■Development of Environmental Education by Delivering Lectures on Request

In FY2010, to contribute to the development of a sustainable society, JR East initiated environmental education programs for children to understand environmental issues and their relationship to society. JR East employees working in each area are visiting neighboring schools for the programs. In FY2018, the program was implemented at 80 schools, primarily elementary schools, in the JR East area. As these initiatives were well-received, we received an Excellence Award at the Career Education Awards sponsored by the Ministry of Economy, Trade and Industry in FY2018.

Delivering Lectures

■Initiatives for: environmental activities of the Shinanogawa Power plant

In July 2016, we opened the "Citizen house; Ojiya Shinanogawa Hydroelectric Plant House" as a part of popularization activities for the Shinanogawa Hydraulic Power Plant to give the opportunity to learn about the mechanism of hydraulic power generation which is a source of clean energy. We have been popular among the people of the local community, and in December 2017, the number of visitors reached 100,000.
Also that, we release juvenile salmon as a part of initiatives to harmonize water usage and the river environment of the Shinanogawa River with the people of the local community.

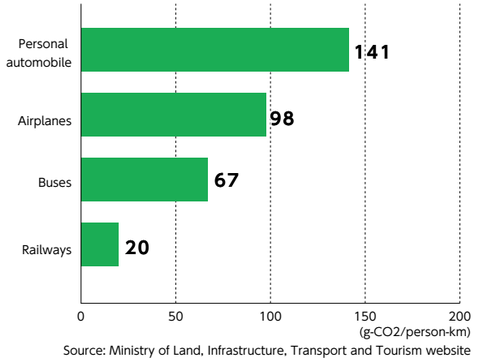
Ojiya Shinanogawa Hydroelectric Plant House

Measures to Prevent Global Warming

■Energy conservation and CO_2 reduction

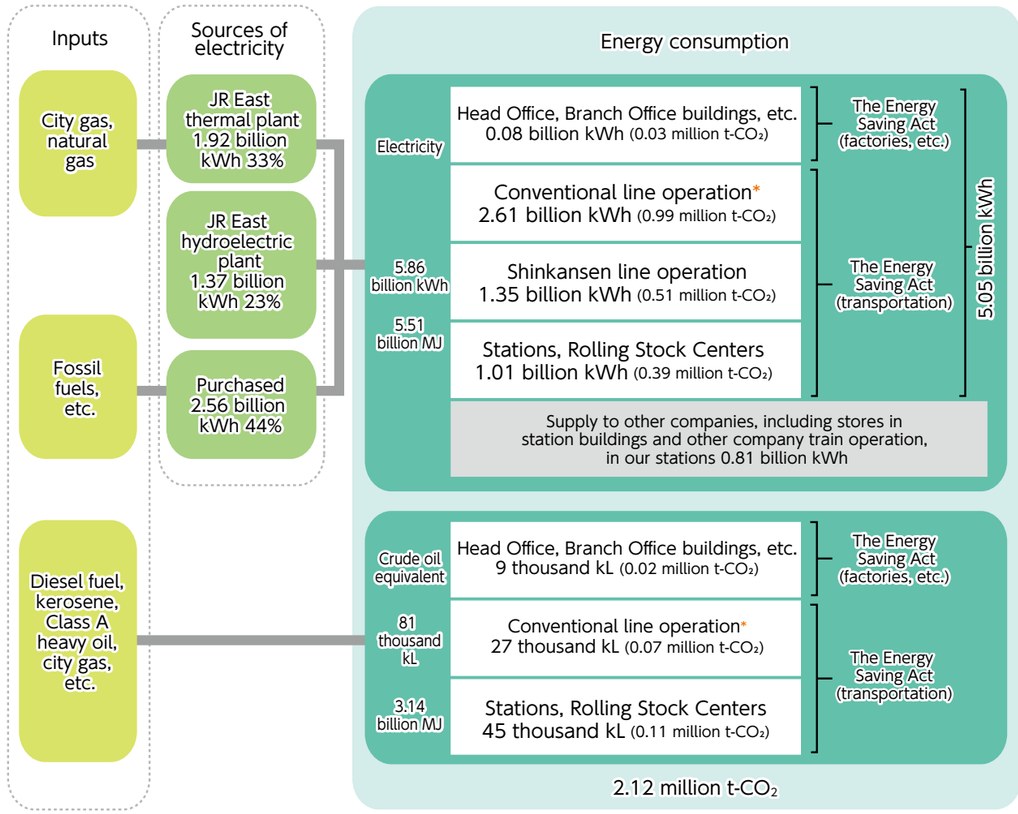
Railways are an environmentally friendly mode of transportation that accounts for a low share of the total CO_2 emissions produced by the transportation sector relative to their share of transportation volume.
However, JR East consumes around 5 billion kWh of power each year, which is a massive amount corresponding to approximately 1.4 million households.
We will therefore strive to save energy for train operation, which accounts for about 80% of our total energy consumption, and furthermore, it will be necessary to conduct energy saving activities even in offices and others.
The energy flow map shows the flow of energy from input through 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 are also used to operate diesel trains and stations and office air-conditioning.

