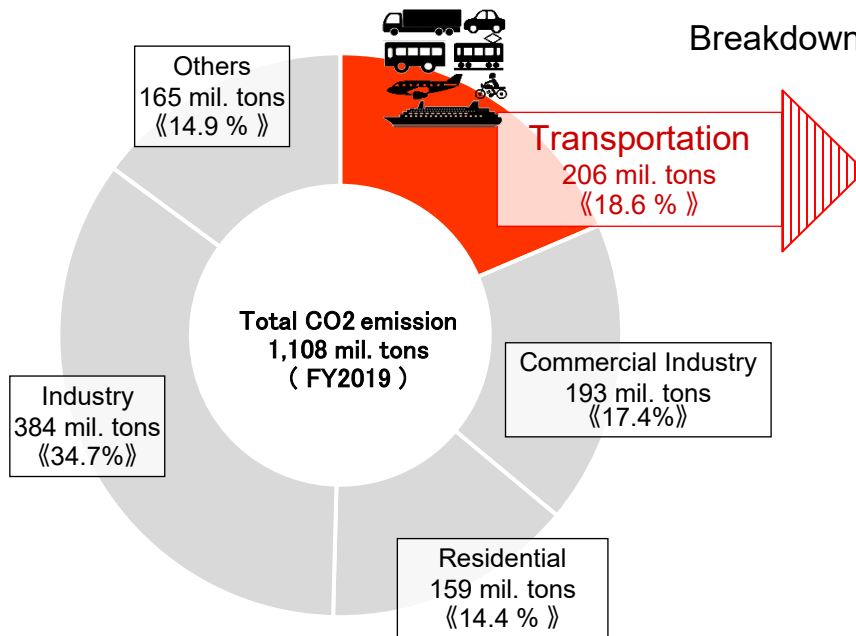


Efforts toward Decarbonization in Japan

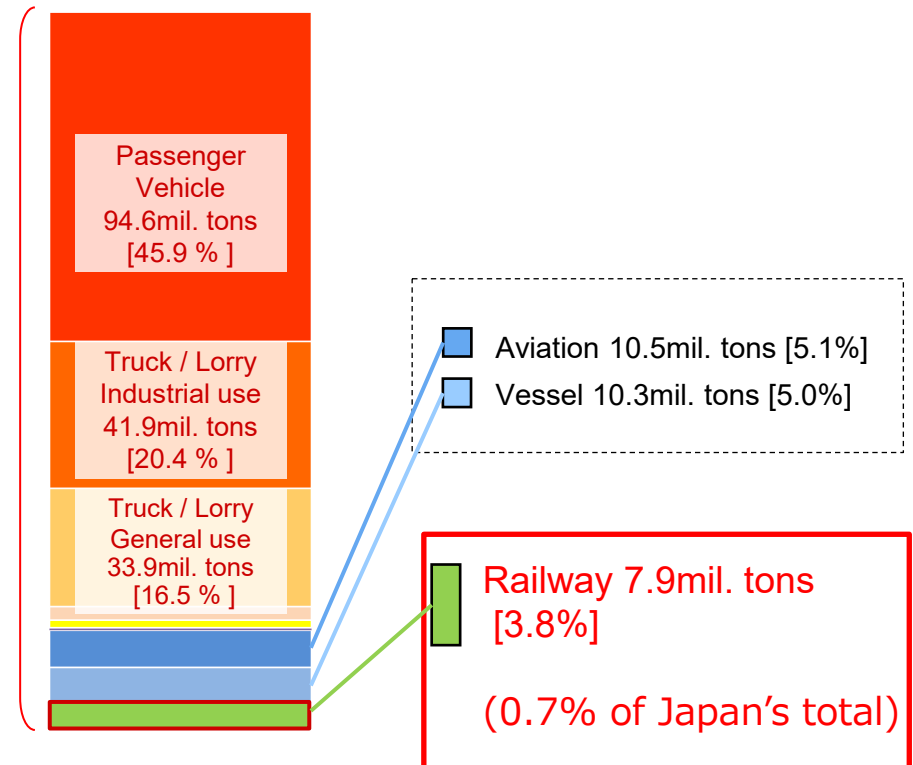
Takamasa KADONO

Director for International Cooperation Policy Coordination,
International Policy and Project Division,
Railway Bureau, MLIT

