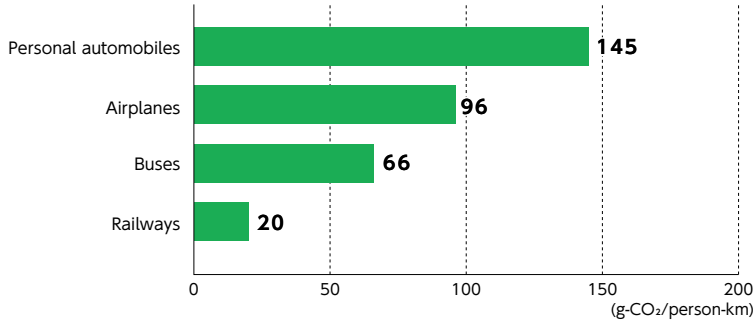
Measures to Prevent Global Warming

■Energy conservation and CO_2 reduction

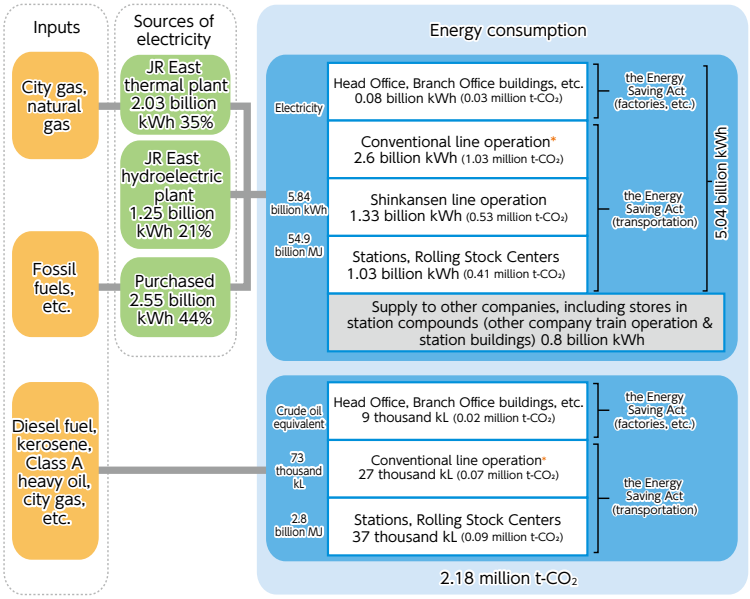
Railways are an environmentally friendly mode of transportation that accounts for a low share of the total CO_2 emissions produced by the transportation sector relative to their share of transportation volume. In FY2016, CO_2 emissions per transportation amount were 20 g-CO_2/person-km for railways compared to 145 g-CO_2/person-km for private automobiles.
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 a variety of 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 (passengers)]



Source: Ministry of Land, Infrastructure, Transport and Tourism website (FY2016)

[JR East Energy flow map]☆



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

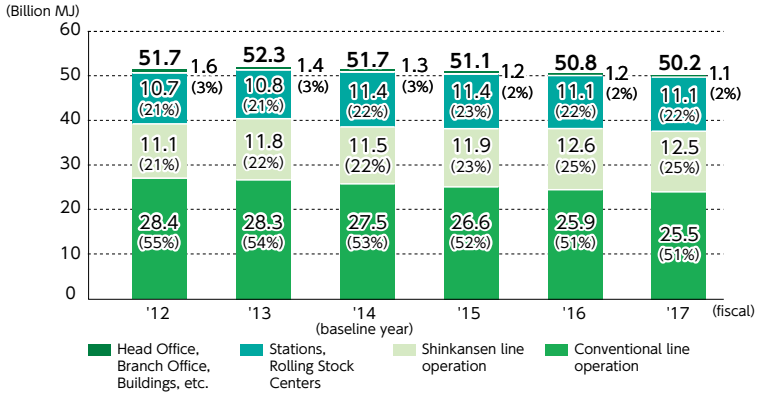
* Including BRT (Bus Rapid Transit)

●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 Rationalizing Energy Use (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 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 as 0 MJ.