[CO_2 emissions per transportation amount (FY2017 passengers)]



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

[JR East Energy flow map]☆



(CO_2 emissions are the amount calculated with' adjusted' emission coefficients)

* Including BRT (Bus Rapid Transit)

●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 premise which are operated by group companies is not included in the boundary. Thus, 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).

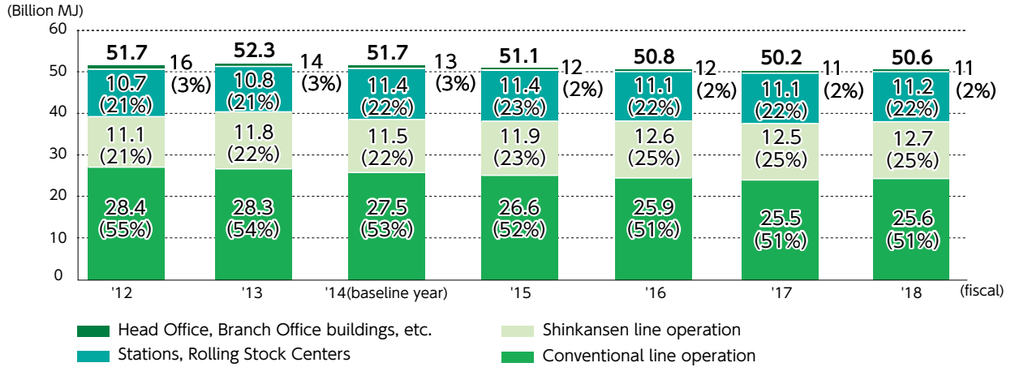
●Calculation method

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

●Hydraulic power generated by JR East

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

[Composition of energy consumption by JR East]☆



■Trends in CO_2 Emissions of JR East☆

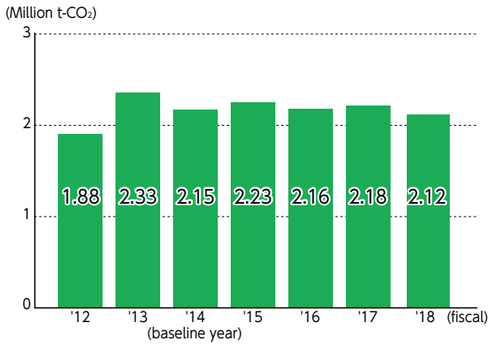
Our CO_2 emissions in FY2018 totaled 2.12 million tons, a decrease of 30 thousand tons compared to FY2014 (the baseline year). This is due to an improvement of the CO_2 emission coefficients of JR East's electric power due to an efficient operation of its Kawasaki Thermal Power Plant and other factors. In this report, we are also reporting CO_2 emissions in Scopes 1 and 2 in accordance with the definition of the GHG Protocol*.

We are moving forward with activities to reduce all CO_2 emissions resulting from our business activities by calculating CO_2 emissions* in Scope 3 and identifying supply chain emissions.

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

*Supply chain CO_2 emission Sum of Scope 1, 2 and 3 which is the CO_2 emissions resulting from the whole organization activities of business operations such as raw material procurement, production, capital investment goods, business trips, commuting and others.

[Trends in JR East's total CO_2 emissions]



●Boundary

The boundary of CO_2 emissions is the same as that for the energy consumption described in p. 87.

