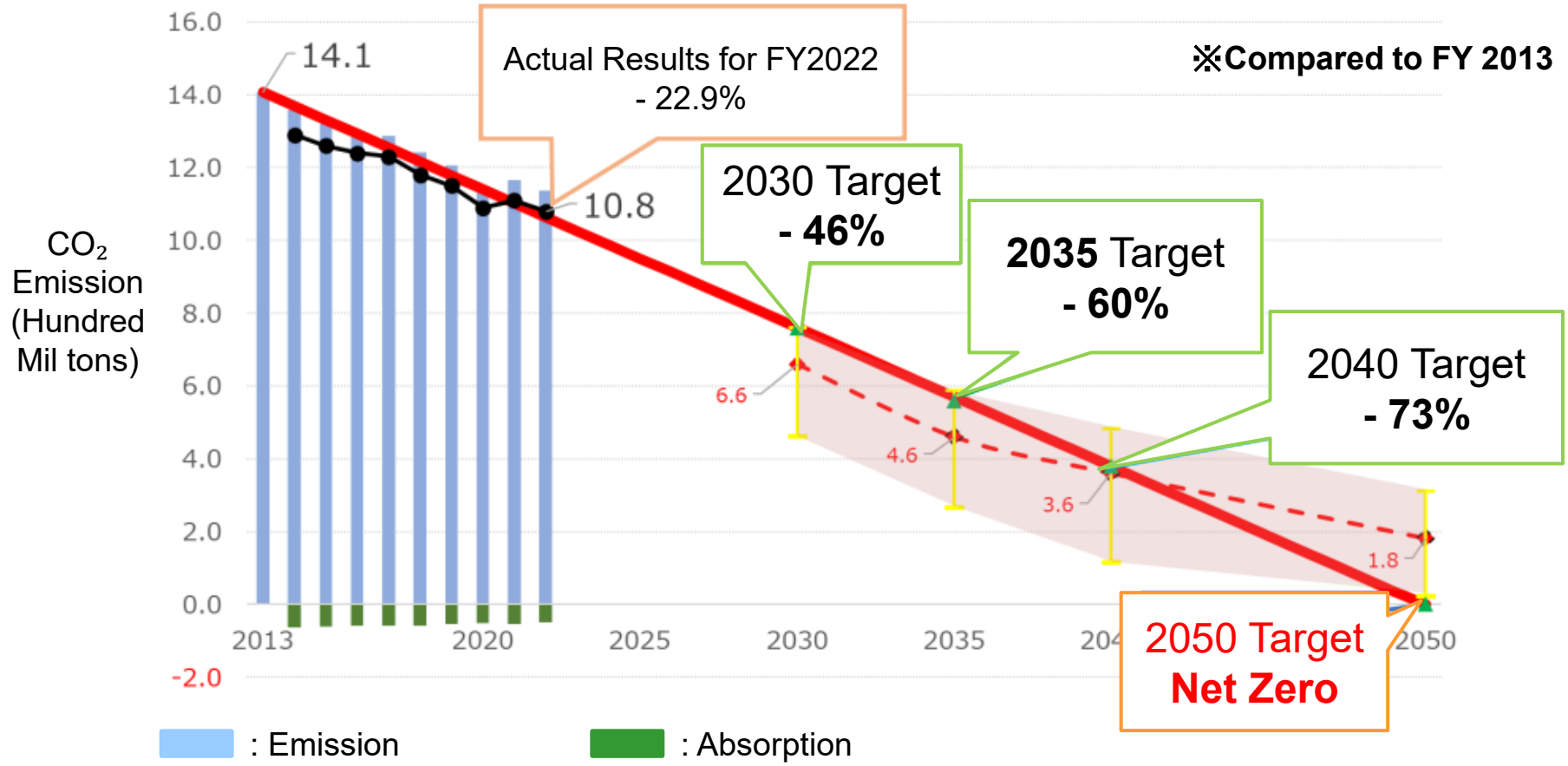
January 19, 2026

KOBAYASHI Nobuyuki
Director, International Policy and Project Division,
Railway Bureau,
Ministry of Land, Infrastructure, Transport and Tourism (MLIT)

Table of Contents

1. Plan for Global Warming Countermeasures

- Cabinet decision : February 18, 2025
- **2050 Greenhouse gas emission target : Net zero**
- Emission target (Compared to FY 2013)
  FY 2035 : - 60%　　FY 2040 : - 73%
- **Accelerate GX investments** to achieve decarbonization and economic growth.



2-1. Environmental Features of Japan's Railway

The railway sector in Japan has one of the world's highest passenger transport volumes and a higher modal share compared to other developed countries.