CO2 emission by segments



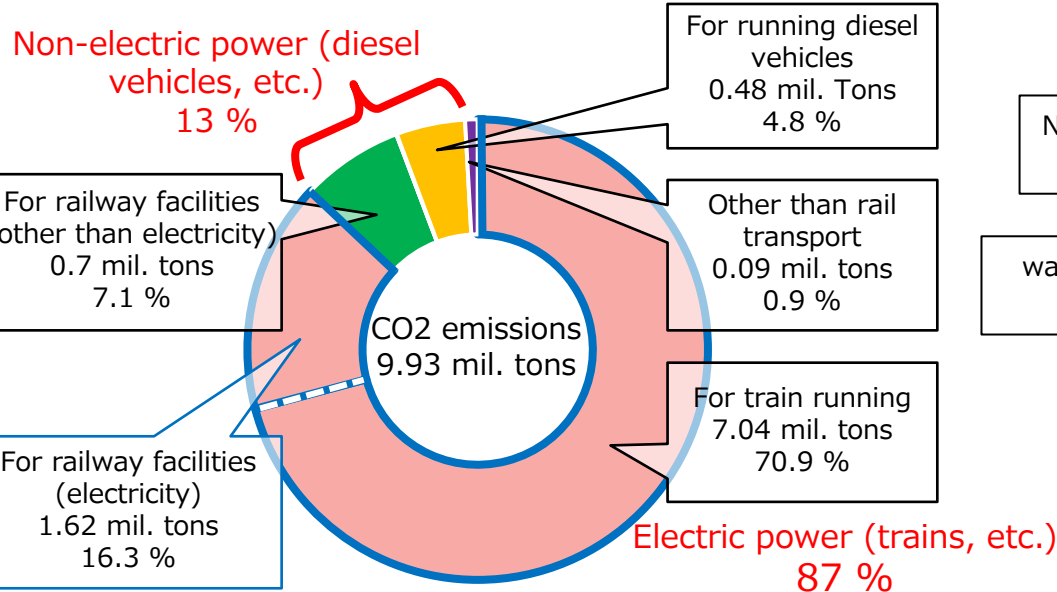
CO2 emission from transportation



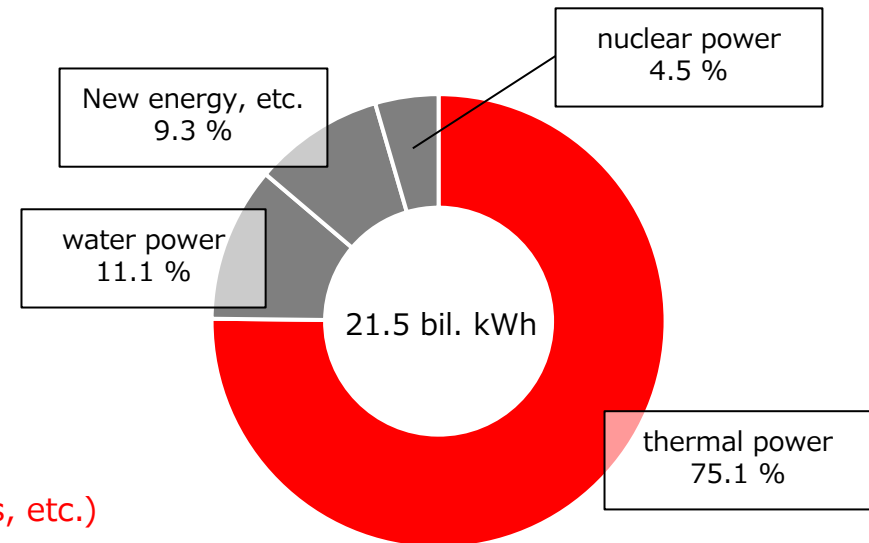
- ※ Due to rounding, the numbers in the summary not match.
- ※ Emissions associated with power generation by electric utilities and heat generation by heat suppliers are allocated to the final demand according to their respective consumption.
- ※ Source: GHG Inventory Office in Japan "The GHG Emissions Data of Japan"

- Total CO2 emissions from the railway sector are 9.93 million tons (0.9 % of Japan's total)
- **87%** of railway operators' CO2 emissions come from **electricity**, and 3/4 of electricity comes from thermal power. In order to significantly reduce CO2, it is essential to consider **how to procure electricity**.
- It is important to produce **renewable energy** using railway assets, and develop and introduce **low -CO2 vehicles** such as diesel hybrid vehicles and storage battery vehicles. Furthermore, in the medium to long term, **transportation of energy** (hydrogen, etc.) by rail is also important.

CO2 emissions of railway operators (FY2019)



Composition of Electricity Procured by Railway Operators



※ Created by the Railway Bureau based on the Annual Report of Railway Statistics, reports based on the Law Concerning the Rational Use of Energy (Energy Conservation Law), and materials published by energy supply companies.