●Calculation Method

CO_2 emissions have been calculated based on the method specified in the Act on Promotion of Global Warming Countermeasures. However, the CO_2 emissions attributable to the purchased electricity are calculated, including those from the electricity used for rail transport, by using adjusted emission coefficients for each electric power company. The CO_2 emissions in the FY2018 calculated by using actual emission coefficient is 2.15 million tons CO_2, down 50 thousand tons CO_2 compared to the previous fiscal year.

Item	Scope 1	Scope 2
FY2018 Emission Volume	1.39 million tons CO_2	1.33 million tons CO_2

Scope 1…CO_2 emissions directly attributable to fuel consumed in the operation of diesel railcars and the operation of JR East's thermal electric power plant.

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.

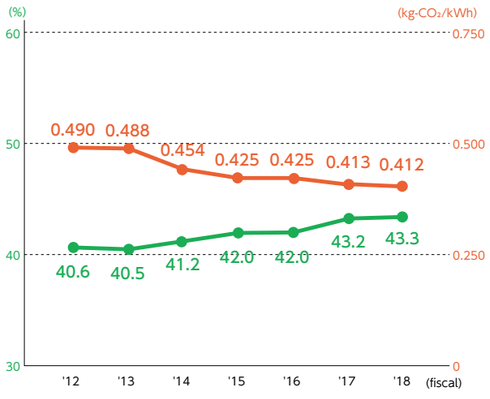
*The sum of the Scope 1 and Scope 2 emissions and the total CO_2 emissions do not match, since the former includes emissions associated with the production of electricity supplied to other companies.

■Thermal Power Plant of JR East

JR East operates a thermal power plant in Kawasaki City, Kanagawa Prefecture, with a total capacity of 741 thousand kW. The plant uses combined-cycle power generation units* with improved efficiency and switched fuel from oil to natural gas when the plant was renovated to reduce CO_2 emissions. Unit 1 is currently undergoing construction that will update it from kerosene to natural gas, targeting operation in 2021.

*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 from the exhaust heat.

[CO_2 emission factor and power generation efficiency at the JR East thermal power plant]☆



●Calculation method

CO_2 emissions from the thermal power plant of JR East are calculated based on the method stipulated in 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 all power generated by JR East (thermal power and hydraulic power)

Emission factor adjusted in FY2018 was 0.277 (kg-CO_2/kWh)

■Reducing energy consumed for train operations☆

We are putting into service more new-generation energy efficient railcars, with features such as regenerative brakes, which can convert kinetic energy during deceleration into electric energy, and Variable Voltage Variable Frequency (VVVF) inverters, which control motors without wasting electricity. By the end of March 2018, JR East had 12,160 energy-efficient railcars in operation. This accounts for 97.3% of our railcar fleet.

E235 series:
The Yamanote line was equipped with a state-of-the-art train information management system

E7 series:
The Hokuriku Shinkansen that incorporates the highest level of cutting-edge technology

E233 series:
VVVF inverter cars for commuter and suburban transportation

■Diesel-powered, electric-motor-driven hybrid railcars and the accumulator railcar train

The Kiha E200 type cars, which entered service on the Koumi Line in July 2007, are the world's first diesel-powered, electric-motor-driven hybrid railcars. Compared with the previous trains, fuel consumption rate has been reduced by about 10% and the noise level of the trains idling at stations and accelerating on departure has been lowered by 20–30 dB. Moreover, starting from October to December 2010, we began operating the HB-E300 Series, a new type of resort train equipped with a hybrid system similar to the Kiha E200 type, in the Nagano, Aomori and Akita areas, and in May 2015, we began operating HB-E210 Series cars on the Senseki-Tohoku Connecting Line. Additionally, as a new measure toward reduction of the environmental burden in non-electric zones, we are proceeding with the development of an accumulator system, which debuted in March 2014 with the EV-E301 ACCUM railcar train, put into service on the Karasuyama Line. The introduction of the EV-E301 has enabled an elimination of emissions, as well as a reduction in CO_2 emissions and noise associated with diesel engines. In March 2017 we started operation of the accumulator railcar train of the "EV-E801 series" which is designed for usage on the alternating current (AC) section between Akita station and Oga station.

EV-E801 series
Accumulator railcar train for use on alternating current (AC) section

■Promotion of proactively adopting LED lighting for all new cars

On our conventional lines, LED lighting has been introduced on new rolling stock manufactured since 2013.

