Environment

CONTENTS

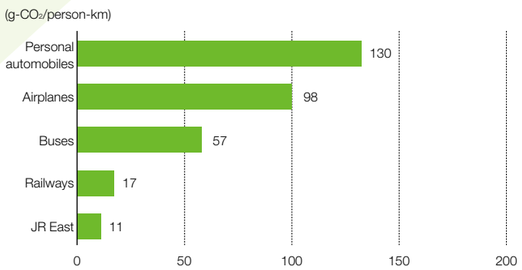
Priority commitment goals

Related goals

Aiming to Realize a Sustainable Society

Within the transportation sector, railways are an environmentally friendly mode of transport with relatively low CO_2 emissions per transportation volume. The JR East Group is promoting efforts to contribute to the realization of a "decarbonized society," while aiming to further improve its environmental friendliness and realize a sustainable society.

CO_2 emissions per transportation amount (FY2020 passengers)



Source: Adapted from Ministry of Land, Infrastructure, Transport and Tourism website

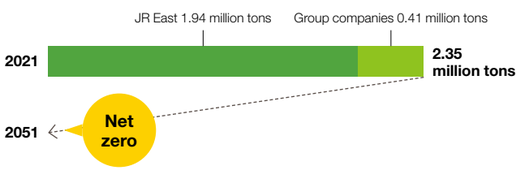
Zero Carbon Challenge 2050

Our Group management vision "Move Up" 2027 positions ESG at the center of our management, while "Zero Carbon Challenge 2050", long-term environmental objectives, announced in May 2020 sets out our aim for net zero CO_2 emissions in the railway business by fiscal 2051.

In October 2020, we announced that Zero Carbon Challenge 2050 would be the goal of the entire JR East Group, and that the Group would work together to achieve effectively net zero CO_2 emissions by fiscal 2051.

With the collective strength of the group, we are taking on the challenge of achieving effectively zero CO_2 emissions in all phases, from creating energy through to utilizing energy.

FY2051 CO_2 emission reduction objectives



Measures to Prevent Global Warming

Toward decarbonization of the entire JR East Group

We are promoting efforts throughout the Group to achieve Zero Carbon Challenge 2050. As a medium-term goal, by fiscal 2031 we aim to achieve objectives in line with the measures in the Paris Agreement adopted at the 21st Conference of the Parties (COP21) to the United Nations Framework Convention on Climate Change.

Note: External Assurance on environmental performance
KPMG AZSA Sustainability Co., Ltd. has been engaged in providing external assurance on a set of selected environmental performance indicators on pages 67–75 so that the reliability of the data in this report is ensured. The particular indicators that are assured are marked with a ☆ for clarity.

Targets for reducing CO_2 emissions and energy consumption by FY2031

Performance indicators		Numerical targets
Total reduction	Railway business CO_2 emissions (t-CO_2)	50% reduction (versus FY2014)
	Energy consumption from railway business activities (Billions of MJ)	40% reduction (versus FY2014)
Reduction in energy consumption intensity	Electricity consumption for train operation (Shinkansen lines) (kWh/car-km)	Annual reduction of 1% (versus FY2021)
	Electricity consumption for train operation (conventional lines) (kWh/car-km)	
	Energy consumption at branch offices, etc. (kL/m²)	

Performance indicators		Numerical targets
Reduction in energy consumption intensity	Energy consumption by all Group companies	Annual 1% reduction at each Group company (five-year average)

Other goals for reducing energy consumption by FY2031

Performance indicators		Numerical targets
Details of initiative	Switching all platform and concourse lighting to LEDs	Total of 415,000 units
	Improving efficiency of large-scale air-conditioning systems	Total of 38 locations
	Improving efficiency of small-scale air-conditioning systems	3,300 units
	Developing renewable energy-based power sources	700MW

Targets for reducing energy consumption by FY2021

Performance indicators		Reference value (FY2014)	Numerical targets	FY2021 result
Total reduction	Energy consumption from railway business activities (Billions of MJ)	51.7	48.5 (6.2% reduction)	47.3 ☆ (8.5% reduction)
Reduction in energy consumption intensity	Electricity consumption for train operation (Shinkansen lines) (kWh/car-km)	2.49	2.36 (5.1% reduction)	2.31☆ (6.9% reduction)
	Electricity consumption for train operation (conventional lines) (kWh/car-km)	1.59	1.46 (8.3% reduction)	1.47 ☆ (7.3% reduction)
	Energy consumption at branch offices, etc. (kL/m²)	0.0407	0.0366 (10.0% reduction)	0.0331☆ (18.7% reduction)

Performance indicators		Numerical targets	FY2021 result
Reduction in energy consumption intensity	Reduction rate of energy consumption intensity of each JR East subsidiary	Every year 1% reduction in each Group company	11% increase by all Group companies

Other goals for reducing energy consumption by FY2021

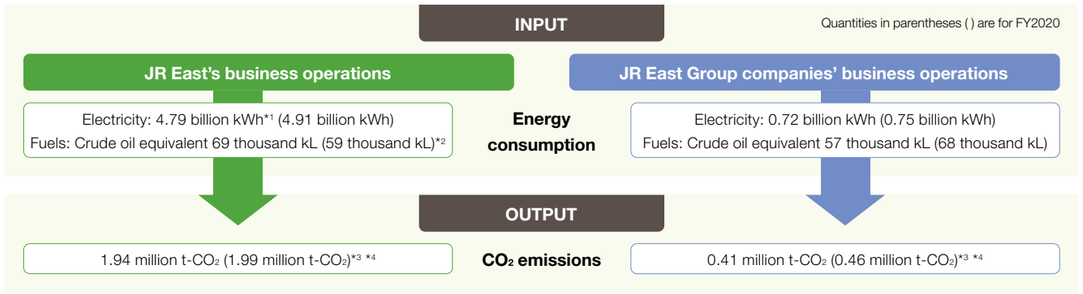
Performance indicators		Numerical targets	FY2021 result
Details of initiative	Implementation of more ecoste model stations	Total of 12 Stations	Total of 12 Stations
	Switching platform and concourse lighting to LEDs	Total of 62,000 units	Total of 83,000 units
	Improving efficiency of large-scale air-conditioning systems	Total of 10 Locations	Total of 10 Locations

