2. Initiatives contributing to the realization of a low-carbon society

- Lowering electric power’s carbon intensity
- Technological developments for constructing the Smart Grid
- Contributing to energy conservation, cost reductions and CO\textsubscript{2} emissions reductions for customers and society
- Overseas activities
- Technical development efforts
- Value chain efforts
- Efforts to reduce other greenhouse gases in addition to CO\textsubscript{2}
Our company joined the Electric Power Council for a Low Carbon Society, and the industry as a whole is seeking to achieve an emission factor of about 0.37 kg-CO$_2$/kWh (user-end) by fiscal 2030.

We will continue the utilization of nuclear power generation with the most emphasis on safety, the maintenance and improvement of the thermal efficiency of thermal power plants, and the development of renewable energies. In addition, with a long-term perspective, we will contribute to the realization of a low carbon society by promoting electrification in society.

### Changes in CO$_2$ emission factor, etc.

Our CO$_2$ emission factor for fiscal 2017 was 0.418 kg- CO$_2$/kWh (after adjustment), and it was great improvement compared to the previous fiscal year. Main factors that we can give are our efforts toward carbon reduction through increased utilization rates for nuclear power, hydroelectric power and, at our Himeji No.2 Power Station, high-efficiency natural gas power generation facilities.
Initiatives contributing to the realization of a low-carbon society

■ Effect of nuclear power generation on CO₂ emission reduction

Nuclear power can greatly contribute to CO₂ emission reduction because it does not emit CO₂ during the generation unlike fuel power which uses fossil fuels such as coal, oil and natural gas.

After the Great East Japan Earthquake (in fiscal 2010), the amount of CO₂ emission and CO₂ emission factor of our company increased significantly due to the increased fuel power generation caused by drastic decline of the capacity factor of nuclear power. CO₂ emission factor has a strong correlation with the capacity factor of nuclear power, which means that CO₂ emission factor increases when capacity factor of nuclear power decreases.

In fiscal 2017, the CO₂ emission factor decreased compared to fiscal 2016 with the resumption of nuclear power plant operation. This indicates how great the effectiveness of nuclear power generation is.

We believe that nuclear power generation putting the most emphasis on safety will continue to be an extremely important from the point of view of energy security, economy, and environment including global warming.

○ Comparisons with values before the Great East Japan Earthquake

<table>
<thead>
<tr>
<th></th>
<th>FY 2010</th>
<th>FY 2016</th>
<th>FY 2017</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ratio of nuclear power generation (%)</td>
<td>78.2</td>
<td>0.0</td>
<td>18.0</td>
</tr>
<tr>
<td>Amount of power from thermal power generation (TWh)</td>
<td>76.6</td>
<td>114.4</td>
<td>89.6</td>
</tr>
<tr>
<td>CO₂ emissions (after adjustment) (10,000 t-CO₂ units)</td>
<td>4,250</td>
<td>5,989</td>
<td>4,822</td>
</tr>
<tr>
<td>CO₂ emission factor (after adjustment) (kg-CO₂/kWh)</td>
<td>0.281</td>
<td>0.493</td>
<td>0.418*</td>
</tr>
</tbody>
</table>

* This value is provisional. Based on the Act on Promotion of Global Warming Countermeasures and other factors, the actual value of the CO₂ emission factor will be officially announced by the national government.
Lowering electric power’s carbon intensity

We are working to reduce the carbon impacts of electricity that we provide to customers, starting with efforts for the operation of nuclear power plants with safety as the first priority. Our efforts also include the maintenance and improvement of the thermal efficiency of thermal power plants as well as the development and popularization of renewable energies.