For Shinkansen cars, LED lighting has been introduced on newly produced E5-series trains and E7-series trains.

At the end of March 2018, a little over 20% of cars owned by JR East, including newly manufactured cars and renovated cars, have LED lighting. We are determined to continue making efforts for further energy saving in railway operations.

LED railcar lighting

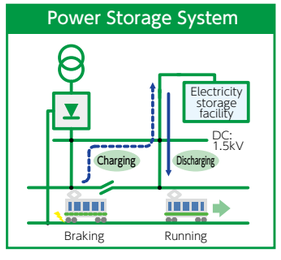
■Effective Use of Regenerative Power

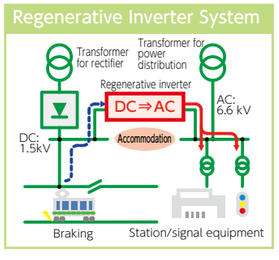
As a measure to reduce energy consumed from ground installations for train operation, we are proceeding with efforts to make more efficient use of regenerative power generated by trains when stopping.

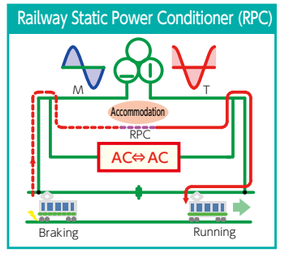
On direct current sections, we are working to introduce power storage systems that temporarily store regenerative power and use it when needed. We have introduced these systems starting with the Ome Line Haijima substation (lithium-ion battery) that entered use in 2013, which was followed by the Takasaki Line Okegawa substation (lithium-ion battery) and the Tohoku Main Line Kuki substation (nickel-metal hydride battery), and are working to introduce it at the Joban Line Kita-Senju substation. In addition, we are developing a superconductivity flywheel electricity storage system as a new medium to store electricity.

Moreover, we are proceeding with the introduction of regenerative inverter systems, which convert direct current regenerative power generated by rolling stock into alternating current power for use by station facilities, signal equipment, etc., at the Takasaki Line Fukiage substation and Keiyo Line Kajibashi substation.

Meanwhile, with regard to alternating current sections, we introduced a railway static power conditioner (RPC) that makes it possible to alternatively accommodate regenerative power generated on feeding sections that previously could not be used, at the Joban Line Ushiku sectioning post. It has been in use since 2015.







■Progress of introducing renewable energy

We have installed solar and wind power generators at stations and rolling stock centers, furthering our self-consumption (utilizing generated energy at our own facilities) initiatives. At some stations such as Tokyo Station, we have installed solar powers on top of platforms and on the roofs of stations, utilizing them for the station's facilities, etc. In addition, the electricity generated at the solar power generator installed inside the Keiyo Rolling Stock Center is used not only at the rolling stock center, but also to operate railways via our own distribution lines. With these initiatives, we self-consumed approximately 1.63 million kWh in FY2018.

For initiatives using the feed-in tariff (FIT) scheme for renewable energy, we have sequentially set up and started operating solar power generators known as mega solar power plants and large-scale wind power generators, and have generated approximately 18.2 million kWh of electricity in FY2018. We will continue to gradually introduce these generators. Moreover, regarding biomass power generation, we began the operation of the joint venture Hachinohe biomass power plant (output approximately 12 MW: Hachinohe City, Aomori Prefecture) in April 2018. For geothermal power generation, we are conducting a development study on geothermal resources in Shizukuishi-cho, Iwate Prefecture. In addition, in November 2017, Group company JR-East Energy Development Co., Ltd. started operating a joint venture with Tomioka-machi, Fukushima Prefecture, the Tomioka Revitalization Mega Solar Power Plant SAKURA (output approximately 30 MW). Going forward, we will continue to actively introduce and use renewable energy.

Wind

Between Michikawa and Shimohama on Uetsu Main Line
JR Akita Shimohama Wind Power Generation Station
Power generation output approx. 2 MW
(Began use in December 2016)

Solar light

Tomioka Revitalization Mega Solar Power Plant SAKURA
Power generation output Approx. 30 MW
(Began use in November 2017)

Biomass

Hachinohe biomass power plant
Power generation output Approx. 12 MW

Geothermal

Omatsukurayama southern region geothermal resource development survey
Surface study currently underway

TICKET TO TOMORROW

Fell, Use and Replant

Technical Director, Hachinohe Biomass Electric Power Co., Ltd.