[Composition of energy consumption by JR East]☆



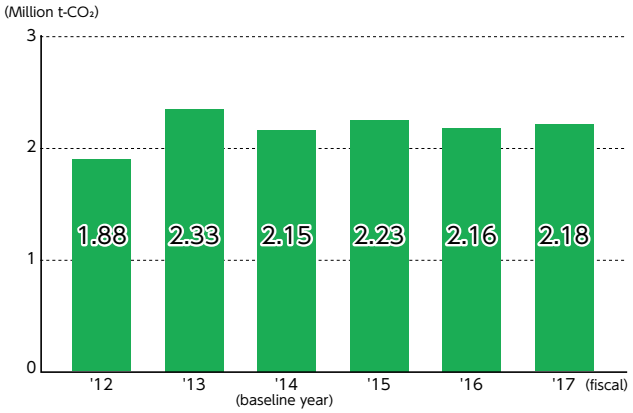
■Trends in CO_2 Emissions of JR East☆

Our CO_2 emissions in the fiscal year ending March 2017 totaled 2.18 million tons, an increase of 30 thousand tons compared to FY2014 (the reference year). This is due to a decline in the CO_2 emission coefficients of electric power companies and other factors. As we did in last fiscal year, 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. 106.

●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 fiscal year ending March 2017 calculated by using actual emission coefficient is 2.20 million tons CO_2, up 0.04 million tons CO_2 compared to the previous fiscal year.

Item	Scope 1	Scope 2
FY2017 Emission Volume	1.38 million tons CO_2	1.36 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.

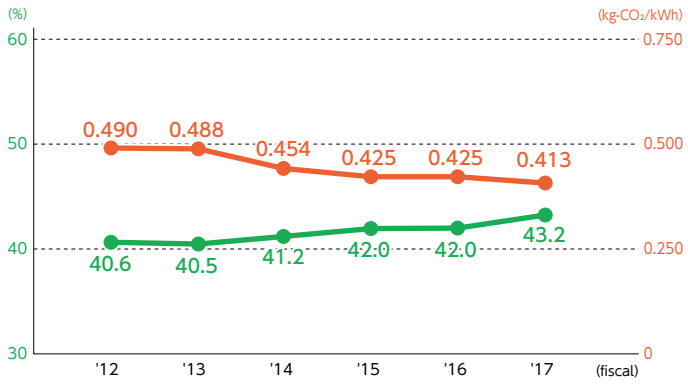
*The sum of the Scope 1 and Scope 2 emissions and the total CO_2 emissions do not match, since the former includes emissions associated with the production of electricity supplied to other companies.

■Thermal Power Plant of JR East

JR East operates a thermal power plant in Kawasaki City, Kanagawa Prefecture, with a total capacity of 741 MW. 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. In addition to the start of operation of No. 4 plant in April 2014, we are proceeding with renovation of No. 1 plant for commencement of operations 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 thermal power plant of JR East]☆



●Calculation method
CO_2 emissions from the thermal power plant of JR East are calculated based on the method stipulated in 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 FY2017 was 0.298 (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.
In the fiscal year ending March 2017, JR East had 11,934 energy-efficient railcars in operation. This accounts for 96.2% of our railcar fleet.