■Targets for Group companies

Measures to Prevent Global Warming

Energy consumption and CO_2 emissions of the entire JR East Group☆

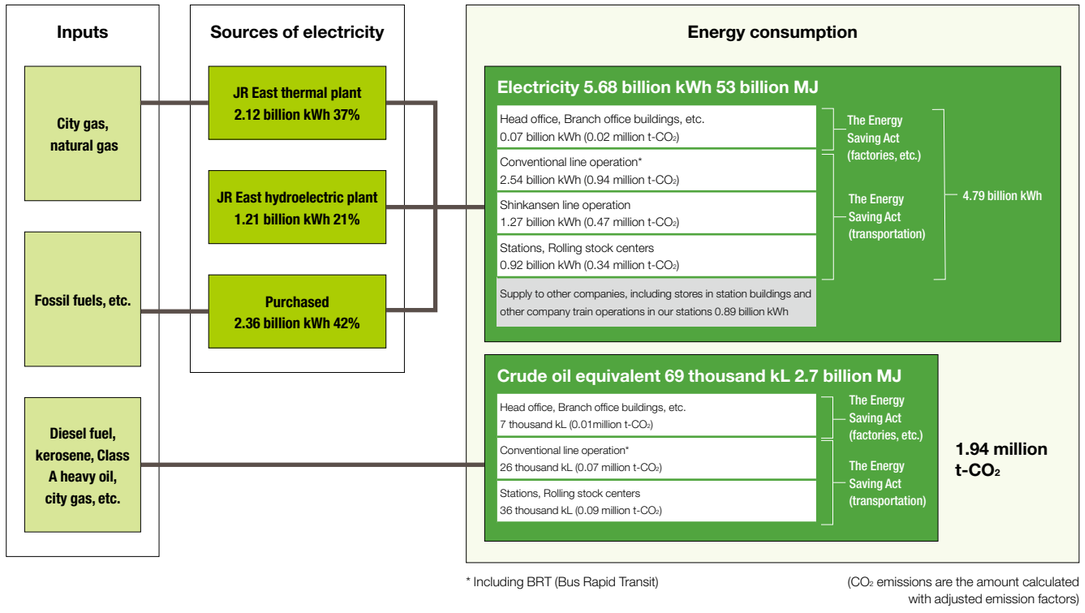
FY2021 results



*1 Electricity: Both electricity generated in JR East's power plants and used internally and electricity purchased from electric companies are included. For details about electricity generation and use please refer to "JR East Energy flow map".
*2 Fuels: Natural gas and other fuels used for generating electricity in JR East's thermal power plants are not included.
*3 CO_2 emissions by Scope: Scope 1 emissions of the entire Group are 1.44 million t-CO_2☆ and Scope 2 emissions are 1.39 million t-CO_2☆.
*4 CO_2 emissions attributable to electricity purchased from external suppliers are calculated based on the adjusted emission factors.

Energy flow map☆

This shows the flow at the company from energy input through to consumption. Power supplied by our own power plants and power companies is used for train operation and for station and office lighting and air-conditioning. Diesel fuel and kerosene, etc. are also used to operate diesel trains and stations and office air-conditioning.



* Including BRT (Bus Rapid Transit)

(CO_2 emissions are the amount calculated with adjusted emission factors)

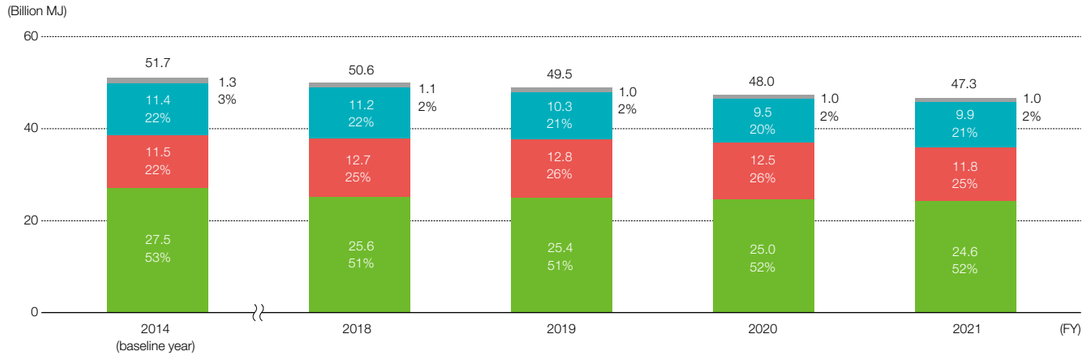
• Boundary
Though, in principle, the boundary for energy consumption is only JR East, it nonetheless includes energy consumption for the applicable operations of the companies with whom we entrust station operations. On the other hand, the energy consumption of shops on station premises which are operated by Group companies is not included in the boundary. We match the boundary for the energy consumption for the entire JR East business with that of transportation, plants, and others defined by the Act on the Rational Use of Energy (The Energy Saving Act).

• Calculation method
Energy consumption was calculated by the method defined by the Energy Saving Act.