Nuclear power generation prioritizing safety

Since nuclear power generation emits no CO₂, it is an important source of energy that prevents global warming. With understanding of residents of local communities, we continue the safe and stable operation of plants that have resumed operation and restart plants as soon as the safety is confirmed by appropriately responding to examinations of the Nuclear Regulation Authority. We will also keep independently and continuously promoting safety measures that exceed regulatory requirements.
Initiatives contributing to the realization of a low-carbon society

2. Initiatives contributing to the realization of a low-carbon society

Maintaining and improving the thermal efficiency of thermal power plants and further increasing natural gas use

We continuously undertake measures related to facilities and operation, working to reduce the amount of fuel used and suppress the amount of CO₂ emissions by maintaining and increasing thermal efficiency.

We undertook to convert the Himeji No. 2 Power Station, one of our largest natural gas-fired thermal power plants, to a combined-cycle power plant* with advanced 1,600°C class gas turbines. We are working to suppress the amount of CO₂ emissions by increasing thermal efficiency to about 60%, which is the highest global standard, and reducing the amount of fuel used.

Moreover, at Units 1 and 3 of the Aioi Power Station, in addition to the heavy oil and crude oil we had been using thus far, we began using natural gas, which is less expensive and better for the environment. Unit 1 began in May and Unit 2 began in August 2016.

※Combined cycle power generation: Power is generated by using both gas turbines and steam turbines capturing exhaust heat from the gas turbine with high thermal efficiency.
2. Initiatives contributing to the realization of a low-carbon society

Lowering electric power’s carbon intensity

○ Combined cycle power generation

This method of generating electric power incorporates a gas turbine whose waste heat is reused to drive a steam turbine.

Clean natural gas is burned in a combustor, and the gas turbine is powered by high-temperature combustion gas that, after being discharged from the gas turbine, is efficiently recovered by means of a heat recovery boiler.

Thermal power plant replacement (Himeji No. 2 Power Station example)
Lowering electric power’s carbon intensity

■ Development and promotion of renewable energy

Like nuclear power, renewable forms of energy such as hydropower, solar power, and wind power emit no CO$_2$ when generating power, making them effective energy sources for preventing global warming. As a unified group, we are accelerating efforts toward the target of incorporating 500,000 kW of renewable energy in Japan by 2030.

We have been working to increase the output of existing hydropower plants and to develop power generation using renewable energy sources, including land-based wind, solar and biomass. As of March 2018, we had announced the start of operation for about 110,000 kW of generation capacity. We will continue to work for the development of diverse renewable energy sources, including offshore wind farms and geothermal power plants with a broad view that includes all of Japan as well as overseas locations.

On the other hand, solar and wind power generation are easily affected by the weather, and power generated in excess of demand can have an effect on the quality of electricity. Furthermore, power generation costs become high because energy densities and usage rates of power generation facilities are low. We are working to overcome these issues related to supply stability and generation costs and seeking to expand the utilization of renewable energy sources. We will continue advancing carbon intensity reduction for electricity further by utilizing various energy sources in a well-balanced manner.
2. Initiatives contributing to the realization of a low-carbon society

Lowering electric power’s carbon intensity

- Ratio of renewable energy sources among power generated (amounts generated by our company in fiscal 2017)

![Pie chart showing the ratio of power sources](image)

- Thermal power: 72% (67.8 TWh)
- Nuclear power: 14% (12.9 TWh)
- Renewable energies: 15% (13.8 TWh)

Notes:
- Figures may not match due to rounding up.
- Some unconfirmed imbalances are included.
- Sending ends are included.
- Generated power amounts reflect the composition ratio of our electricity output to demand.
- Renewable energies include hydropower and new energies, for example (wind power, solar, geothermal, biomass and waste).
2. Initiatives contributing to the realization of a low-carbon society

Lowering electric power’s carbon intensity

• Solar power development

In June 2018, Kanden Energy Solution Co., Inc. (Kenes) began operation of the Ako Nishihama Solar Power Station (1,990 kW output) in Ako City, Hyogo Prefecture. Our corporate group has solar power generation plants in a total of ten locations. They effectively reduce CO₂ emissions by a total of about 27,000 tonnes per year.