E235 series:
New rolling stock models equipped with state-of-the-art train information management system were introduced on the Yamanote Line

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 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.
On top of that, in March 2017 we started operation of the accumulator railcar train of the "EV-E801 series" which is aimed 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

TICKET TO TOMORROW

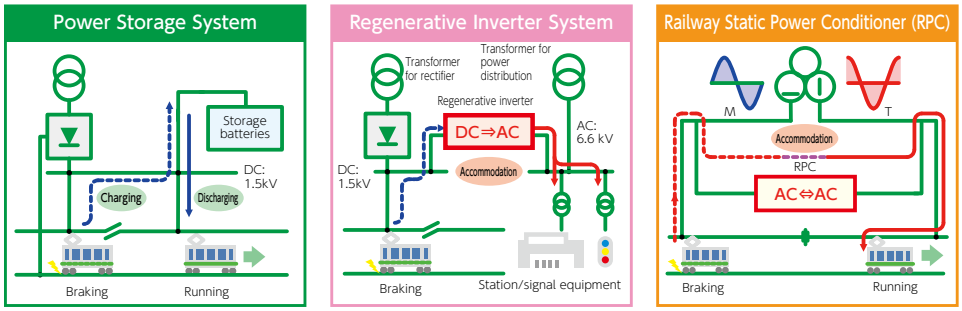
Aiming for further improved quality of ACCUM

Keiichiro Ito
Chief Rolling Stock Engineer, Koyama Rolling Stock Center, Omiya Branch Office

I am responsible for technical guidance during regular inspections and manual creation for the ACCUM (EV-E301 series) operated on the Karasuyama Line and studies relating to other rolling stock.
Since the first train-set entered service, we have succeeded in operating it without any major problems, and we are acquiring data on storage batteries, which is essential for future quality management, and conducting periodic analysis, but there are some areas where it is difficult to make judgments about storage battery deterioration trends based solely on the data we currently have, so we will continue considering what we need to do as we move forward.
We also receive inquiries from the crew members who actually operate the trains about storage battery consumption in different usage environments. Going forward, in addition to taking all necessary measures to maintain rolling stock, we will devote effort to acquiring various data on storage batteries and ensuring safe, stable transportation in collaboration with stakeholders.

■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 in a total of three locations so far, starting with the Ome Line Hajima 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).
Moreover, as a new initiative, 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 alternately accommodate regenerative power generated on feeding sections, which previously could not be used, at the Joban Line Ushiku sectioning post. It has been in use since 2015.



■Proactively adopting LED lighting for all new cars

On our conventional lines, LED lighting has been introduced on new rolling stock manufactured since 2013. We are also steadily adding rolling stock with LED lighting for the Yamanote Line E235-series, which is currently being manufactured.
For Shinkansen cars, LED lighting has been introduced on newly produced E5-series trains and E7-series trains, and we will continue to introduce it on additional E5-series trains produced in future.
In summary, at the end of March 2017, over 10% 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