While biomass power generation is a type of renewable energy that does not produce CO_2 like solar and wind power generation, it has an advantage in that it can stably generate electricity without the influence of natural conditions such as the weather.
At Hachinohe Biomass Power Generation, we conduct an initiative where branches, leaves, short pieces of lumber that are left behind at felling sites, bark that used to be processed as waste at sawmill factories, etc., are utilized as fuel. Moreover, combustion ash produced at the power plant is reused as a part of raw materials at cement factories. We resourcefully utilize our valuable forest assets.
We wish to achieve our mission to continue operating our facilities without trouble and contribute to global environment conservation and the revitalization of the local community through the cycle of "fell, use and replant."

■Development of the "Eco-station" model station

We are implementing "eco-stations" which introduce various environmental conservation activities into stations such as energy saving and renewable energy. By July 2018 we had completed the development of ten "Eco-station" model stations.
Our basic policy in developing these has been to incorporate "Ecomenu" green technologies based on to four pillars. Our goal is to establish 12 stations by 2020.

【Four pillars】

Saving energy: Promoting better energy-saving measures
Creating energy: Actively introducing renewable energy
Eco-consciousness: Developing facilities that enable customers to be eco-conscious
Environmental harmony: Creating a dynamic balance between people and the environment

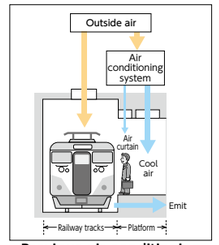
Oga Station

[Established Eco-station model stations (as of July 2018)]

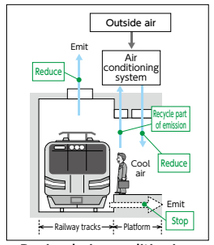
Station Name	Operation Start Date
Yotsuya	March 2012
Hiraizumi	June 2012
Kaihimmakuhari	September 2013
Yumoto	March 2015
Fukushima	April 2015
Urawa	March 2017
Niitsu	April 2017
Musashi-Mizonokuchi	April 2017
Kobuchizawa	July 2017
Oga	July 2018

■Saving energy at stations

As we have done for office buildings, we have promoted energy conserving initiatives at stations, such as revision of air conditioning systems in line with the upgrading of facilities and replacing platform lighting into LED lighting.
In FY2018 we replaced a total of about 7 thousand platform lights with LED lighting and through this replacement we were able to reduce annual power consumption by about 1.5 million kWh.
As for the air conditioning system for underground platforms at Tokyo Station (Sobu Line and Keiyo Line), we had been bringing in outside air, cooling it, and then sending that cooled air up to the concourse and emitting the air to the outside. However, starting in 2015, we started construction to upgrade this to recycle and reuse the cooled air, and this was completed in FY2018. The combination of the reduced air conditioning load and improved efficiency due to the renewal of air conditioning facilities has reduced CO_2 emissions by 60%.



Previous air conditioning method
Cool outside air to cool concourse, etc. and emit it.



Revised air conditioning system
Cool outside air and recycle part of the cool air to reduce the air conditioning load.

High-efficiency turbo refrigeration and air conditioning units after facility upgrading

We are also pursuing further energy-saving efforts, such as using the BEMS* that we introduced in conjunction with the air conditioning facility upgrading and modifying how we use our air conditioning based on data analysis.

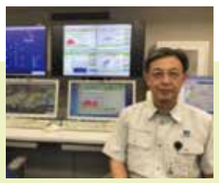
Example of BEMS screen

*BEMS (Building Energy Management System) : system that plays a role in saving energy by measuring building energy use and indoor environment conditions.

TICKET TO TOMORROW

Energy Saving Initiatives at Stations

Tokyo Station Facility Monitoring Center Manager, Tokyo Branch Office, JR East Facility Management Co., Ltd.



We work to improve operations by monitoring daily in order to stably and efficiently operate Tokyo Station's air conditioning facilities. Unlike office buildings, the conditions of stations are intricately related and constantly changing including the number of customers, drafts caused by trains, and train stoppage time. For this reason, we analyze the facilities' operation data gathered by BEMS at over 2,000 points, and conduct eco-tuning that corresponds to the station's conditions. Moreover, as we can detect the operational conditions of facilities, we also contribute to increasing the efficiency of inspection operations.
In the future, as a member of the JR East Japan Group, we hope to utilize the BEMS data with the PDCA cycle to provide comfortable spaces inside stations.