• Wind power development

In the city of Tahara, Aichi Prefecture, Kenes’ Tahara No. 4 Wind Power Station (6,000 kW [2,000 kW × 3 units]) has been in continuous operation since May 2014. Together with the Awaji Wind Power Station (12,000 kW), our Group operates wind power stations in two locations, which reduce our CO₂ emissions by about 18,000 tonnes/year in total.

• Development of biomass power generation

In December 2016, Kenes began operation of the Asago Biomass Power Plant (5,600 kW output) in Asago City, Hyogo Prefecture. This plant generates power using the biomass of domestic unused wood as a fuel. With the cooperation of the Hyogo Forest Public Service Corporation, the Hyogo Prefectural Federation of Forest Owners Cooperative Associations manufactures the fuel chips and Kenes generates power from these chips. This business scheme conducted with cooperation between government and private interests is the first of its kind in Japan.

In addition, we are planning the construction of a biomass power plant (75,000 kW output) that utilizes materials from overseas in order to advance a biomass power generation project in the town of Kanda in Miyako, Fukuoka. With the intention to start commercial operation in October 2021, we established Biopower Kanda LLC as a new company on November 9, 2017 for the construction of this power plant.

The realization of this biomass project would indicate that our group has the second biomass-fired power plant and it would be our first biomass power plant outside the Kansai area.

Asago Biomass Power Plant

Ako Nishihama Solar Power Station

Tahara No.4 Wind Power Station
Lowering electric power’s carbon intensity

○ Stable operation and functional enhancement of hydropower
Hydropower is a purely domestic energy source with excellent supply stability and economic efficiency. In addition, it emits no CO₂, making it an important energy source for preventing global warming. Kansai Electric Power will continue stable operation of our hydropower plants by carrying out appropriate maintenance, improving the output and efficiency at our existing facilities, promote adoption of an adjustable-speed system at our pumped-storage hydropower plants, and develop small- and mid-scale hydropower generation, with the goals of flexible response to supply and demand fluctuations and further mitigation of our environmental impact.

• Facility upgrades for hydropower plants
We are systematically implementing equipment upgrades, such as water turbine and generator replacement, at existing hydropower plants. When performing these equipment upgrades, we will appropriately determine the best upgrade time frames. By using computerized analytic technologies, we will optimize the shape of the water turbines and other elements to suit each power plant location. This will allow us to replace older equipment with new equipment offering better power generation efficiency, and thus increase our power output.

At the Kurobegawa No. 2 Hydropower Plant in Kurobe City, Toyama Prefecture, we upgraded the facilities of water turbine and generator unit 1 in May 2017, increasing maximum output from 72,000 kW to 72,500 kW. (approximately 365.1 – 376.2 GWh of power generated annually)

• CO₂ reduction through the incorporation of adjustable speed pumped-storage hydropower
At the Okutataragi Hydropower Plant Units 1 and 2, we are introducing pumped-storage systems with variable speed capabilities. This system can respond to demand that fluctuates by small amounts when pumping water up. Doing this will enable us to reduce the operation of thermal power plants, which are responsible for frequency control. This technology has already been adopted at the Okawachi Hydropower Plant Units 3 and 4, which have the largest capacities in the world. Unit 4 began operation in December 1993 and Unit 3 in June 1995.
Initiatives contributing to the realization of a low-carbon society

2. Lowering electric power’s carbon intensity

• Increasing generated power at existing power plants

<Plan overview>

The Sakaigawa Hydropower Plant has been drawing water from the Sakai River. We are promoting a plan to increase water volume at the Sakaigawa Power Station by drawing water from the Kasura River, which is a tributary to the Sho River, to the Sakaigawa Dam located upstream from the Sakaigawa Hydropower Plant with weir on the Kasura River.

The realization of this plan will expand this output by approximately 17 million kWh (equivalent to the power consumed by about 5,400 household demand).