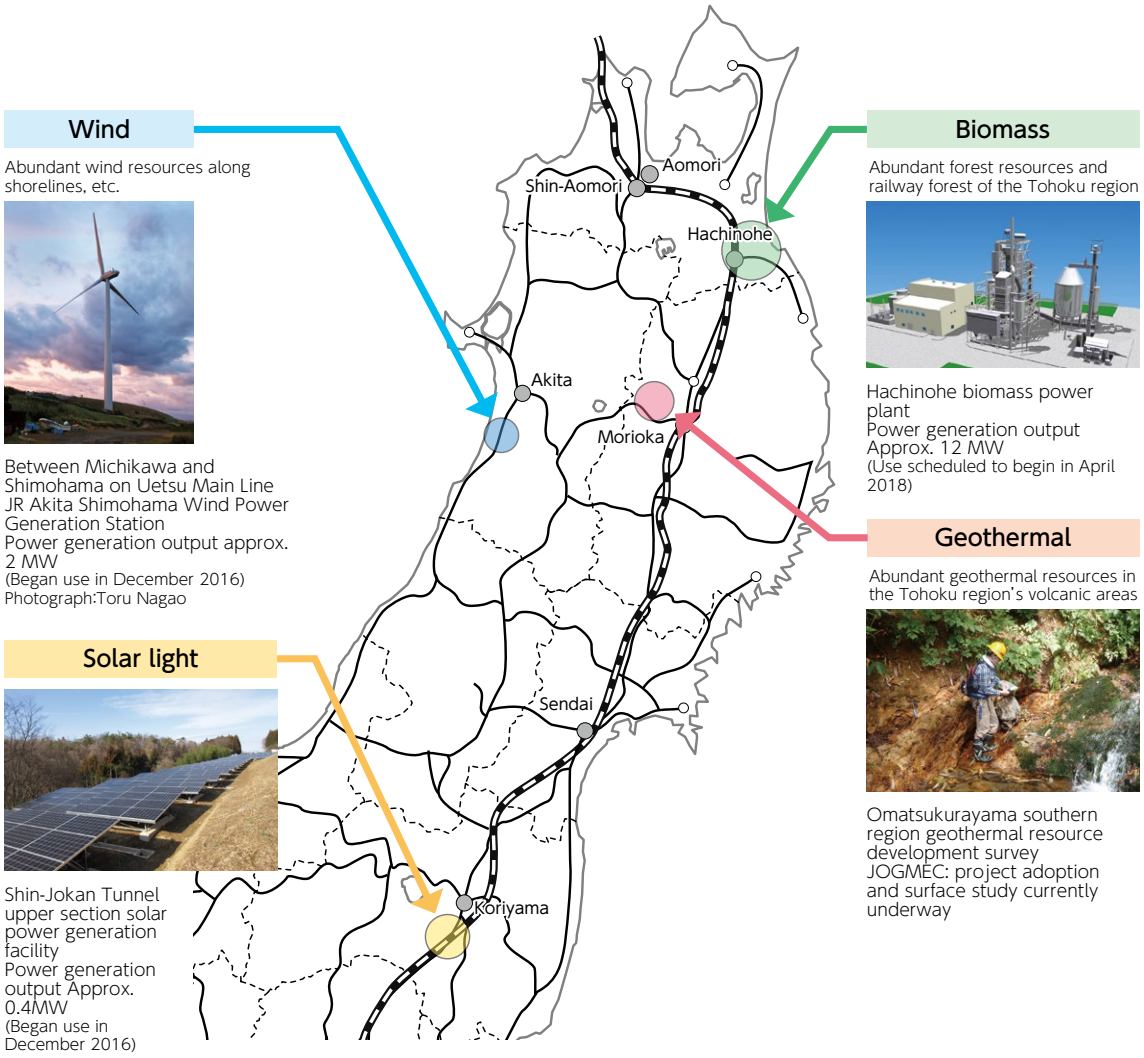
LED lighting in use sticker

[Main railcars on which LED lighting has been introduced]

Model	Line/Area	No. of Train-sets (No. of cars)
E233-series trains	Saikyo Line	31 train-sets (310 cars)
	Yokohama Line	28 train-sets (224 cars)
	Nambu Line	35 train-sets (210 cars)
EV-E301-series trains	Karasuyama Line	4 train-sets (8 cars)
HB-E210-series trains	Senseki-Tohoku Line	8 train-sets (16 cars)
E235-series prototype trains	Yamanote Line	1 train-set (11 cars)
E129-series trains	Niigata area	55 train-sets (160 cars)
E721-1000 series	Tohoku Main Line	19 train-sets (76 cars)
EV-E801-series trains	Oga Line	1 train-set (2 cars)
HB-E300-series (Buna train)	Gono Line	1 train-set (4 cars)
New E5-series trains	Tohoku Shinkansen	5 train-sets (50 cars)
E7-series trains	Hokuriku Shinkansen	19 train-sets (228 cars)