■Environmentally friendly and energy efficient office buildings

We have pursued energy saving initiatives by hardware measures such as introducing LED lighting and high efficiency devices into office buildings and also by software measures such as implementation of "cool-biz" initiatives, thermal control of air conditioners and scrupulous shutting off lights by employees. JR Shinjuku Miraina Tower, which opened in 2016, has acquired a class S rating as an environmentally friendly and energy-efficient office building, which is the highest rating under the CASBEE environmental labeling system, an initiative of the Ministry of Land, Infrastructure, Transport and Tourism.

Thanks to their superior performance as office buildings reducing CO_2 emissions, seven offices—including GranTokyo South Tower, GranTokyo North Tower, JR Shinagawa East Building, and Sapia Tower—earned recognition as Offices Taking Excellent Specific Global Warming Countermeasures (top-level office building) under the Tokyo Metropolitan Ordinance on Environmental Preservation. During the first planning period under the ordinance (FY2011 to FY2015), we were able to reduce CO_2 in the amount largely exceeding the obligatory amount. We will use the exceeded amount of reduction for emission trading within the Group and others as stipulated in the ordinance.

Top-Level Offices	Semi-Top-Level Offices
Sapia Tower, JR Shinagawa East Building GranTokyo South Tower, GranTokyo North Tower JP Tower, JR Minami-Shinjuku Building	JR Tokyo Meguro Building

JR Shinjuku Miraina Tower, ranked "S" in the CASBEE

JR Minami Shinjuku Building recognized as a top-level workplace

Top-level establishment certification presentation ceremony (July 2018)

■Shinagawa Development Project

As part of our efforts to take a leading role in addressing climate change at the global level, the Shinagawa Development Project, with the support of the Tokyo Metropolitan Government, joined the Climate Positive Development Program[*1] run by C40[*2], which recognizes low-carbon urban development projects, in FY2016. Going forward, we will continue to contribute to the creation of a sustainable society.

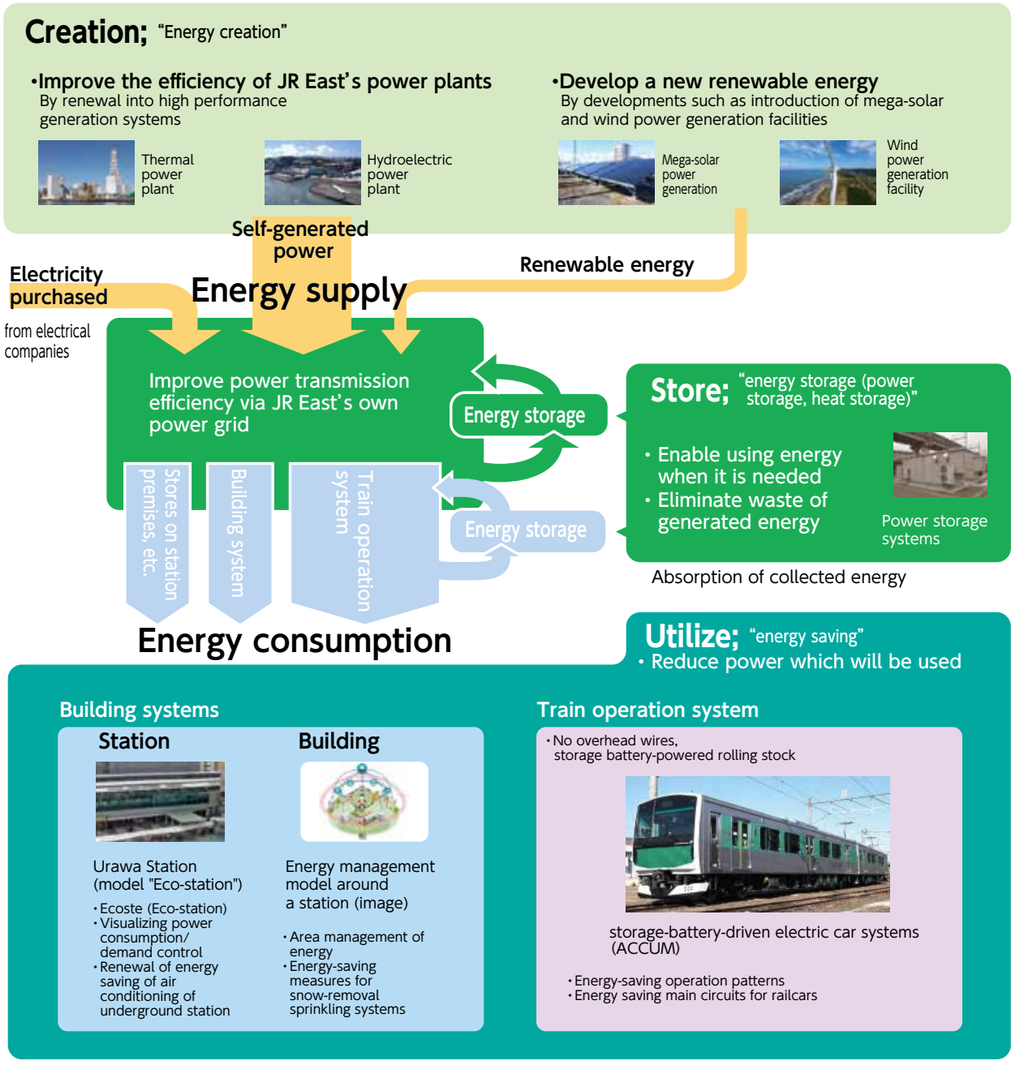
*1 Climate Positive Development Program A program that creates models for highly sustainable urban development. Its purpose is to be a leader for global society as a whole by widely promoting examples of pioneering development models around the world.