• Efficient utilization of river maintenance flow

As one of Kansai Electric Power's efforts to further reduce its power generation carbon footprint, we constructed the Dashidaira Power Station at our Dashidaira Dam (Unazuki, Toyama Prefecture). This power station uses river maintenance flow discharge to generate a maximum output of 520 kW when it starts operation in November 2015. It protects the scenery and otherwise maintain the river environment downstream. This power station uses this water to generate power.
Technological developments for constructing the Smart Grid

The Kansai Electric Power Group aims for the realization of a low-carbon society and better usability for customers through the construction of a smart grid (next-generation electricity transmission and distribution network).

■ What is the “Smart Grid”?
Our Group has positioned the smart grid as a key to achieving an efficient, high quality, reliable electricity transmission and distribution system, employing advanced information, telecommunications, and storage battery technologies to achieve a low-carbon society and a better energy environment for customers without sacrificing the stability of the basic power grid.

■ Meeting the challenges of large-scale renewable energy use
With large-scale or focused introduction of renewable energy, including solar power, into the electric power grid, the stability of the power grid can be compromised. For this reason, as technology measures for grid facilities, we are advancing systems to evaluate these impacts and research for the development of supply and demand control technologies using advanced voltage control and power storage.

Furthermore, we are undertaking a virtual power plant demonstration project that applies the supply and demand management functionality of a power plant (virtual power plant) to numerous customer devices, including storage batteries and electric vehicles, connected to the power grid by using IoT technologies and controlling them collectively through the Internet. By doing so, we are seeking to optimize energy use and further increase the adoption of renewable energy sources.
2. Initiatives contributing to the realization of a low-carbon society

Technological developments for constructing the Smart Grid

■ Usability improvements for customers

We have completed installing smart meters, which have communication functions and can measure and record the amount of electricity a customer uses every 30 minutes, in factories, office buildings and other customers that receive high-voltage and extra-high-voltage electricity. In addition, we had incorporated 9.32 million units for households and other customers that receive low-voltage electricity by the end of fiscal 2017. We will complete installation for all customers by the end of fiscal 2022 and also continue converting to remote automatic meter reading.

Among the many benefits, installing smart meters contributes to the energy conservation of society as a whole, enables flexible handling of various rate options, makes meter reading work more efficient, and enables formation of efficient facilities according to the conditions of electricity use. Through this endeavor, which leads the nation, we are improving usability for customers by promoting measures that allow them to see their energy use. We are supporting their efforts to conserve energy, cut costs and reduce CO₂ emissions with services such as the Hapi e-Miruden Service (residential), which allows people to see the status of their electricity use, and the Electricity Usage Notification service (business).

Number of smart meters installed (for customers who receive low-voltage power)

![Bar chart showing number of smart meters installed from 2009 to 2022.](image)

Number of smart meters installed (for customers who receive low-voltage power)

- About 9.32 million (About 71% adoption rate)
2. Initiatives contributing to the realization of a low-carbon society

Contributing to energy conservation, cost reductions and CO₂ emissions reductions for customers and society

By enabling customers to use energy efficiently and comfortably, we are contributing to increased energy efficiency, lower costs, and reduced CO₂ emissions for customers and society. We are also promoting energy conservation and CO₂ emissions reductions at our workplaces.

Encouraging efficient energy use

With the goals of realizing energy conservation, cost cutting and CO₂ reduction for our customers and society, we are offering high-efficiency systems that utilize renewable energy sources and heat pump technologies, as well as proposing effective operation procedures, for example. In addition, we are providing total support for energy management to customers and other members of society and undertaking activities that serve these purposes, including the services that allow customers to see energy use.

Serving residential customers

For our residential customers we are proposing “complete electrical conversions” that realize more effective use of energy and comfortable and convenient lifestyles. This is achieved by combining electrical appliances, particularly our EcoCute energy-efficient hot water supplies and “IH cooking heaters” that are safe comfortable and convenient, with our Hapi e-Time discount electricity rate options and Hapi e-Miruden web service that makes electricity use visible.