Energy consumption

This chart shows the energy consumption of the railway business and its breakdown. Train operation accounts for about 80% of the energy consumed, and the remaining 20% is used at stations, rolling stock centers, and head office and branch office buildings. The amount of energy consumed in fiscal 2021 was 47.3 billion MJ, a reduction of 4.4 billion MJ compared to fiscal 2014.

Energy consumption in railway business activities☆



■ Head office, Branch office buildings, etc.
■ Stations, Rolling stock centers
■ Shinkansen line operations
■ Conventional line operations

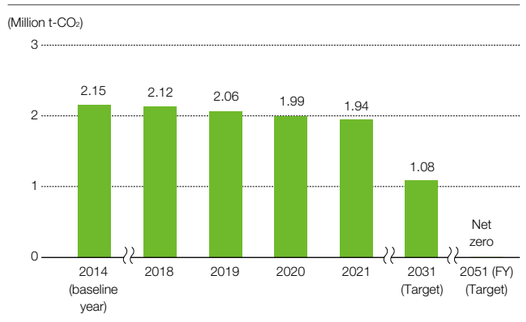
• Hydraulic power generated by JR East
The foregoing energy consumption is calculated by the idea of the Energy Saving Act, but hydraulic power generated by JR East is calculated by multiplying by 9.76MJ/kWh. As for hydraulic power generated by JR East, reports required by the Energy Saving Act are reported by the 0MJ.

Trends in total CO_2 emissions

The chart below shows changes in CO_2 emissions related to the railway business. Our CO_2 emissions in fiscal 2021 totaled 1.94 million tons, a decrease of 210 thousand tons compared with fiscal 2014 (the reference year). In this report, we are also reporting CO_2 emissions in Scopes 1, 2, and 3 in accordance with the definition of the GHG Protocol*.

* GHG Protocol: The standard for calculation and reporting of greenhouse gas emissions which was formulated by the organization which was established mainly by the WRI (World Resources Institute) and WBCSD (World Business Council for Sustainable Development).

CO_2 emissions from railway business☆



• Boundary of data
The total scope of CO_2 emissions is the same as the total scope of energy consumption described above.

• Calculation methods
Our calculation of CO_2 emissions is based on the methods set forth in the Act on Promotion of Global Warming Countermeasures. However, for CO_2 emissions on energy provided from external sources and used as electric power in railway transport, our calculations use adjusted emission factors for each electric power company. Using basic emission factors, CO_2 emissions for fiscal 2021 were 1.96 million t-CO_2 (down 0.05 million t-CO_2 year on year).

CO_2 emissions by scope (non-consolidated)

Item	Scope 1☆	Scope 2☆	Scope 3
CO_2 emissions in FY2021	1.35 million t-CO_2	1.15 million t-CO_2	4.09 million t-CO_2

Scope 1: All CO_2 emissions directly attributable to fuel consumed in the operation of diesel railcars, operation of JR East thermal electric power plant, etc.
Scope 2: CO_2 emissions indirectly emitted from the use of electricity purchased from electric power companies.
Scope 3: CO_2 discharged by the other companies which are related to our business activities.

* The sum of the Scope 1 and Scope 2 emissions and the total CO_2 emissions do not match, since the former includes emissions associated with the production of electricity supplied to other companies.
* Scope 3 emissions include 0.98 million t-CO_2☆ (1.03 million t-CO_2) for Category 1, 2.38 million t-CO_2☆ (2.71 million t-CO_2) for Category 2, 0.46 million t-CO_2☆ (0.34 million t-CO_2) for Category 3, and 0.27 million t-CO_2☆ (0.67 million t-CO_2) for Category 13. Figures in parentheses are values for FY2020.

• Calculation methods
Calculation standards for each category are as follows.
Category 1: Calculated as the amount spent on the purchase of products and services (only JR East) in relation to repairs or for system use x emission factor*1 for each product and service
Category 2: Calculated as the amount of capital expenditure (only JR East) x emission factor*2 per unit price of capital goods in the railway transport department
Category 3: Calculated as purchased fuel, electricity, and heat used (only JR East) x emission factor*3 for each type of energy by amount used
Category 13: Calculated as total floor area of buildings owned by JR East x emission factor*2 per building used and unit of total floor area for food and beverage shops
*1 Uses emission factor data from the Embodied Energy and Emission Intensity Data for Japan Using Input-Output Tables (3EID) (2005 edition)
*2 (FY2021): Uses emission factor data from the Emission Intensity Database for the Calculation of an Organization's Greenhouse Gas Emissions Generated by the Supply Chain, Ministry of the Environment. Uses the basic unit data of Database (Ver.3.1) (March 2021) (Emission Intensity Database V3.1). In the calculations of Category 13, for multipurpose facilities, the basic unit of usage with the highest usage rate for usage as restaurants, original unit per unit area, is adopted as the representative value.
(FY2020): Uses emission factor data from the Emission Intensity Database for the Calculation of an Organization's Greenhouse Gas Emissions Generated by the Supply Chain, Ministry of the Environment. Uses Database (Ver.2.6) (March 2019). Calculations for category 13 uniformly apply the intensity data for usage as restaurants, original unit per unit area.
*3 (FY2021): For fuel, uses IDEA (Inventory Database for Environmental Analysis).
Emission Intensity Database for the Calculation of an Organization's Greenhouse Gas Emissions Generated by the Supply Chain (Ver. 2.3) (December 27, 2019), for electricity and heat, uses emission factor data from Datebase (Ver.3.1).
(FY2020): For fuel, uses intensity data from the Basic Database for the Carbon Footprint Communication Program, Ver. 1.01, Ministry of the Environment; for electricity and heat, uses emission factor data from*2.