Passenger Transport Modal Share by Country
(FY2022, per Passenger-Kilometers)

	Railway	Road Transport	Others
Japan	**28%**	65%	7%
UK	9%	91%	1%
Germany	9%	87%	5%
France	12%	87%	1%
USA	1%	83%	16%

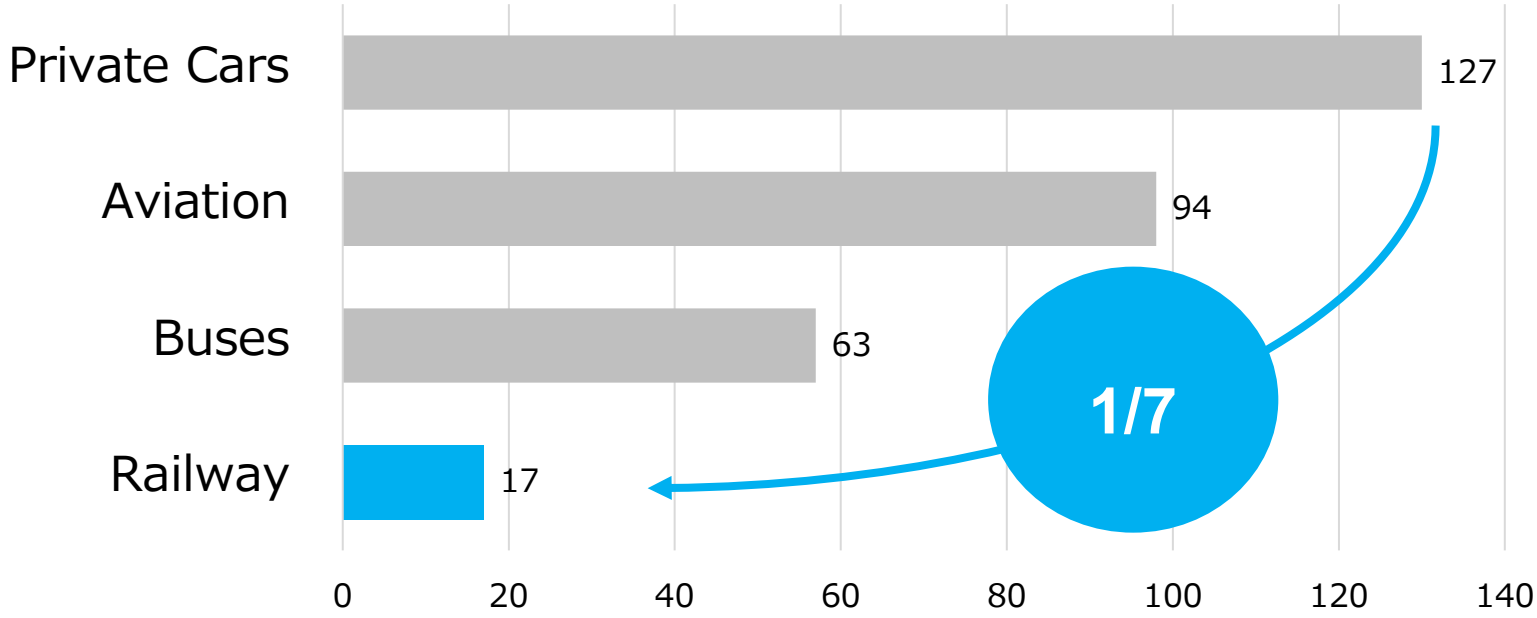
*Based on various statistical and published sources.
*Survey methods and definitions may differ by country.

2-2. Environmental Features of Japan's Railway

Railway sector is an environmental frontrunner,
with the lowest CO_2 emissions per unit of transportation
compared to other modes.

CO_2 Emissions per Unit of Passenger Transport

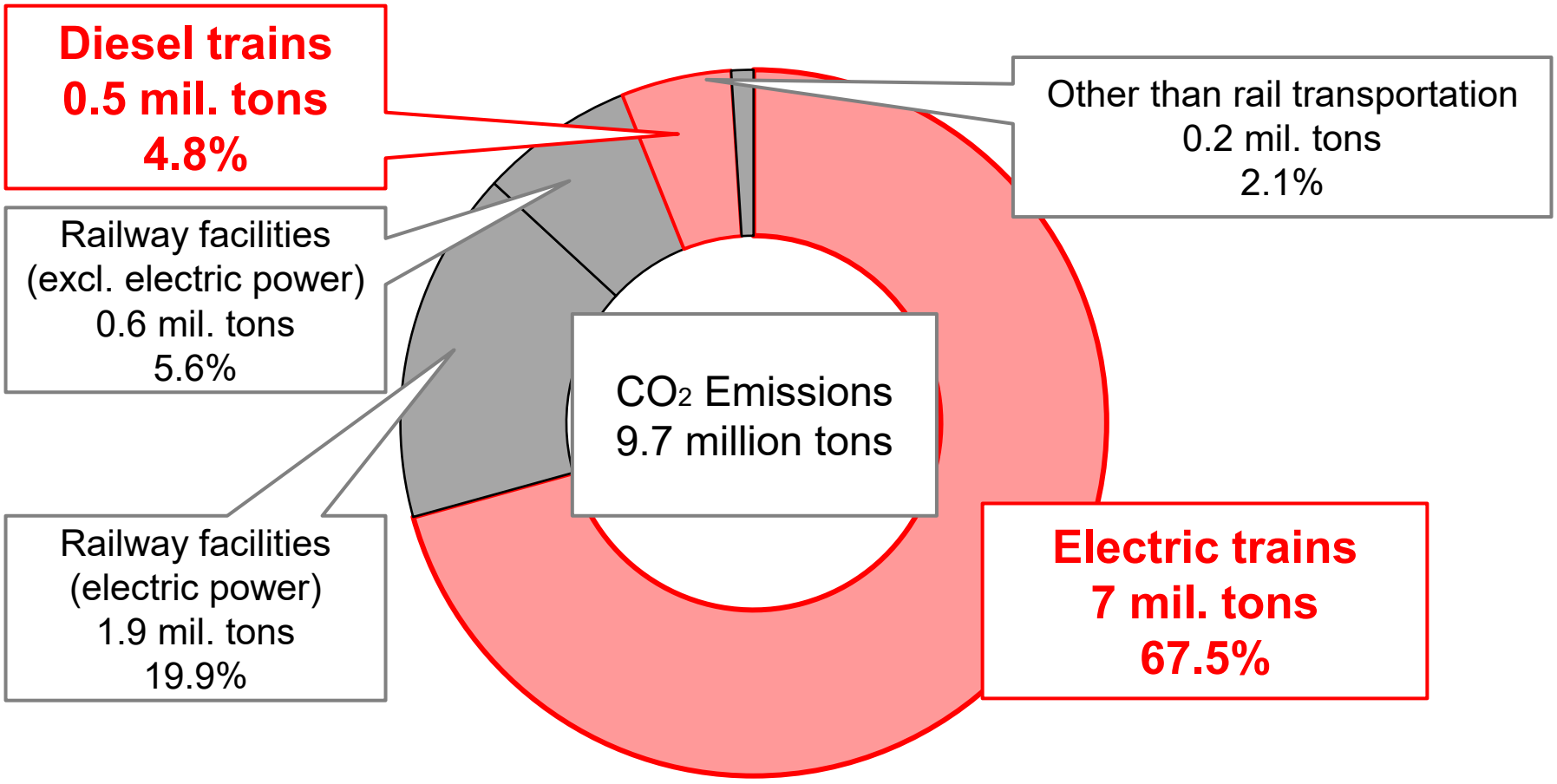
CO_2 emissions intensity (g-CO_2/passenger-kilometer), FY2023