Moreover, with our Internet-based Hapi e-Miruden service we have established “environmental household account books” in which users can input kerosene charges along with electricity and gas to check their total household CO₂ emissions. On this service we also provide “energy conservation advice” with useful information related to energy conservation. In these ways, we are advancing a variety of efforts that contribute to helping customers conserve energy, cut costs and reduce CO₂ emissions.
Serving corporate customers

We provide our customers with support for total energy management according to customer needs and offer advice regarding optimal energy systems and their application. In addition, we work with other Group companies to offer a range of services including energy conservation diagnoses and energy management support appropriate to the customer’s facility usage patterns. We remain committed to helping our customers minimize their energy consumption, achieve cost savings, and reduce their CO₂ emissions.
2. Initiatives contributing to the realization of a low-carbon society

Contributing to energy conservation, cost reductions and CO₂ emissions reductions for customers and society

■ Energy conservation and CO₂ emissions reductions at our workplaces

○ Energy management at business branches

We have currently implemented energy management for 89 business locations. At various small and large buildings, we are undertaking rational control by utilizing energy management systems suited to building characteristics.

We have been employing energy management measures at 20 business locations since fiscal 2007. In our efforts, we measure the amount of electricity used by application and by time period for buildings in order to investigate and implement effective energy conservation means.

### Primary energy consumption intensity at business branches employing energy management system

<table>
<thead>
<tr>
<th>Year</th>
<th>Primary energy consumption intensity (MJ/m² • yr)</th>
<th>Ratio (compared with FY 2006) (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006</td>
<td>2,927</td>
<td>100.0</td>
</tr>
<tr>
<td>2007</td>
<td>2,844</td>
<td>97.2</td>
</tr>
<tr>
<td>2008</td>
<td>2,833</td>
<td>96.8</td>
</tr>
<tr>
<td>2009</td>
<td>2,596</td>
<td>88.7</td>
</tr>
<tr>
<td>2010</td>
<td>2,448</td>
<td>83.6</td>
</tr>
<tr>
<td>2011</td>
<td>1,894</td>
<td>64.7</td>
</tr>
<tr>
<td>2012</td>
<td>1,608</td>
<td>55.0</td>
</tr>
<tr>
<td>2013</td>
<td>1,483</td>
<td>50.7</td>
</tr>
<tr>
<td>2014</td>
<td>1,435</td>
<td>49.0</td>
</tr>
<tr>
<td>2015</td>
<td>1,360</td>
<td>46.5</td>
</tr>
<tr>
<td>2016</td>
<td>1,331</td>
<td>45.6</td>
</tr>
<tr>
<td>2017</td>
<td>1,326</td>
<td>45.3</td>
</tr>
<tr>
<td>2018</td>
<td></td>
<td>40.0</td>
</tr>
</tbody>
</table>

Notes:
- Electricity consumption is corrected for air temperature.
- From FY 2011 to 2015, the reduction achieved through energy conservation is included.
- 20 business locations employing energy management, as of March 2018
Contributing to energy conservation, cost reductions and CO₂ emissions reductions for customers and society

・KEPCO Building (headquarters)

Received “10 Year Award” from the Society of Heating, Air-Conditioning and Sanitary Engineers of Japan

In May 2016, our continuous efforts to improve the energy performance and operation of our headquarters building in the 10 years since construction was completed received high evaluation. The energy consumption in the 10th year was about 32 percent less than in the year of completion, achieving energy conservation comparable to a new building. Our headquarters building was also recognized as the first “Building with High Energy Conservation Performance” in the “Osaka Prefecture Energy Conservation Level Determination System”.

・Kansai Electric Power Hospital

Winner of the Director General of the Agency for Natural Resources and Energy Prize of the 2016 Energy Conservation Grand Prizes

In January 2017, the Kansai Electric Power Hospital received this prize because of high evaluations of its design with thorough energy conservation in its 2015 rebuilding and approaches taken in energy conservation since completion. We succeeded in reducing the amount of primary energy consumption by floor area 37% compared to conventional large-scale hospitals.