※ Using the calculation method and emission factors in the Greenhouse Gas Emissions Calculation, Reporting and Publication System.

※ Calculated by determining the average of businesses subject to periodic reporting under the Energy Conservation Law and estimating based on CO2 emissions related to vehicle running.

- In electrified sections, in addition to making railway vehicle lighter and using LEDs, energy-saving devices such as **VVVF inverters** and **regenerative braking** are being introduced to railway vehicle.
- In non-electrified sections, storage batteries are installed in the trains, and hybrid trains that run on electricity from diesel generators and storage batteries (**diesel hybrid trains**), or trains that run on non-electrified sections with electricity stored in electrified sections (**storage battery trains**) are being developed.

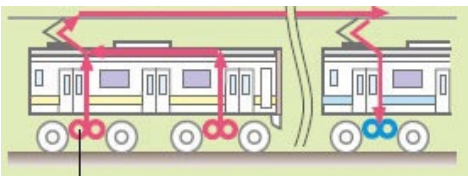
Regenerative braking

Acceleration



The train receives electricity from the overhead wire and drives the motor to move it.

Braking (power generation)



The generated power is returned to the overhead wire and used to accelerate other trains.

Source : JR East HP

Diesel hybrid vehicle



Source: JR Kyushu HP

Storage battery train

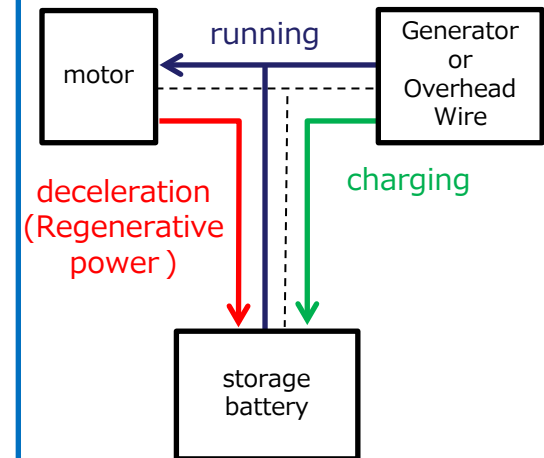


819 DENCHA
DUAL ENERGY CHARGE TRAIN



Source: JR Kyushu HP

Drive image diagram

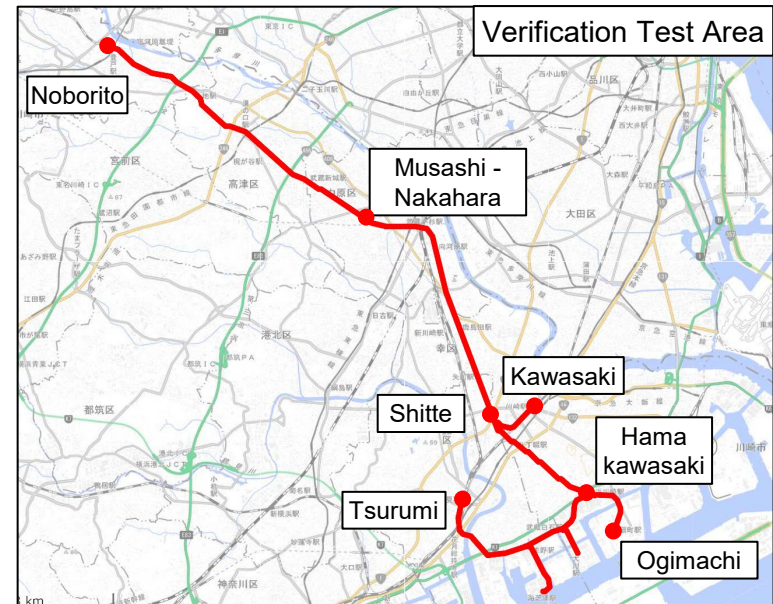


- Reduces CO2 emissions by storing regenerated power during deceleration and using it while driving .

- JR East is working with a manufacturer to develop a fuel cell railway vehicle " HYBARI " .
- Demonstration tests are conducted on the Tsurumi Line, Nambu Line, etc. from Mar. 2022.
- JR Central is conducting research and preparing for experiments on fuel cell vehicles, and JR Hokkaido is considering introduction of fuel cell vehicles.