2-3. Environmental Features of Japan's Railway

Approximately three-quarters (about 72%) of railway operators' CO_2 emissions come from train operation

CO_2 Emissions from Railway Operators (FY2020)



*Based on various statistics and reports.

2-4. Environmental Features of Japan's Railway

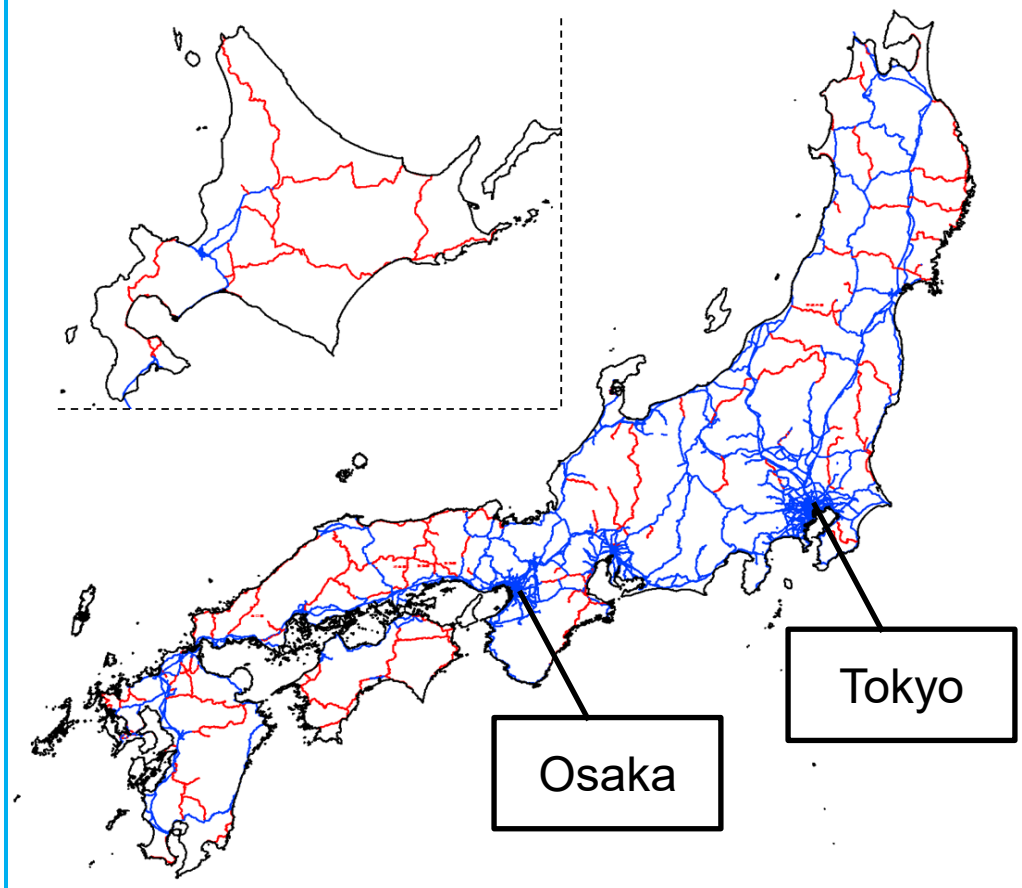
- A wealth of assets including station buildings, rolling stock depots and tracks
- Railway stations serving as hubs for local communities
- Railway networks forming wide-area connections

An image from "Environmental Vision 2030" by TOKYU CORPORATION

3-1. Electrification Status of Japan's Railway

Since nearly 40% of Japan's rail networks are non-electrified, conversion from diesel fuel is a challenge and needed to be addressed.