■Progress of introducing renewable energy

We also promote use of renewable energies, including solar and wind power. Solar panels have been installed on our own buildings at stations, rolling stock centers, and elsewhere. In February 2011, we installed 453 kW of solar panels above the entire platform for tracks 9 and 10 at Tokyo Station, which serve Tokaido Line trains.
In February 2014, we began using a 1,050 kW mega-solar facility for the first time at JR East, inside the Keiyo Rolling Stock Center, and the electricity that it generates is being used to reduce costs at the Rolling Stock Center and operate railways via our own distribution lines. As a result of such initiatives, about 1.6 million kWh of the power generated by solar panels in FY2017 was for JR East's own use.
Meanwhile, we are also steadily moving forward with the introduction of mega-solar generation facilities using the feed-in tariff (FIT) scheme. Use of a solar power generation facility began between Tomobe and Uchihara on the Joban Line in February 2015 and in the upper section of the Shin-Jokan Tunnel between Shin-Shirakawa and Koriyama on the Tohoku Shinkansen in December 2016.
Furthermore, in December 2016, we began operation of the JR Akita Shimohama Wind Power Generation Station located on JR East land between Michikawa and Shimohama on the Uetsu Main Line, and we are currently constructing a wood biomass power plant in Hachinohe City with the aim of beginning operation in April 2018. Going forward, we will continue working to introduce and use renewable energy.



■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.
Beginning with Yotsuya Station in March 2012, by July 2017 we had completed the development of nine "Eco-station" model stations as trial stations for the Eco-station concept. Our basic policy in developing these has been to incorporate "Ecomenu" green technologies corresponding to four pillars. By 2020, our goal is to have established 12 Eco-station model stations.
At Musashi-Mizonokuchi Station, which began operation as an Eco-station in April 2017, there are solar panels installed on the station building's roof and an independent hydrogen energy supply system has been introduced that enables operation using only water and sunlight. Based on this, in the event of a disaster, it will be possible to supply power to facilities required to use the station as a temporary shelter by using stored hydrogen to power fuel cells.

[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

Independent hydrogen energy supply system (Musashi-Mizonokuchi Station)

[Established Eco-station model stations (as of July 2017)]

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

TICKET TO TOMORROW

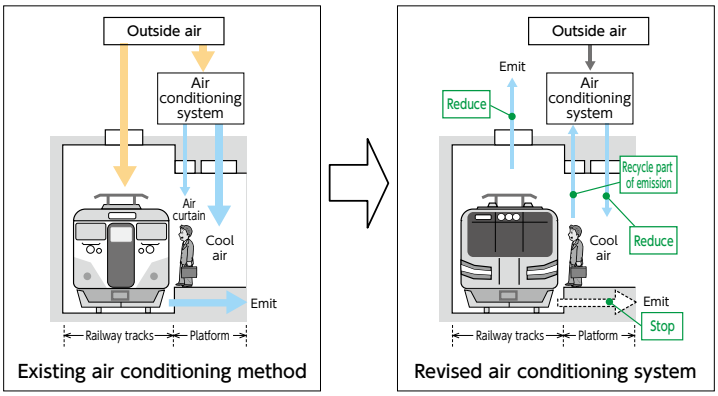
"Hydrogen Eco-Station" Musashi-Mizonokuchi Station

Kouta Asatani
Musashi-Mizonokuchi Station Staff, Yokohama Branch Office

I have worked on making customers "know" and "feel" that Musashi-Mizonokuchi Station is a model "Eco-station." During construction, we posted newsletters on the temporary fences to communicate the overview of "Eco-station" and the changes the station was undergoing. We received a strong response after completion, and the natural wood wall and wall greening, in particular, were favorably accepted by many as they directly project the eco-friendly feel.
Furthermore, as part of the comprehensive partnership agreement concluded with Kawasaki City, we have launched new initiatives with communities, such as having Takatsu-ku of Kawasaki City to include a visit to the hydrogen power generation system site in its eco tours. All of us here will continue to strive to create a station that will be loved by local residents through the "Eco-station" initiative.