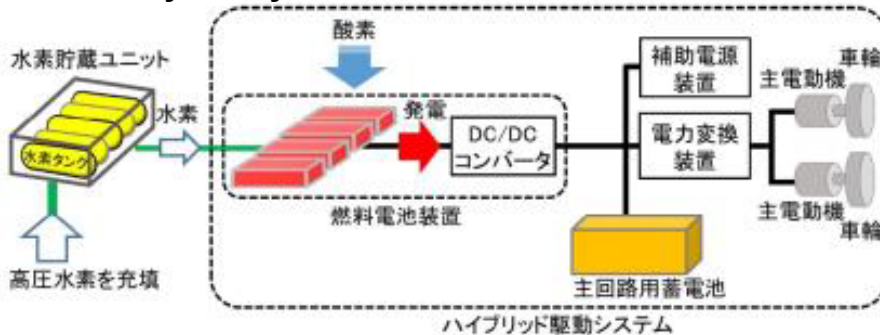


Source: Materials provided by JR East



Source: JR-East

< Fuel cell hybrid system of "HYBARI" >



* Technology of fuel cell vehicle "MIRAI" is utilized for the fuel cell device.

Source: JR East HP

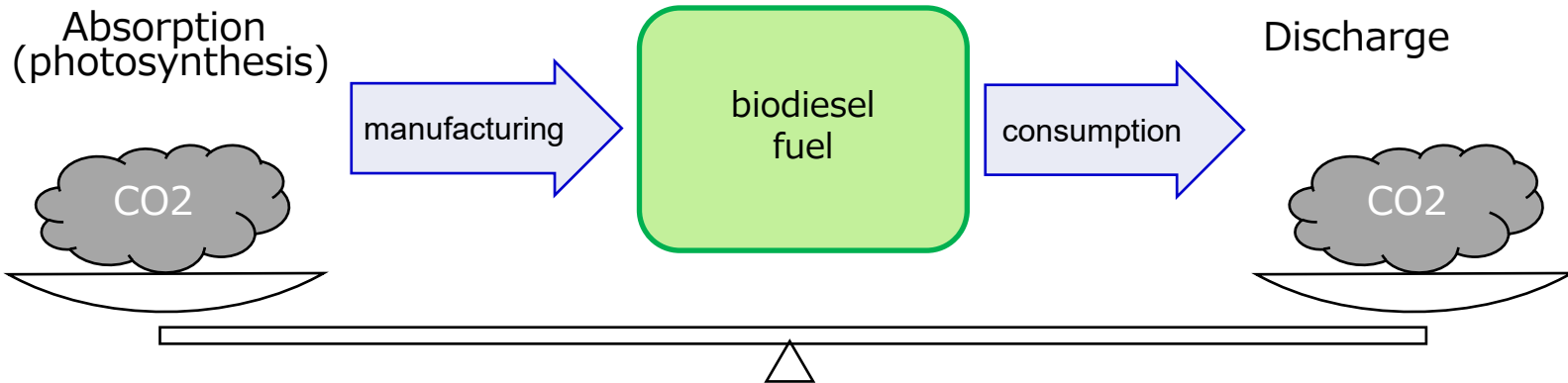
- CO2 absorption by microalgae, etc., and CO2 emissions during diesel train operation are offset, resulting in virtually zero **CO2 emissions**.
- Since FY2022, MLIT is supporting a **survey for the introduction of next-generation biodiesel fuel for diesel cars** conducted by Railway Technical Research Institute (RTRI) and others.

Waste cooking oil, microalgae, etc.

Diesel car

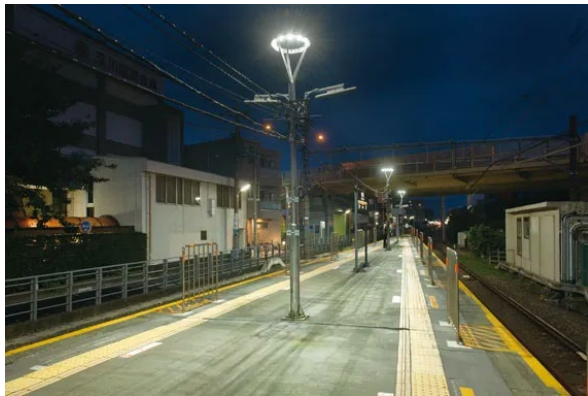


CO2 absorption & emission offset



- Introduction of **LED lighting**, **outdoor greening**, **permeable roofs** such as membrane roofs that allow natural lighting, **energy-saving escalators / elevators** is being promoted.
- In order to utilize regenerative power in station facilities, a **station auxiliary power supply device** has been introduced.