Electrification status of Japan's railway



(FY2021)

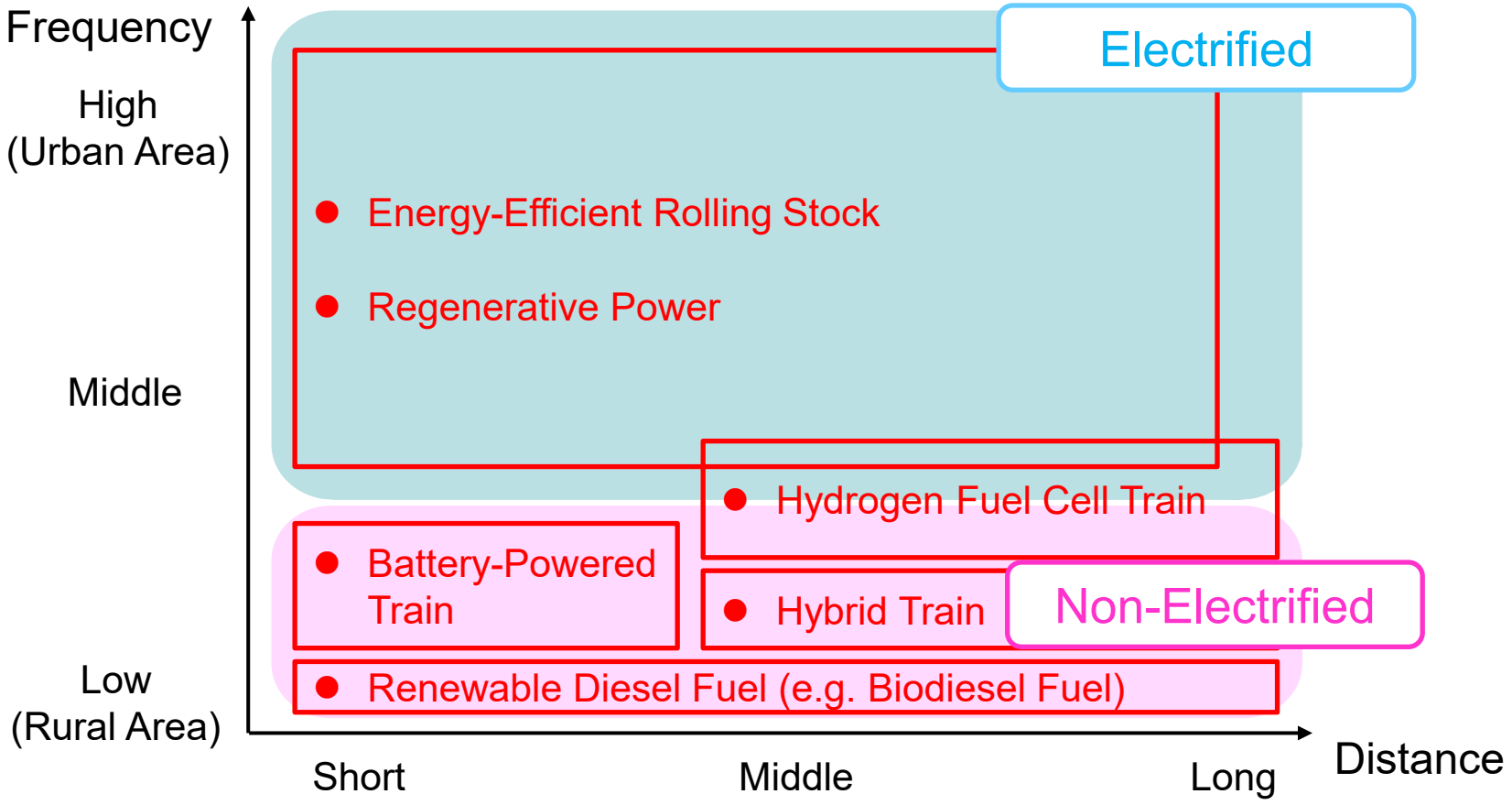
BLUE : electrified
15,692km ≒ 9750mile
【64%】

RED : NON-electrified
8,835km ≒ 5490mile
【36%】

3-2. Electrification Status of Japan's Railway

Battery-Powered Train, Hydrogen Fuel Cell Train, Hybrid Train and Renewable Diesel Fuel are types of railway decarbonization initiatives in the non-electrified sections.

Types of railway decarbonization initiatives



Study Group on Accelerating Railway Carbon Neutrality (CN)

Background

- Toward achieving carbon neutrality by 2050.
- While railways are energy-efficient and highly electrified, they increasingly adopt green power amid growing focus on electricity sourcing methods.

Purpose of the Study Group

- Further initiatives taken by advanced railway operators
- Broader deployment across various railway operators

Members

- MLIT
- Government Organizations
  (Ministry of Environment, Agency for Natural Resources and Energy)
- University Professors
- Railway Operators, Research Institutes
- Industry organizations (Railway, Power and Hydrogen-related)

Time & Frequency

- Six meetings held from March 2022 to May 2023

4-2. Strategy and Policy Measures

Strategy toward Railway CN (three pillars)

Decarbonization of Railway Operation Itself (Rolling Stock, etc.)

Decarbonization Utilizing Railway Assets (Station, Depot, etc.)

Decarbonization through Rail Use

■ By 2050,
- **Achieve carbon-neutral railway.**
- Lead the transport sector in environmental sustainability.
- **Support a carbon-neutral society** as essential and familiar transportation infrastructure.