In addition, the Kansai Electric Power Hospital also received the Osaka City Mayoral Award of the 2016 Osaka Environmentally Friendly Architecture Awards in December 2016.
Contributing to energy conservation, cost reductions and CO₂ emissions reductions for customers and society

- **Kansai Electric Power Company Minami Osaka Sales Branch Office**

- Received 31st Technology Encouragement Award from the Society of Heating, Air-Conditioning and Sanitary Engineers of Japan in May 2017.

- Received a 6th Carbon Neutral Award Branch honorable Mention in May 2018.

The Minami Osaka Sales Branch Office received 31st Technology Encouragement Award from the Society of Heating, Air-Conditioning and Sanitary Engineers of Japan in May 2017, having been highly evaluated for its continuous energy conservation efforts through very efficient air-conditioning operation as a result of realizing its own control system and conducting performance evaluation meetings. They were able to reduce primary energy consumption intensity by about 52% compared to the target at the time of design, realizing environmental performance appropriate for a “next-generation sales office that is good for the environment and people.

Status of energy efficiency management and systems incorporation in real estate

<table>
<thead>
<tr>
<th>Building scare</th>
<th>Number of offices</th>
<th>Energy consumption ratio</th>
<th>Management methods</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large offices</td>
<td>6000〜10000㎡</td>
<td>14</td>
<td>60%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Make visible the status of energy use by utilizing existing central monitoring data</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Analyze and evaluate various types of data and make corresponding improvements led by building manager</td>
</tr>
<tr>
<td>Medium offices</td>
<td>1500〜8500㎡</td>
<td>20</td>
<td>17%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Install power use meters (about 30〜100 points)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Make visible the status of energy use in real-time</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Analyze and evaluate power measurement data and make improvements by architectural engineer</td>
</tr>
<tr>
<td>Small offices</td>
<td>400〜6000㎡</td>
<td>55</td>
<td>23%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Visualization of electricity meter leading value on corporate-wide portal site</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Throughout the company share examples of energy conservation achieved at medium offices</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Conduct energy conservation walk-throughs investigation</td>
</tr>
</tbody>
</table>
Overseas activities

We have been implementing a wide range of initiatives outside Japan in an effort to devise solutions to global issues including environmental problems by utilizing our technical expertise, knowledge, and know-how we have cultivated over the years of our experienced operation as an electric power utility.

Nam Ngiep 1 Hydropower Project
Lao People’s Democratic Republic

On the Nam Ngiep River, the tributary of the Mekong River which forms the boundary between Laos and Thailand, we are constructing power stations in two locations with a capacity of 272 MW (Main Power Station) and 180 MW (Re-Regulation Power Station). With a height of 167 m and width of 530 m, the Main Dam is as large as the Kurobe Dam. This is a BOT* project with 27-year concession period, after which the ownership will be transferred to the Lao Government.

We began investigations for the Nam Ngiep 1 Hydropower Project in 2004 as a leading development company. This is the first overseas project in which Kansai Electric took the largest shareholder’s position. In 2013, we established the Nam Ngiep 1 Power Company together with EGAT International (Thailand) and the Lao Holding State Enterprise. Main construction work started in October 2014 and in April 2016, placing concrete for the dam began. The reservoir impounding began in May 2017 at the Re-Regulation Dam and May 2018 at the Main Dam. Commercial operation is scheduled to begin in 2019.

Utilizing our experience as an electric power business in Japan, we are responsible for engineering and work progress and quality control for the entire construction project. We have issued orders for the main construction work, which has been divided into civil engineering, electrical-mechanical, hydro-mechanical and other categories, and we have contracted with Japanese companies that have high levels of engineering capabilities. The construction of the dam, installation of the power generation equipment and other facilities are advancing under the supervision, primarily led by employees dispatched from our company. By undertaking the project in an “ALL JAPAN” organization and widely communicating its advantages, we believe that we can contribute to the expanded export of quality Japanese infrastructure.