*2 C40(C40 Cities Climate Leadership Group) Established in 2005 as a network of cities around the world that work together to reduce greenhouse gas emissions. As of August 2018, there are 96 participating cities, including Tokyo, which joined in 2006.

Shinagawa Development Project "Global Gateway Shinagawa" image

Research and development for reduction of environmental loads

The JR East Group possesses a comprehensive energy network from power generation, transmission, and distribution to usage. We are aiming to establish a railway energy management system that combines these with creation (energy-creating technology such as mega-solar and wind power generation facilities of renewable energy), use (energy-saving technology such as energy-saving operating patterns), and storage (energy-storing technology such as power storage systems).

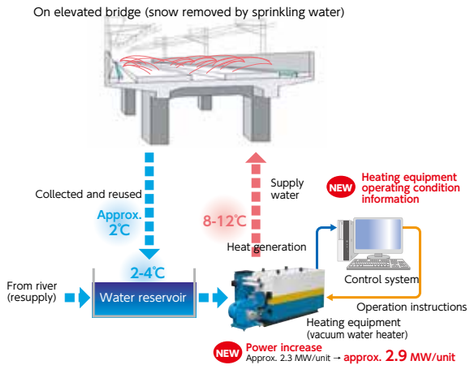


○**Energy-Saving Measures to Improve the Efficiency of Snow Removal Sprinkler Equipment**

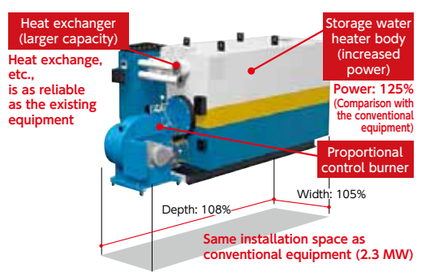
In addition to replacing aging snow removal sprinkler equipment, which helps to ensure stable Shinkansen transportation in regions with heavy snowfall, we are working on energy-saving by improving the equipment's efficiency. Snow removal sprinkler equipment is a system that prevents accumulation of snow on elevated bridges by sprinkling warm water that is heated using a heating device. At the same time, these systems also consume a huge amount of energy, and equipment on the Tohoku, Joetsu, and Hokuriku Shinkansen Lines uses 10,000 to 15,000 kL of kerosene per year in winter alone; converted into CO_2 emissions, this corresponds to 25,000 to 37,000 t.

We therefore developed a new, high-efficiency control system that uses heating equipment operating condition information and heating equipment that has a higher output while still occupying the same installation space as conventional equipment, and implemented it first at the Joetsu Shinkansen Nakajima Snow Removal Base (Nagaoka City, Niigata Prefecture), in FY2018. With this, we are working to reduce fuel consumption by 10%.