■ Toward this goal, in the 2030s, aim to reduce CO_2 emissions in the railway sector **by 46% compared to FY 2013.**

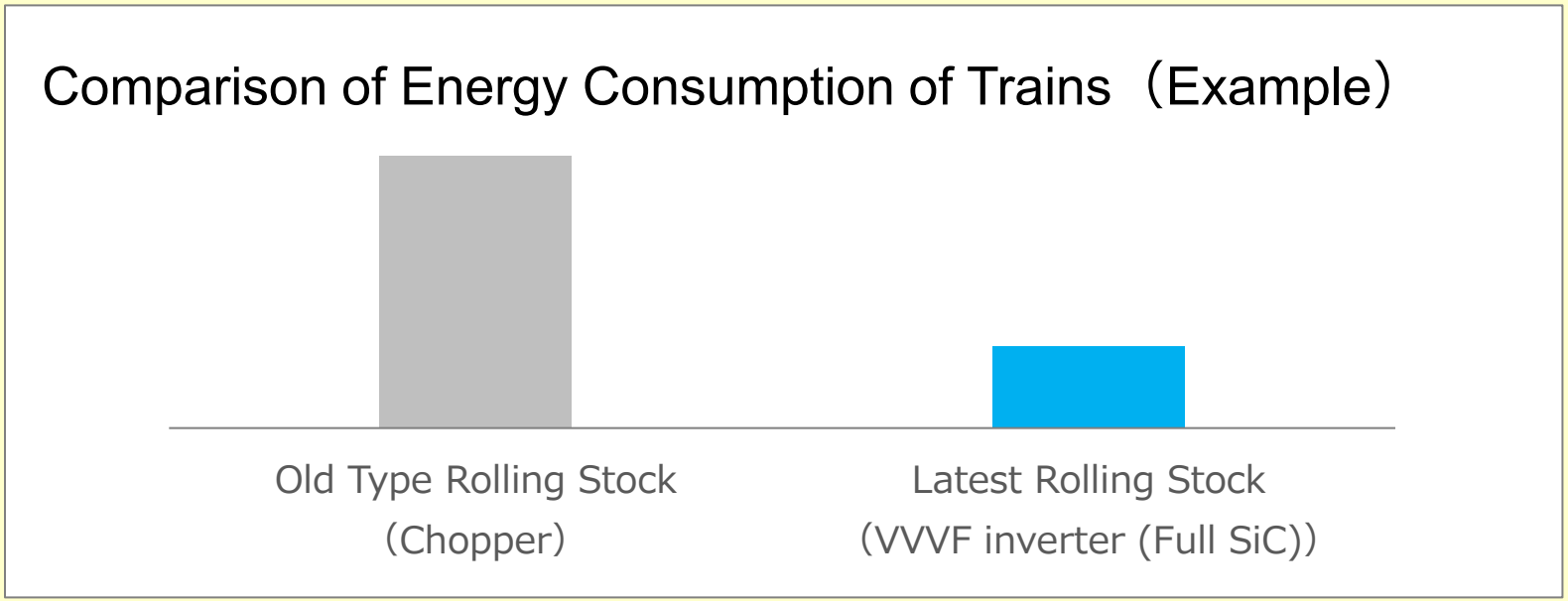
Decarbonization of Railway Operation Itself

I. Introduction of **highly efficient rolling stock**

II. Utilization of **regenerative energy** generated during deceleration

III. Introduction of **battery-powered trains and hybrid trains** in the non-electrified sections

IV. Use of **renewable diesel fuels,** and Introduction and Development of **hydrogen fuel cell trains**



※Including the effects of utilizing regenerative power and reducing vehicle weight

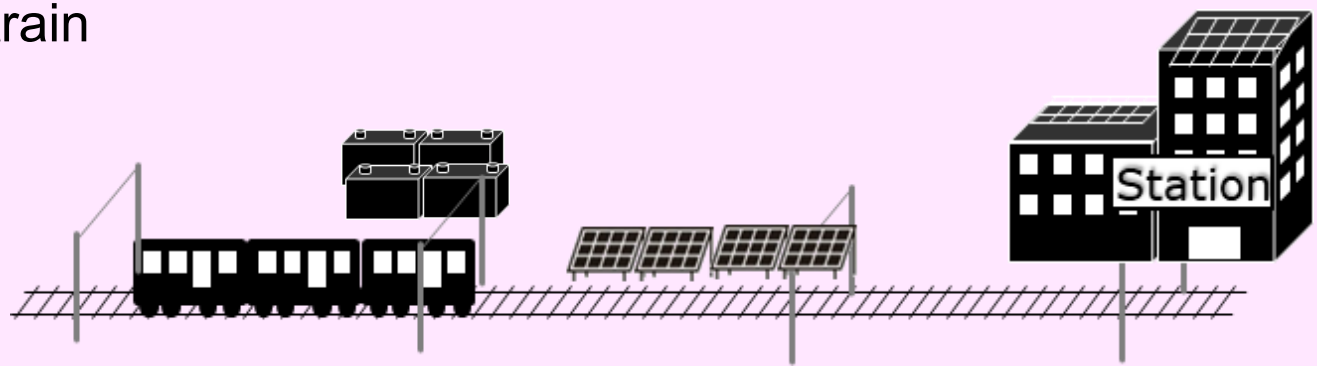
※VVVF：Variable Voltage Variable Frequency

Decarbonization Utilizing Railway Assets

I. **Energy creation** (e.g. Solar power)
Installation of renewable energy generation facilities at station buildings, depots, right of way, etc.