Measures to Prevent Global Warming

Overview of JR East Group's energy initiatives

The Group aims to optimize energy at various stages: creating, delivering, storing, and utilizing. Moreover, approximately 25% of energy consumed during train operations, etc., is renewable energy such as hydroelectric, solar, and wind power, which produce zero CO_2 emissions.

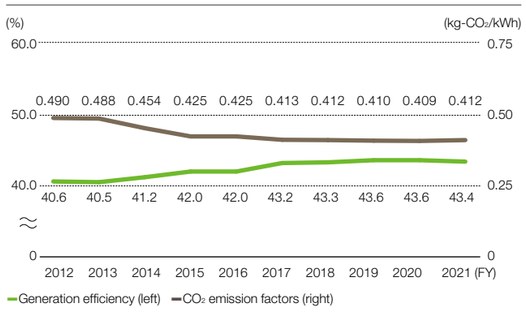
Electricity generated by JR East's own power plants

JR East operates a thermal power plant in Kawasaki City, Kanagawa Prefecture with total output of 809,000kW, fueled by city gas and natural gas. We are proceeding with the introduction of an efficient combined cycle power generation facility. Through the plant's renewal, it is being equipped with combined-cycle power generation units* with improved efficiency and reduced CO_2 emissions. The renewed Unit 1 came into operation in June 2021.

JR East runs its own hydroelectric power plants in Tokamachi City and Ojiya City, Niigata Prefecture with a total output of 449,000kW. These plants support our railway transportation operations as a clean energy power source that does not generate CO_2. We also aim to harmonize with the river environment and coexist with the local community through the development of fishways and the release of salmon fry.

* A combined-cycle power generation unit is a power generation unit that combines gas turbines propelled by combustion of gas with steam turbines driven by steam generated using the exhaust heat.

CO_2 emission factors and power generation efficiency at thermal power plant of JR East☆



• Calculation method
CO_2 emission factor for JR East's thermal power plant is based on the Act on Promotion of Global Warming Countermeasures, and power generation efficiency is based on the method stipulated in the Energy Saving Act.

• CO_2 emission factor of electricity generated by JR East (thermal power and hydroelectric power): The emission factor adjusted in FY2021 was 0.283 (kg-CO_2/kWh).

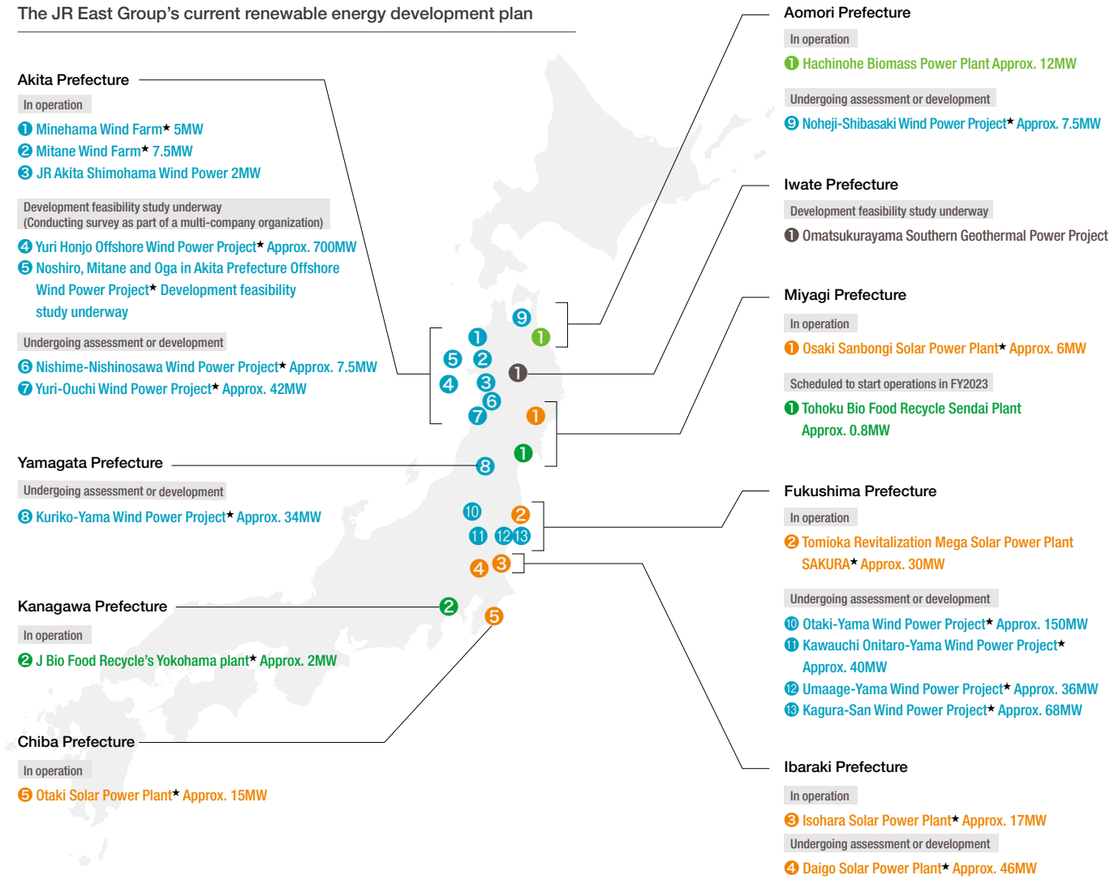
Progress in introducing renewable energy

We place solar panels on the roofs of platforms and station buildings and in rolling stock centers, using the energy they generate for our own use or for other trains passing through our tracks. In July 2018, we installed a compact wind power turbine at Oga Station. In addition to covering that station's electricity requirements, some power from the turbine is used for the ACCUM train, which is driven by an AC storage battery. Through such efforts, in fiscal 2021 we generated approximately 2.10 million kWh for our own consumption.