LED lighting



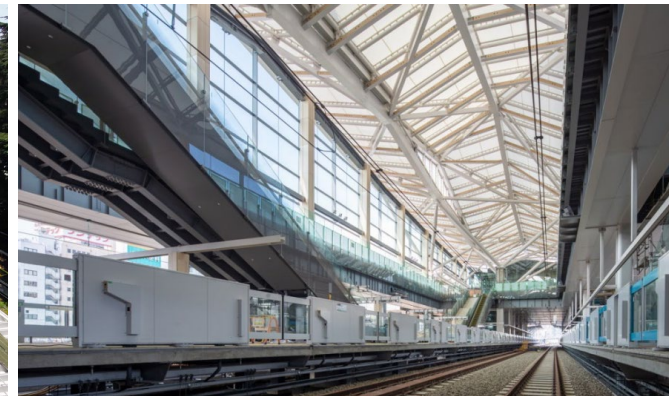
Source: Iwasaki Electric HP

Greening on platform roof



Source: JR East Architectural Design HP

Permeable roof



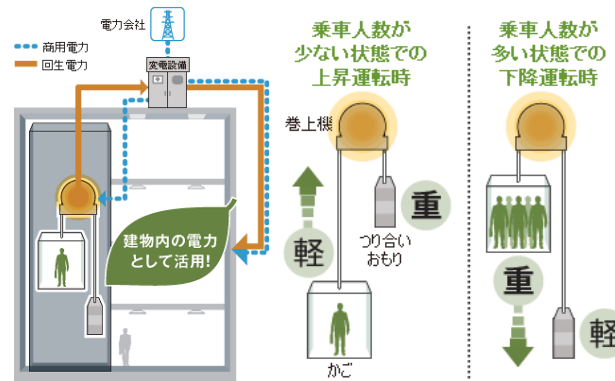
Source: JR East HP

Escalator with motion sensor



Source: Mitsubishi Electric HP

Elevator using regenerative power



Source: Hitachi Building Systems HP

Station auxiliary power supply



Source: Tokyo Metro HP

- Solar power generation utilizing railway assets such as platform roofs and railway slopes.

Installation examples

[Platform roof]



Source: JR East HP

[Station roof]



Source: JR West HP

[Slope]



Source: Sagami Railway HP

[Idle land]



Source : JR East HP

- Wind power generation utilizing railway assets such as station premises and forest land

Installation examples

[Station premises]



Source: JR East HP

[Forest land]



Source: JR East HP

[Station roof]



Source: Odakyu Electric Railway HP

[Station premises]



Source: JR West HP

- Railway Bureau of MLIT is holding a review meeting from March 2022. In the process of consideration, the strengths of railways were reaffirmed, and the importance of **effective utilization of railway assets, cooperation with other sectors** such as areas along railway lines and the energy industry, and contribution to Japan was highlighted.
- The interim report was released in 2022.

Background

- **Electricity accounts for 87%** of CO2 emissions from railways, **3/4 of electricity comes** from thermal power.
- Railways consume 2% of Japan's total electricity.
- Expansion of ESG finance , discussion of carbon pricing



Direction

- Decarbonization **"of railways "** and **"by railways "**
 - **Local production and consumption type**
 - **Direct delivery type**
 - **New train type**

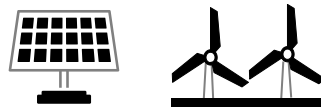
< Image of decarbonization "by railways " and "of railways" >

Decarbonization by railways

Consume :public facilities, shopping center



Produce: Generate renewable electricity



Consume: Home, Electric Vehicle



Store: Hydrogen supply station



Expansion of renewable energy supply and consumption

Decarbonization of railways

Produce: Renewable energy generation using railway asset



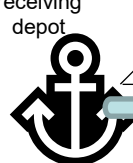
Reduce: Energy saving of station

Transport: Transmission of renewable energy

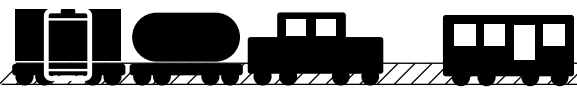
- Reduce**
- : CO₂-free vehicle
 - : New vehicle (Power generate vehicle etc.)
 - : Energy saving vehicle
 - : Improve operational efficiency

Transport: Energy transportation by freight rail

Hydrogen receiving depot



Produce: Regenerative power



Store: Storage battery, Hydrogen Storage Facilities

Store: Hydrogen supply station



Consume: Vehicle, Station facilities

Transport: Installation of hydrogen pipeline



***Thank you
for your kind attention***