II. **Installation of storage batteries**
Installation of large-scale storage batteries in substations, under the overhead structure of a railway, etc.

III. **Clean energy transportation**
Renewable energy transmission by use of overhead wires, etc., development of hydrogen hubs at stations, and hydrogen transportation by train



Decarbonization through Rail Use

I. **Further increase of the use of railway which is environmentally advantageous**

II. **Visualization of CO_2 reduction effect by the use of railway**
Encouraging behavioral changes in companies, shippers, consumers, etc.

Overview of the Public-Private Research Group on GX in the Railway Sector

Background and Purpose

In pursuit of carbon neutrality, global expectations for railways are rising.
Based on progress in technologies such as hydrogen fuel cell trains and biodiesel fuels, we will promote decarbonization across the entire railway network, including non-electrified sections. At the same time, we aim to leverage these efforts to strengthen Japan's industrial competitiveness. Looking ahead to 2040, we will set goals and formulate strategies for Green Transformation (GX) in the railway sector.

Member

Ministry of Land, Infrastructure, Transport and Tourism
Academic Experts: University Professors
Railway Industry, etc.: Railway Operators, Manufacturers, Industry Associations, Research Institutions
Observers: Agency for Natural Resources and Energy

Event Schedule and Frequency

From March to September 2025, a total of four meetings were held, culminating in the publication of the "Basic Approach to Green Transformation in the Railway Sector" on September 16.

Goals for Advancing the Railway Sector's GX

(Major railway operators)

Energy Conservation

～2030
- Accelerating the introduction of high-efficiency vehicles utilizing next-generation semiconductors and high-performance motors
- Each business operator shall formulate a plan to promote the utilization of regenerative power.
- Commercially viable superconducting power transmission system for operational lines

～2035
- The replacement with high-efficiency rolling stock and equipment has, in principle, completed the conversion of all trains to VVVF control. Expand the utilization of regenerative power based on the plan shown on the left
- Deployment and expansion of superconducting power transmission systems on commercial lines

～2040
- Reducing energy consumption by at least 25% compared to fiscal year 2013, including measures such as energy-saving operation and other software-based approaches.
- Expanding the overseas deployment of energy-saving vehicles, equipment, and systems

+

Fuel conversion

～2030
- Commencing commercial operation of hydrogen vehicles
- Commencing commercial operation using biodiesel fuel

～2035
- Starting in fiscal year 2031, new rolling stock introduced on non-electrified sections shall be hybrid vehicles, battery-powered vehicles, or hydrogen vehicles as a general rule.

～2040
- Reducing diesel fuel consumption for railway vehicles by more than 40% compared to fiscal year 2013 levels
- Expanding hydrogen vehicles and other technologies overseas

+

Renewable Energy

～2030
- Taking into account the development status of next-generation solar cells and other technologies, each operator should set renewable energy introduction targets, including the utilization of railway assets.

～2035
- Doubling the installed capacity of renewable energy generation utilizing railway assets within 10 years

～2040
- Approximately 70% of the electricity used by railways comes from non-fossil sources.

2050 Carbon-Neutral

(Country/Related Organizations, etc.)

Environmental Improvement

- Examination of support systems for introducing vehicles and equipment utilizing high efficiency and next-generation fuels
- Framework for collaboration with other industries to ensure stable procurement of next-generation energy sources
- Formulation of standardization strategies for overseas expansion
- Streamlining of various regulations and systems to accelerate and sustain GX
- Promotion of modal shift and rail transportation

CO2 Emissions
Net Reduction of 5.4 Million Tons
(Compared to FY2013)

Carbon Neutral Investment Promotion Tax Credit

- FY 2024 tax reform has enabled railway operators introducing high-decarbonization trains to be eligible for tax credit or special depreciation.
- If certain criteria are met under Act on Strengthening Industrial Competitiveness, tax credit or special depreciation is applied to equipment investments.

Case

■ Eligible Operator：
East Japan Railway Company

■ Period：From April 2025 to March 2028

■ Contents：
①Improved energy efficiency through train replacement
(Introduction of trains with VVVF inverter)

②Reduction of CO_2 emission
(Introduction of hybrid trains)