In addition to working with JR East Energy Development Co., Ltd. to develop renewable energy, we are actively introducing renewable energy (wind, solar, and geothermal) initiatives, centered on the Tohoku region. Taking advantage of the feed-in tariff (FIT) system, we have steadily launched operations at mega solar power plants and large wind power generation plants. In fiscal 2021, we generated approximately 91.50 million kWh of electricity.Through the use of "non-fossil fuel certificates" obtained from renewable energy and the supply of CO_2-free electricity, we aim to achieve zero CO_2 emissions for our train operations in the Tohoku area by fiscal 2031.

Our targets for renewable energy power development are 0.7 GW in fiscal 2031 and 1 GW in fiscal 2051.

The JR East Group's current renewable energy development plan



The star (★) indicates JR East Energy Development Co., Ltd. development and investment projects.
● Wind power generation ● Solar power generation ● Geothermal power generation
● Wood biomass power generation ● Biogas power generation

We plan to work with JR East Energy Development Co., Ltd., collaborating with local communities on further study and development to promote solar and wind power generation plants. By fiscal 2051, we aim to develop enough renewable energy to cover around 30–40% of the energy we use in the railway business. This figure rises to 50–60% for renewable energy if the hydroelectric power plants we operate are included.

Measures to Prevent Global Warming

Reducing energy consumption for train operations

Regarding trains, we are promoting the introduction of energy-saving vehicles equipped with regenerative braking that converts kinetic energy during deceleration into electrical energy, as well as VVVF inverters (Variable Voltage Variable Frequency inverters that convert direct currents to alternating currents) for efficient motor control. In addition, we have replaced some diesel vehicles in non-electrified sections of the railway with diesel hybrid vehicles and battery-powered trains (nicknamed ACCUM). Besides trains on the Karasuyama Line, all vehicles on the Oga Line have been operating by ACCUM since March 2021. As of the end of March 2021, 98.5% of the vehicles (12,198 railcars) were energy-saving vehicles.

E235 series (Yokosuka Line)

EV-E801 series (Oga Line)

Train crew energy-saving activities

To reduce power consumption in operating the Yamanote Line, we have launched an energy-saving operations project team (PT) to collect and analyze data.

The amount of power saved by replacing old vehicles with new ones is about 3%, but we expect this energy-saving project to reduce power consumption by 10% or more.

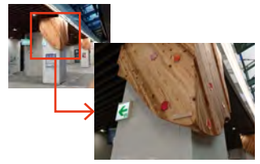
We will continue our efforts to spread awareness of the importance of energy-saving operations throughout the company.

Ikebuburo Transportation Depot, Tokyo Branch Office

Ecoste

Through our "ecoste" initiative, we are introducing a variety of elements at stations under the four headings of Energy Conservation, Energy Creation, Eco-Awareness, and Environmental Harmonization. Joining our 12 pilot ecoste stations, Takanawa Gateway Station was completed as an ecoste station in March 2020, and Sendagaya Station followed in December of the same year. We will continue to develop ecoste stations by leveraging the knowledge we have accumulated so far.

Sendagaya Station (Energy creation using solar power generation)



Sendagaya Station (Environmental harmony through using cross laminated timber [CLT] building materials)

Utilization of hydrogen energy

Initiatives we have taken thus far relating to the use of hydrogen energy include introducing fuel cell (FC) buses and FC vehicles, and opening hydrogen stations.

From around March 2022, we will start trials of hybrid (fuel cell) test trains (nicknamed HYBARI for HYdrogen-HYBrid Advanced Rail vehicle for Innovation) on the Tsurumi Line and the Nambu Line, and promote their adoption in the future based on the outcome of the trials.

In addition, JR East has signed an agreement with Toyota Motor Corporation aiming to contribute to the creation of attractive communities by building a hydrogen supply chain with bases at stations. This is an effort to promote hydrogen-based mobility collaboration between railways and automobiles.

Going forward, we will continue to work to diversify our energy sources, and we will accelerate efforts to realize a hydrogen society based on our station and railway line resources.

Hydrogen stations

Fuel cell bus (JR Takeshiba Hydrogen Shuttle Bus)

Hybrid railcar FV-E991 (HYBARI)

Measures for Resource Circulation

Resource recycling targets by FY2031

Performance indicators			FY2031 target (%)
Raise recycling ratios (per fiscal year)	Recycling rate for waste generated at stations and on trains		94
	Recycling rate for PET bottles in waste generated at stations and on trains		100
	Recycling rate for waste generated at general rolling stock centers, etc.		96
	Recycling rate for waste generated in facility construction projects		96
Reduce emission factors (FY2021 standard)	Provided by B2C (Business to Consumer)	Reduction in single use plastic	25
		Switching from single use plastic containers and packaging to renewable materials	60
		Reduction rate of final disposal amount of food waste	50
	Waste (general/industrial) reduction rate and recycling rate*1	Reduction ratio*2	32
		Recycling rate*2	73

Single-year goals and achievements in FY2021

Performance indicators		FY2021 goal (%)	FY2021 result (%)
Raise recycling ratios (per fiscal year)	Recycling rate for waste generated at stations and on trains	94	93
	Recycling rate for waste generated at general rolling stock centers, etc.	96	94
	Recycling rate for waste generated in facility construction projects	96	85
	Implementation rate of recycling by group companies	100	100*3

■ Targets for Group companies

*1 Excludes overseas Group companies
*2 Excludes companies that do not generate waste
*3 Waste recycling rates at group companies

Groupwide waste generation, amount recycled, recycling rate (FY2021 results)