■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.
Since Great East Japan Earthquake, we are replacing mainly station platform lighting into LED lighting. In FY2017, we replaced a total of about 7 thousand platform lights with LED lighting and by this replacement, we were able to reduce annual power consumption by about 1.5 million kWh.
The air conditioning system for the Sobu Line underground platform at Tokyo Station 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. With the upgrading of the air conditioning system since 2015, we now recycle and reuse the cooled air to reduce the air conditioning load, which reduces CO_2 emissions by 60% combined with the effects of renewing air conditioning facilities. Similar upgrading work is also under way on underground Keiyo Line platforms at Tokyo Station.



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

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.

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

Example of BEMS screen

■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.
In addition to the JR Kanda Manseibashi Building and JP Tower, JR Shinjuku Miraina Tower, which opened in 2016, has acquired a class S rating as an environmentally friendly and energy-efficient 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.

*LEED (Leadership in Energy and Environmental Design)
An environmental indicator for buildings that is widely used in the U.S. and elsewhere. The JR Kanda Manseibashi Building has two certifications: Gold LEED-CS (Core & Shell) and Gold LEED-C (Commercial Interior).

JR Kanda Manseibashi Building, LEED-certified*, ranked "S," in the CASBEE

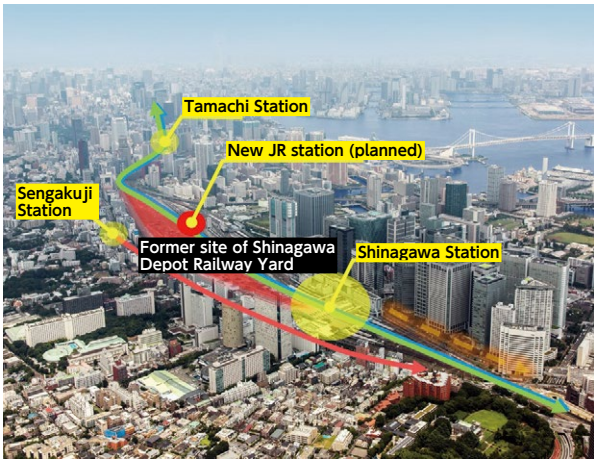
GranTokyo South Tower, recognized as a top-level establishment

Top-level establishment certification presentation ceremony (July 2017)

■Shinagawa Depot Railway Yard Development Project

As part of our efforts to take a leading role in addressing climate change at the global level, the project to develop the former site of Shinagawa Depot Railway Yard, 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 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, 2016, there are 85 participating cities, including Tokyo, which joined in 2006.
*2 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.



■Greening rooftops

We have been promoting the planting of greenery on JR East station and office building rooftops with the aim of reducing the heat island effect and decreasing the need for air conditioning. By taking advantage of its location on a station rooftop, "soradofarm," membership rental farms placed next to the garden, provides services such as agricultural, environmental education and creates local community through vegetable cultivation experiments and earns a positive favorable reputation from many customers. At present, these services are implemented at Shinjuku, Ebisu, Ogikubo, Hachioji, Takasaki and others.
As of the end of March 2017, we had completed 94 greening projects
(including some cases of moss planting) encompassing a combined rooftop area of 34,487 m².