Train Replacement

205 Series : Non-VVVF

KiHa 110 Series : Diesel

E131 Series : VVVF

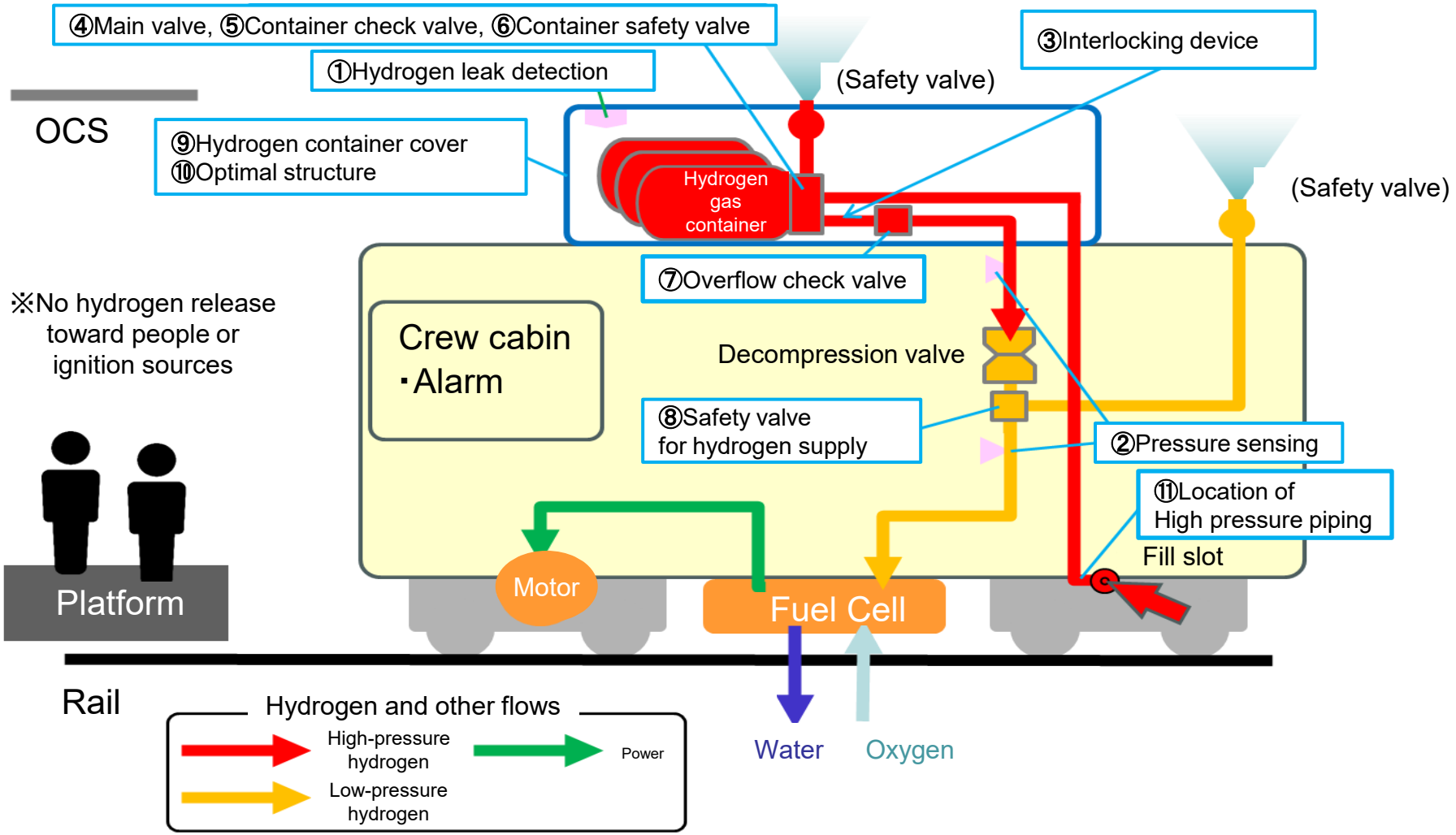
HB-E220 Series : Hybrid

(From MLIT HP)

4-7. Strategy and Policy Measures

Regulatory Review for Introduction of Hydrogen Fuel Cell Trains

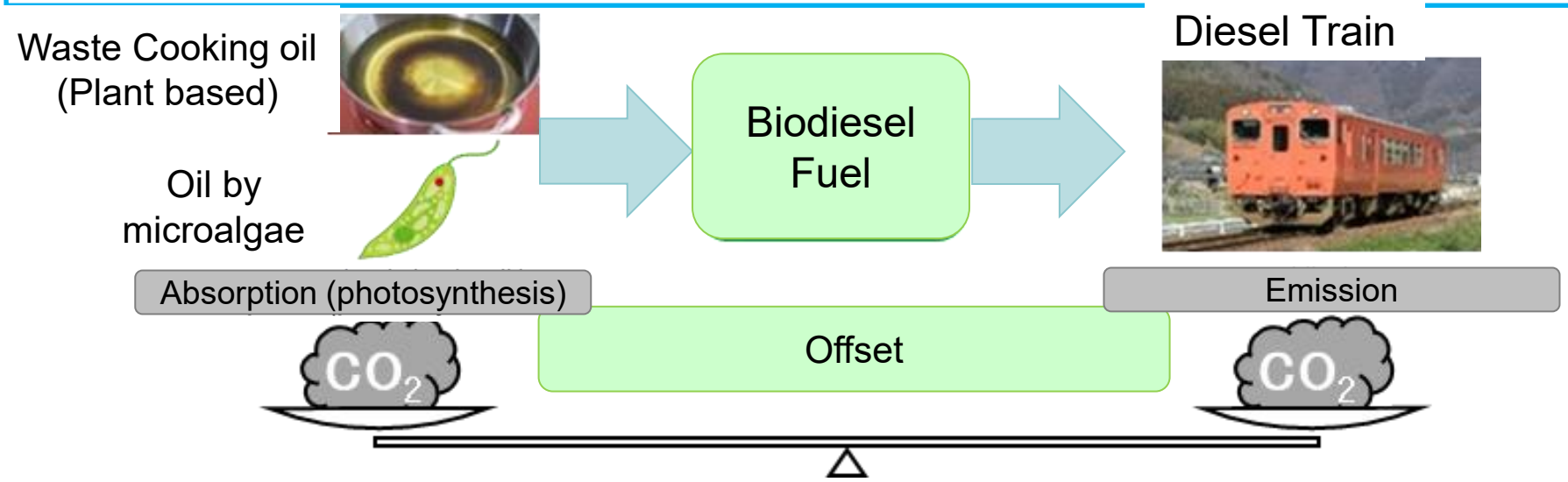
To promote the development of Hydrogen-fueled trains by operators, **new technical standards for the structure of trains** using compressed hydrogen were established on April 1, 2025