Quantities in parentheses ( ) are for FY2020

JR East waste generation, amount recycled, recycling rate*3

General waste discharged

Offices	2,134t (2,355t)
Stations and trains	18,332t (30,349t)
General rolling stock centers, etc.	428t (504t)
Tickets	118t (254t)
Other field office*1	940t (715t)
Power plants	12t (14t)
Total☆	21,964t (34,191t)

General waste 21,964t → Recycling rate☆ 89% (19,564t)

Industrial waste discharged

Construction projects*2	399,210t (447,273t)
General rolling stock centers etc.	14,538t (20,823t)
Medical waste	215t (206t)
Other field offices*1	1,468t (1,074t)
IC ticket cards	131t (96t)
Power plants	245t (43t)
Total☆	415,807t (469,515t)

Industrial waste 415,807t → Recycling rate☆ 85% (352,212t)

*1 Other field offices: Technical centers, equipment maintenance centers, and other locations such as train crew offices
*2 Construction projects: Waste generated by our construction projects, but for which contractors legally become the waste-discharging entities, is included in industrial waste
*3 Waste includes salable waste

Group company waste generation, amount recycled, recycling rate*3

General waste discharged

General Transportation	1,377t
Retail & Services	13,351t
Real Estate & Hotels	35,632t
Others	82t
Total☆	50,442t (85,336t)

General waste 50,442t → Recycling rate☆ 60% (30,503t)

Industrial waste discharged

General Transportation	7,812t
Retail & Services	6,960t
Real Estate & Hotels	19,273t
Others	780t
Total☆	34,825t (40,451t)

Industrial waste 34,825t → Recycling rate☆ 89% (30,910t)

Recycling includes thermal recycling* where general waste is treated at incineration plants, etc. and industrial waste is incinerated as intermediate treatment for heat recovery.

* Thermal recycling is a recycling method in which the heat arising from the incineration of waste is used to create steam and hot water, which in turn is used to generate electricity and for hot-water supply

Water and office paper usage by the entire Group

Quantities in parentheses ( ) are for FY2020

JR East usage volume

Water use*☆ **9.46 million m³** (10.97 million m³)

Office paper use **1,016t (1,203t)** (of which 95% [97%] is recycled paper)

JR East Group companies' usage volumes

Water use*☆ **6.77 million m³** (9.23 million m³)

Office paper use **914t (1,005t)** (of which 85% [84%] is recycled paper)

* Water consumption is the total of tap water, industrial water, and groundwater consumption

Measures to Prevent Global Warming

In order to realize a resource recycling-based society, the Group is working as one on the three Rs (Reduce, Reuse, Recycle) to reduce the amount of various types of waste generated and disposed of in its business activities.

Collecting

Collection of recyclable waste at stations, etc.

Waste carrying vehicles

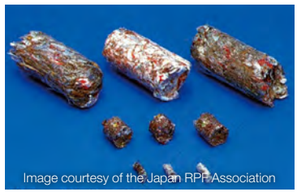
Sorting

JR East Tokyo Materials Recycling Center

Collection and sorting work at the JR East Tokyo Materials Recycling Center

Recycling

Office paper recycled from newspaper



RPF made from waste plastic*

* RPF (Refuse derived paper and plastics densified fuel): High-grade solid fuel from used paper and waste plastics mainly in industrial waste

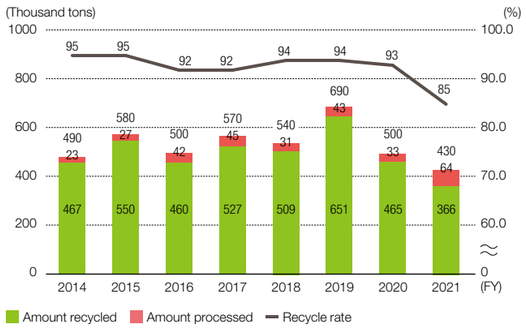
Collection and reuse of waste from stations and trains

JR East Tokyo Materials Recycling Center (operated by JR East Environment Access Co., Ltd.) carefully sorts waste from stations and trains that contains recyclable materials. Such waste as magazines and newspapers is recycled into office paper that is used within the Group. Used tickets are all recycled into such items as toilet paper (recycling rate of 100%).

Reducing and recycling waste from construction projects and general rolling stock centers

With construction projects, which account for about 70% of the waste we generate, we are working to reduce waste by appropriately treating construction by-products and standardizing in-house design and construction methods. In addition, at general rolling stock centers, we rigorously separate waste into about 30 types and promote waste reduction and recycling.

Waste from stations, trains, general rolling stock centers, and construction projects



Recycling rates

	FY2014	FY2019	FY2020	FY2021
Waste from stations and trains	94%	94%	93%	93%
Waste from general rolling stock centers	93%	96%	95%	94%
Waste from facility construction projects	96%	94%	93%	85%
Total	95%	94%	93%	85%

Initiatives to reduce use of plastics

From October 2019 through September 2020, we implemented a Get Rid of Plastic Waste campaign to reduce plastic waste and raise awareness of plastic waste issues. Stores directly managed by Group companies had by the end of September 2020 completed the replacement of plastic shopping bags and straws with biodegradable alternatives. In December of the same year, we received an award for excellence in the corporate category from the Ministry of the Environment for our efforts in support of its campaign to reduce the use of carrier bags. In fiscal 2021, we set medium- to long-term targets for reducing the use of and using alternatives to single-use plastics.

Initiatives to tackle food waste

In addition to measures already in place, in fiscal 2021, we set a medium- to long-term target for reducing the final disposal amount of food waste by fiscal 2031.