* Build-operate-transfer (BOT) is a type of project arrangement whereby a project company builds a facility and manages and operates it for a certain period to recover its investment, after which it transfers ownership of the facility to the public sector / authority.
Overseas activities

■ Rajamandala Hydroelectric Power Project
Republic of Indonesia

We are constructing a run-of-river hydroelectric power plant with a capacity of 47 MW, located on the Citarum River, in Java Island, the Republic of Indonesia (commercial operation scheduled in 2019). This is a BOT* project which will sell electricity to the PT Perusahaan Listrik Negara (state electricity company of Indonesia) utilizing the water released from an upstream hydroelectric power plant** operated by a local power company.

While this project is designed to make profit for Kansai Electric Power, it is also supposed to contribute to the development of Indonesia where power demand is growing remarkably. We will be able to supply affordable and low carbon electricity in a stable manner over the long term.

* Build–operate–transfer (BOT) is a type of project arrangement whereby a project company builds a facility and manages and operates it for a certain period to recover its investment, after which it transfers ownership of the facility to the public sector / authority.
** Saguling Hydroelectric Power Plant (700 MW) owned by PT Indonesia Power (100% subsidiary of PLN)
Overseas activities

- Contributing to the development of renewable energy sources

Our company is setting up infrastructure and working to reduce global environmental impacts by participating in GSEP* efforts, including micro hydroelectric power generation in the Kingdom of Bhutan, solar power generation at Tsubaru, and the Dhiffushi Solar Ice Project (DSIP) in the Republic of Maldives.

On Dhiffushi Island, in order to balance the amount of power generated by solar and the amount of electricity used, an ice machine was installed instead of a storage battery. This ice is provided for the fishing business, which is a principal industry on the island. This has received great attention as a replicated model project that could be developed on other islands and in other countries. Our company has also worked to promote it publicly. We will monitor the project for five years in order to confirm that, for example, the equipment we transferred stays in good condition and that the power system is stabilized. Through this effort we expect that about 50 tonnes of CO₂ can be reduced per year.

※ GSEP : GSEP stands for “Global Sustainable Electricity Partnership.” Comprised of nine major electric power companies from seven countries, including Japan, the USA and France, in this organization leaders from each company exchange ideas about the development of sustainable energy sources, climate change problems and other global issues related to the electric power business as a whole.

Energy Globe Award received

The DSIP was selected as the most outstanding project in the Republic of Maldives in the Energy Globe Awards (2017), which is given to excellent environmental projects around the world. This project was highly evaluated for the reasons that include the economic benefits brought by the ice machine to the local community and residents, the fact that no waste is generated by a storage battery for storing excess power and that the project could easily be reproduced on other islands.
Overseas activities

■ Workshops held in Pacific island nations

As part of GSEP*, we have been holding 14 workshops since 2005 for the Pacific Power Association. The past topics are “Grid interconnection of renewable energies,” “Tariff Structure” and so on.

In 2017, we offered lectures titled “Renewable energy grid connections” in Fiji (March) and in Guam (June) respectively. In addition to explaining issues related to the massive installation of renewable energy sources and the measures for handling them, we also introduced our latest efforts and countermeasures of our company such as the “Apollon” solar power short-term forecasting system, smart grids and demand side management etc.

In these ways, our company is contributing to the resolution of global environmental problems through technology transfers and personnel cultivation programs related to the various issues faced by island nations.

All participants visited a solar power plant on Guam.

Our employees enthusiastically answered questions from each of the participants.
Technical development efforts

By making use of our specialized technical capabilities as an electric company, we are contributing to the emergence of a low-carbon society using our technological breakthroughs.