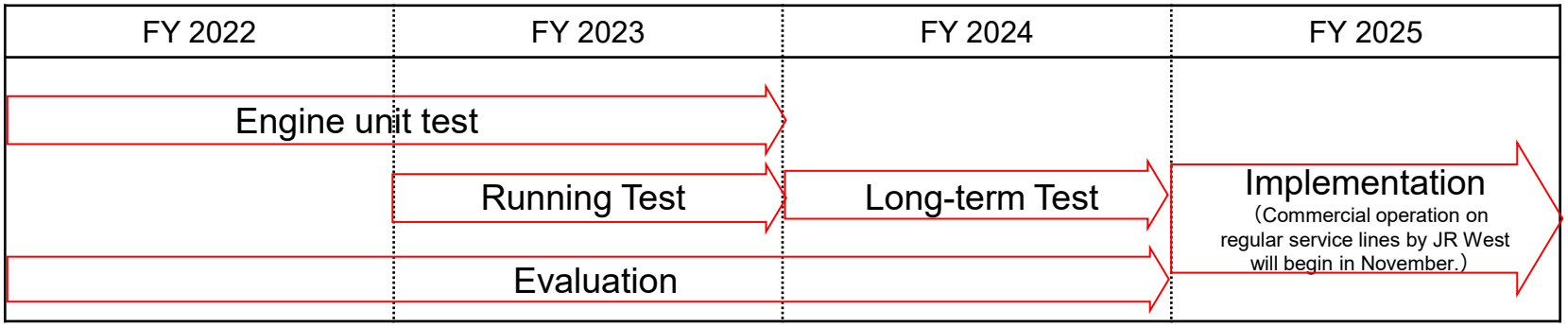


4-8. Strategy and Policy Measures

Utilization of Biodiesel Fuel

- Since FY 2022, MLIT has subsidized initiatives promoting technical development of biodiesel fuel.
- Commissioned to a team of the Railway Technical Research Institute and JR companies.
- Planned for deployment to operators from FY 2025 and onward.





Thank you very much

for your kind attention

(Reference) Basic Approach to GX in the Railway Sector

- Global interest in railways is growing as a response to climate change, presenting an excellent opportunity for Japan's railway industry to capture overseas demand and grow by leveraging cutting-edge energy-saving technologies and innovative rolling stock. We must seize this opportunity and **pursue GX investments in the railway sector through public-private collaboration.**

- The government will vigorously promote the introduction and widespread adoption of next-generation vehicles and related equipment with high decarbonization effects, **aiming to stimulate development and production investment, achieve mass production and standardization**, and reduce costs.

- Regarding hydrogen-powered vehicles being developed by multiple railway operators, **we will promote collaboration and coordination across operators and manufacturers** to resolve common technical challenges, **aiming for the early practical implementation of hydrogen vehicles capable of operating across a wide range of lines**. During the transition, based on the concept of a "technology portfolio," we will utilize various options appropriately according to the situation.

- To ensure a stable supply of next-generation fuels such as hydrogen and biodiesel, **we will strengthen frameworks for collaboration with other sectors and industries** regarding demand creation and supply chain development.

- Public and private sector stakeholders will collaborate to advance the domestic and international standardization of Japan's railway technology. This will enhance capabilities for overseas projects by reducing manufacturers' design and production burdens, while also **promoting the overseas deployment of the "Japanese Railway GX Package" through the utilization of energy-saving and decarbonization technologies.**

- Manufacturers will secure the design and manufacturing capabilities necessary to capture overseas demand, invest in equipment, and aim to improve productivity. **They will also introduce carbon footprint assessments** for railway vehicles to spread emission reduction efforts throughout the entire supply chain.

- **Railway operators will maximize the front-loading of GX investments, such as introducing next-generation rolling stock, based on the premise of environmental improvements by the national government and related organizations**. They will take responsibility for post-introduction operations and strive to achieve their emissions reduction targets early—reducing emissions by 5.4 million metric tons in real terms compared to fiscal 2013 levels by the 2030s—through initiatives addressing both hardware and software aspects.

- From the perspective of stable energy supply, **railway operators—as electricity consumers—will also advance the transformation of railway systems to accommodate renewable energy as a primary power source.** This includes utilizing railway assets for renewable energy generation and installing energy storage systems to serve as balancing capacity for variable renewable energy. Public and private stakeholders will collaborate on wide-area sector coupling.

- The government and railway operators will work together **to promote modal shift for both freight and passenger transport**, linking improvements in railways' environmental performance to overall emissions reductions in the transportation sector. On the other hand, while increasing the use of railways—where environmental advantages can be leveraged—may lead to an increase in total emissions within the railway sector, it is important to note that in such cases, the resulting effect on overall emissions reductions in the transportation sector must be appropriately considered.