Food recycling through biogas power generation

We recycle food products and operate a biogas electricity generation business through J Bio Food Recycle (jointly established by JR East Environment Access Co., Ltd. with the JFE Group). Since 2018, J Bio Food Recycle has been operating a power generation business that converts food waste to biogas at its Yokohama plant.

In our first venture in biogas power generation outside the Tokyo metropolitan area, we established Tohoku Biofood Recycling Co., Ltd. in Sendai City, Miyagi Prefecture, in partnership with Tohoku Railway Transport Co., Ltd., JFE Group, and Tokyo Gas Co., Ltd. Tohoku Biofood Recycling's Sendai plant is scheduled to open in the spring of 2022.

J Bio Food Recycle's Yokohama plant

Tohoku Bio Food Recycle's Sendai plant (Conceptual drawing)

Reduction of food waste by food sharing

JR East Start UP Co., Ltd. and JR East Cross Station Co., Ltd. conducted an experiment in collaboration with CoCooking Co., Ltd., TABETE Rescue Deli, to purchase surplus food items that "*Ekinaka*" stores inside Tokyo Station have been unable to sell and sell them on to station employees after the stores have closed. The experiment began in January 2000 and so far we have achieved a reduction of about 4.3 tons of food waste. Full-scale operations began in March 2021.

Others

Biodiversity Initiatives

Since fiscal 2005 we have been planting indigenous trees to regenerate forests. In fiscal 2021, we carried out a tree planting project in Nakanojo Town, Gunma Prefecture.

In addition, WATERS takeshiba has been developing tidal flats and conducting observations and surveys of aquatic organisms in cooperation with local schools, and constantly conducts environmental surveys.

Chemical substance management

Under the Act for Rational Use and Proper Management of Fluorocarbon

We endeavor to reduce the use of substances specified as controlled substances under the Act on the Protection of the Ozone Layer and adopt substitutes that have less impact on the environment. Under the Act on Rational Use and Appropriate Management of Fluorocarbons, we reported a leakage amount of 4 thousand t-CO_2e☆ for fiscal 2021.

Chemical substance management and reduction

The Company is classified as a business operator handling over a certain amount of specified chemical substances under the PRTR system*. Accordingly, 11 of our sites reported emissions and transfer amounts to the relevant local government bodies in fiscal 2021.

Also, considering the impact on ecosystems, we are working to reduce and substitute chemical substances, for example, by introducing stainless steel railcars that do not require painting.

* PRTR system: A system where companies notify their releases and transfers of chemical substances as required by the Act on Confirmation, etc. of Release Amounts of Specific Chemical Substances in the Environment and Promotion of Improvements to the Management Thereof (Law concerning Pollutant Release and Transfer Register [PRTR]). It encourages the monitoring and control of toxic chemical substances emitted into the environment and measures to prevent negative impact on the environment.

TCFD Recommendation-Related Initiatives

Since the adoption of the Paris Agreement, the countries and governments of the world have made a major shift toward decarbonization. Companies now must ascertain the financial impact of climate change-related risk and disclose relevant information. In January 2020, JR East announced its support for the Task Force on Climate-related Financial Disclosures (TCFD) recommendations. Based on objective data, JR East undertakes the quantitative evaluation of the financial impact of future climate change in the transportation service business. This business is vulnerable to natural disasters, which have been worsening as climate change progresses. We are proactively disclosing information using the TCFD framework.

Disclosure of information based on TCFD recommendations

Recommendations	JR East's initiatives
Governance	We have established a Sustainability Strategy Committee chaired by our president and representative director to manage sustainability-related initiatives, set goals regarding climate change mitigation, and confirm progress versus targets. In October 2020, we set "Zero Carbon Challenge 2050" as the goal of the entire Group, which is taking on the challenge of "substantially zero" CO_2 emissions by fiscal 2051.
Strategy	We pinpoint risks and opportunities associated with climate change, conduct impact assessments of our business activities, and verify the adequacy of our business strategies. Specifically, we identify physical risks related to natural disasters as important risks, and carry out detailed scenario analysis using hazard information published by the government.
Risk Management	We identify climate change-related risks for each department and strive to prevent or reduce them. Specifically, we are strengthening and promoting efforts to reduce physical risks in the transportation service business.
Metrics and Targets	As indicators and targets related to climate change, we have set environmental goals for the CO_2 emissions of the entire Group to be "net zero" by fiscal 2051 and, for the railway business, for a 50% reduction in CO_2 emissions and a 40% reduction in energy consumption by fiscal 2031.

Details of strategies

(1) Awareness of risks and opportunities

The risks and opportunities associated with climate change are those that result from the transition to a new framework, such as the strengthening of regulations and technological progress that occurs in the process of decarbonization, and those that result from physical changes, such as severe weather caused by global warming. We examined physical risks after estimating passenger income based on future demographics as a baseline for analysis. We recognize the following points as major climate change risks and opportunities.

Main risks and opportunities		Timeframe
Physical risks	Damage to railway facilities and equipment and suspension of operations due to wind and water disasters	Short term
	Decrease in the number of passengers due to extreme weather events (heavy rain, extreme heat)	Long term
Transition risks	Cost increases due to the introduction/strengthening of a carbon pricing system	Medium term
	Decrease in passenger numbers due to competition with other means of transportation such as electric vehicles	Long term
	Decrease in passenger numbers due to damage/change to tourist attractions	Long term
Opportunities	Increase in passenger numbers due to preference for low-CO_2-emissions transportation	Long term

(2) Details of scenario analysis (physical risks)

The scenario analysis targeted the transportation services business. The number of passengers in the business is expected to fall due to population decline (declining birthrate and aging population), and it is predicted that the impact will be particularly significant in rural areas. In order to ascertain the financial impact of these factors and to verify the adequacy of our business and environmental strategies, we conducted the following scenario analysis with 2050 as the target year.