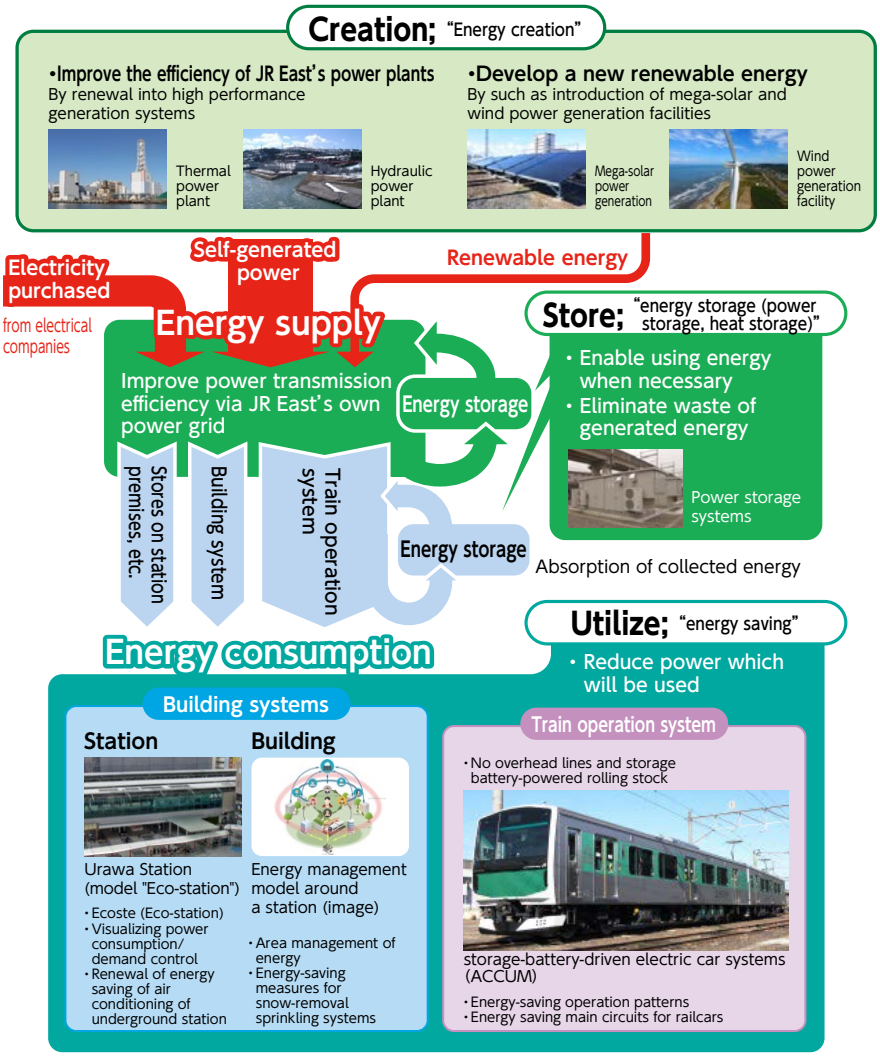
NEWoMan

Rooftop greenery at the Chiba branch building

Takasaki Monterey

■Research and development for reduction of environmental loads

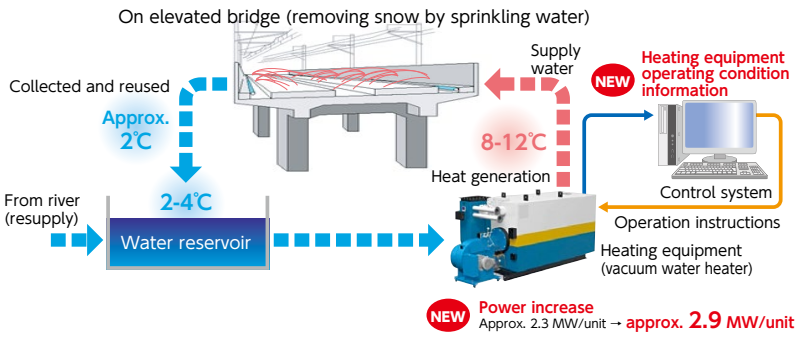
The JR East Group possesses a comprehensive energy network from power generation, transmission, and distribution to usage. We are aiming to establish a railway energy management system that combines these with the creation (energy-creating technology such as mega-solar and wind power generation facilities 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 research and development to save energy 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 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 are therefore developing 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 amount of space, with the aim of reducing fuel consumption by 10%. This fiscal year, we are working to introduce the fruits of our efforts in the field.

[Overview of Snow Removal Sprinkler Equipment and Key Developments]



[Development machine (heating equipment)]