[Overview of Snow Removal Sprinkler Equipment and Key Developments]



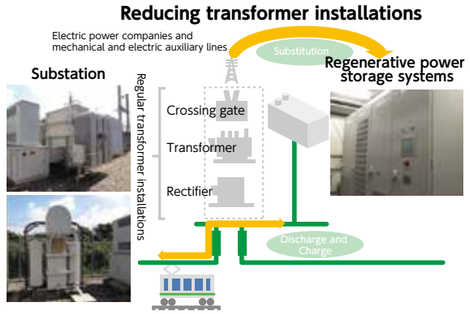
[Development machine (heating equipment)]

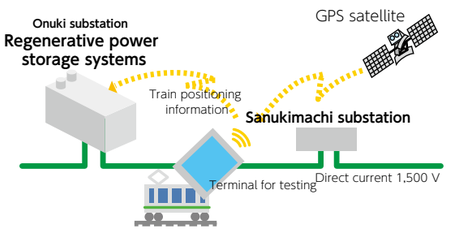


○**Slimming Down Transformer Substations Utilizing Regenerative Power Storage Systems**

By replacing the multiple machines located at substations with regenerative power storage systems, we are aiming to economize maintenance manpower by reductions transformer installations. At the demonstration experiment that has been conducted since October 2017 at the Onuki substation on the Uchibo Line, we are testing whether regenerative power storage systems can supply the electric power that trains need without the functions of a substation.

With this development, we control appropriate amounts of discharge and charge when trains are located at the appropriate sections, utilizing train positioning information gathered from GPS, and discovered that we can potentially reduce battery capacity by approximately 30%. In the future we hope to coordinate train energy conservation operation patterns with above ground facilities control, aiming for energy conservation by railways.





Measures for resource circulation

■Waste reduction and recycling

JR East generates many kinds of waste through its railway operations, including daily general trash removed from trains and stations and industrial waste from our General Rolling Stock Centers. Restaurants and retail stores in our lifestyle businesses also produce garbage and general waste. In order to reduce all these various forms of waste, JR East actively supports the approach known as "reduce, reuse, and recycle." For recycling in particular, goals are set for each type of waste.

■Recycling waste collected from stations and trains☆

Since trash from stations and trains contains recyclable materials, we placed separation bins in stations to have customers cooperate in separating trash. In October 2010, to further improve recycling rates by implementing thorough separation of trash, we built the JR East Tokyo Materials Recycling Center (operated by East Japan Eco Access Co., Ltd.) and started its operation.

JR East Tokyo Materials Recycling Center

○**Recycling trash generated at stations within the company**

Magazines, newspapers and similar paper items collected from our segregated trash boxes at stations and trains are being recycled into coated paper and stationery and used in our offices.

Newspapers and other papers collected in stations and elsewhere are recycled into office paper used by our company.

■Reducing and recycling tickets☆

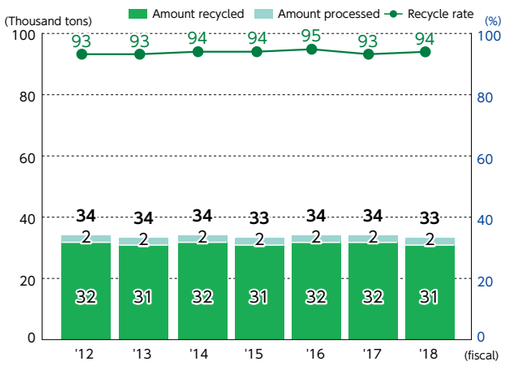
Collected used tickets are sent to a paper mill. After the iron powder has been separated from the backs of the tickets, the paper is recycled to make toilet paper and corrugated cardboard.

Used tickets collected at stations are recycled into toilet paper.

■Recycling at General Rolling Stock Centers☆

JR East Group is recycling waste generated during the manufacture and maintenance of rolling stock. At our regional General Rolling Stock Centers, waste is sorted into 20 to 30 categories to reduce waste generation and promote recycling. Starting in FY2006, we have been collecting data on the volume of retired railcars that are sold as scrap to be recycled so as to monitor our progress.

[Waste from stations and trains]



[Waste from General Rolling Stock Centers]