■ Apollon solar power short-time forecasting system

In preparation for the high-volume adoption of solar power generation, which varies in output according to the weather, we developed the Apollon solar power short-time forecasting system together with the Meteorological Engineering Center, Inc. from fiscal 2012–2014. The Apollon system analyzes the characteristics of clouds from cloud images captured by weather satellites and estimates the solar radiation strength on the Earth’s surface (Figure 1). In addition, it predicts the movement of clouds by analyzing changes in clouds over time shown in weather satellite images (Figure 2) and predicts the amount solar radiation in three-minute intervals for 1 km grid units up to 3 1/2 hours ahead. By utilizing predicted solar radiation amounts, fluctuations in solar power generation output can be predicted in advance, allowing stable control of supply and demand. In this way, our company is contributing to the popularization of solar power, and seeking to build a low-carbon society.
2. Initiatives contributing to the realization of a low-carbon society

Technical development efforts

- Joint development of hot wind generator using high-efficiency air to air heat pump

To respond to the needs for the promotion of energy saving in drying processes in industrial fields, we jointly developed* “Neppu-ton,” a hot wind generator using a high-efficiency air-source heat pump. Mitsubishi Heavy Industries Thermal Systems, Ltd. started sales of it in June 2017.

As with general air conditioners, it has a separate-type configuration comprised of an outdoor unit that takes in heat from the atmosphere and an indoor unit that can directly generate hot wind. It generates hot wind of 90°C, which is the highest-temperature hot wind provided by an air-source heat pump in Japan, and has achieved a high-efficiency of a COP of 3.5**, realizing great reductions in energy use, cost and CO₂ emissions.

We received the Energy Conservation Center Chairman’s Award of the Energy Conservation Grand Prizes (products and business models division) for fiscal 2017.

** Coefficient Of Performance (COP) indicates the energy consumption efficiency of a heat generator
2. Initiatives contributing to the realization of a low-carbon society

Value chain efforts

We are working to introduce and utilize high-efficiency LNG vessels.

Fuel value chain

We are advancing the introduction of LNG vessels with excellent energy conservation performance. Following the LNG EBISU, the LNG JUROJIN and the LNG FUKUROKUJU, which are already in service, we completed the LNG SAKURA in fiscal 2017.

The LNG FUKUROKUJU adopts a new type of steam turbine that reuses the steam once used by reheating them. It achieves 25% reduction of fuel consumption compared to conventional steam turbine.

The LNG SAKURA has Dual Fuel Diesel Engine system for power. We hope to achieve outstanding fuel economy compared to conventional steam turbine systems.

By utilizing the latest thermal insulation systems, they achieve an LNG evaporation rate of 0.08% per day, which is the lowest level in the world, making them outstanding in terms of both environmental and economic performance.
Efforts to reduce other greenhouse gases in addition to CO₂

We are working to suppress SF₆ gas emissions.

**Suppression of SF₆ gas emissions**

SF₆ (sulfur hexafluoride) gas, which is used to fill gas circuit breakers (GCB) because of its high-insulation performance and other merits, is a greenhouse gas that is subject to reduction by the Kyoto Protocol.

To prevent the atmospheric emission of SF₆ gas during internal inspection and removal of GCBs, we are recovering almost all SF₆ gas using recovery equipment before such work.

<table>
<thead>
<tr>
<th>Recovery rate upon inspections</th>
<th>Calendar year</th>
<th>Recovery rate upon removal</th>
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<tbody>
<tr>
<td>99.2%</td>
<td>CY 2012</td>
<td>99.4%</td>
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<tr>
<td>99.1%</td>
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</tr>
<tr>
<td>98.8%</td>
<td>CY 2014</td>
<td>99.5%</td>
</tr>
<tr>
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<td>CY 2015</td>
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</tr>
<tr>
<td>99.3%</td>
<td>CY 2016</td>
<td>99.6%</td>
</tr>
<tr>
<td>99.6%</td>
<td>CY 2017</td>
<td>99.3%</td>
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