1 Estimated change in passenger income based on business area demographics + 2 Estimated physical risk caused by natural disasters

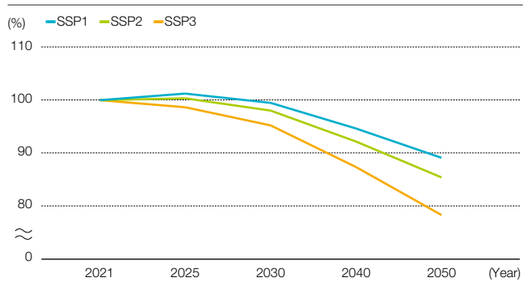
1 Estimated change in passenger income based on business area demographics

We estimated changes in passenger income up to 2050 based on data such as the Shared Socioeconomic Pathways (SSPs)*1 data on population and GDP*2, which are used across a range of fields in climate change research. There was an 11% difference in the population estimate for 2050 between the scenario of "Sustainability" (SSP1), which is our goal, and the opposing scenario of "Regional Rivalry" (SSP3), and a ¥350 billion difference in estimated passenger income. In the estimation of passenger revenue, we take into account the post-COVID-19 era.

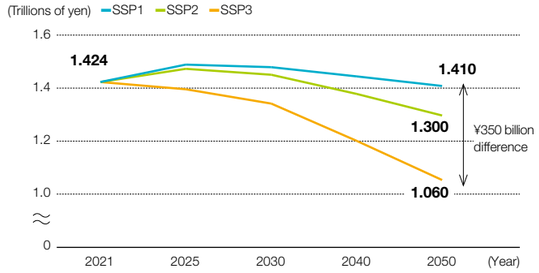
*1 Shared Socioeconomic Pathways (SSPs): Scenarios of projected socioeconomic global changes up to 2100.
*2 Population data taken from the National Institute for Environmental Studies' "Japan Shared Economic Pathways Population Estimates by Municipality." GDP data taken from the International Institute for Applied Systems Analysis (IIASA)'s "Global Dataset of Gridded Population and GDP Scenarios."

Scenario	State of domestic society	Birthrate	Mortality rate
SSP1 (2℃)	Sustainability: Development of renewable energy and environmental technology, urban concentration, compact development with robust networks	High	Moderate
SSP2 (Middle)	Middle of the Road: Maintain the status quo, current trends progress relatively unchanged	Moderate	Moderate
SSP3 (4℃)	Regional Rivalry: Uniform population decline, depopulation of regional areas	Low	Moderate

Business Area Population Estimates by Scenario



Trends in Passenger Revenue by Scenario



2 Estimated physical risk caused by natural disasters

Most of our major railway assets and lines with large passenger revenues are concentrated in and around the Tokyo metropolitan area, and a widespread disaster in this area would have a significant financial impact.

Based on this, flooding caused by the overflow of Class A rivers flowing through the Kanto region (due to projected rainfall) was selected as a specific disaster event for scenario analysis, and the overflow scenario of the Arakawa River, which could be expected to have the greatest financial impact, was chosen.

We conducted a quantitative assessment of the financial impact of this scenario using the inundation assumptions published by the government, the asset value of major lines, and passenger revenue trends.

(3) Analysis results and future approach

1 Impact on passenger income and facilities

This scenario suggested that if the Arakawa River flooded, many major railway lines from the Tokyo metropolitan area to the Kanto suburbs would be inundated, causing financial loss as a result of damage to railway assets such as stations and railways. It became clear that there would also be financial losses caused by the loss of passenger income as a result of the suspension of railway operations due to the flooding and in the period required for restoration.

Distribution of Class A rivers in the Kanto region

2 Financial impact

Based on this scenario and the increase in future flood probability*3, we analyzed the financial impact until 2050. In the single year of 2050, the estimated financial impact (the sum of the decrease in passenger income and the increase in disaster recovery costs) came to ¥3.4 billion under the Representative Concentration Pathway (RCP)*4 2.6 (2℃) scenario and ¥4.0 billion under the RCP8.5 (4℃) scenario.

3 Effect of natural disaster countermeasures

JR East, based on an assumed scale of rainfall, has been raising the height of electrical equipment considered of critical importance to operations and installing water stop plates at building openings. In addition, we have developed a decision support system on railcar evacuation and we have prepared a vehicle evacuation manual (see "Initiatives to address flooding" on page 34), and are promoting counter measures for natural disasters according to the importance of equipment from both perspectives of hardware (physical facilities) and software (human responses). Taking this into account, the increase in financial impact in the RCP2.6 (2℃) scenario becomes ¥1.3 billion while under the RCP8.5 (4℃) scenario it becomes ¥1.6 billion. From here on, we will estimate the financial impact of other major scenarios and confirm the effectiveness of the countermeasures.

*3 Hirabayashi Y. et al, 2013. Global flood risk under climate change. Nature Climate Chnage, 3 (9), pp. 816-821.
*4 Representative Concentration Pathways (RCPs): Representative Concentration Pathway Scenarios used in the IPCC Fifth Assessment Report

Presence or absence of inundation measures	Scenario	Period	Increase in financial impact (Billions of yen) (decrease in fares and increase in disaster recovery expenses)	
			FY2051	Estimate period, total
No inundation measures (hardware / software)	RCP2.6 (2℃)	2021–2050	+3.4	+51.4
	RCP8.5 (4℃)		+4.0	+60.0
Inundation measures in place (hardware / software)	RCP2.6 (2℃)	2021–2050	+1.3	+19.8
	RCP8.5 (4℃)		+1.6	+24.4