Kyuden Group Carbon Neutral Vision 2050

-Starting from Kyushu, the Kyuden Group will lead the way to Japan's decarbonization-

April 28, 2021

Kyushu Electric Power Co., Inc.

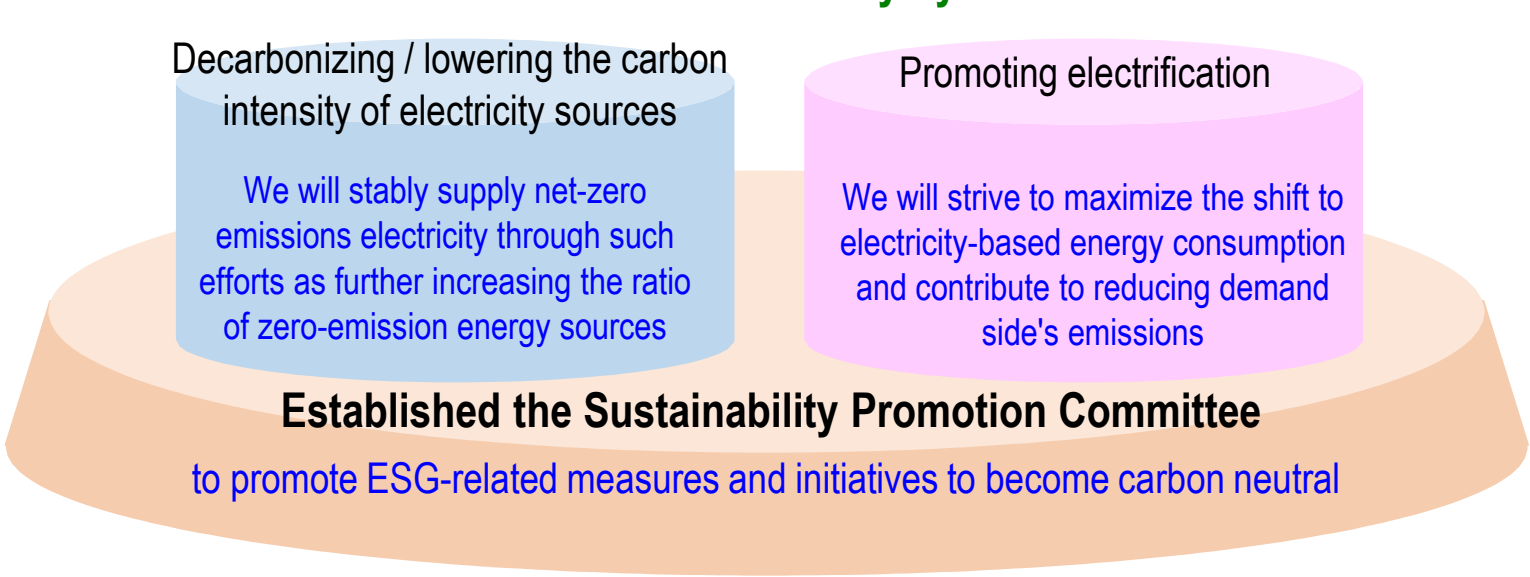
Kyuden Group Will Endeavor to Achieve Carbon Neutrality by 2050

Starting from Kyushu, the Kyuden Group will lead the way to Japan's decarbonization

- Seeing responses to global warming as an opportunity for corporate growth, Kyuden Group will—as a **frontrunner in carbon-reduction/decarbonization efforts**—aspire to serve as an **enterprise group that spearheads Japan's decarbonization initiatives from Kyushu**.

- We will continuously work on "**decarbonizing / lowering the carbon intensity of energy sources"** and "**promoting electrification ".** We consider these as fundamental strategies for clean energy supply and demand.

- A new **Sustainability Promotion Committee**, which is chaired by the president, will promote ESG-related measures and initiatives for becoming carbon neutral.



The road to Carbon Neutrality as envisioned by the Kyuden Group

Decarbonizing/lowering the carbon intensity of energy sources (Supply side)

Promoting electrification (Demand side)

Renewables + Storage

Main energy source ➡ P6

-Promote development of renewables

-Control technology of integrated distributed energy resources

Solar

Wind

Hydro

Geothermal

Battery / Pumped-storage

Nuclear

Maximize use ➡ P7

-Improve capacity factor

-Research next-generation light water reactors, small modular reactors (SMRs), and high-temperature gas-cooled reactors (HTGRs)

-Research hydrogen production

Thermal & New Technology

Net-zero emissions

-Achieve higher efficiency ➡ P13

-Research hydrogen / ammonia production and co-firing

-Research applying CCUS* / carbon recycling technology

CCUS*/carbon recycling

CO_2

Biomass

* Carbon dioxide Capture, Utilization and Storage

Electricity

Heat

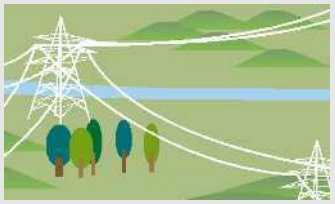
Electricity sourced from non-fossil fuel

Grid

Upgrade transmission/ distribution network ➡P9

-Wide-area operation of power transmission & distribution networks

-Enhance supply-demand balance and grid-stabilizing technology



Electricity

Hydrogen

Procure

To go electric across sectors

Maximize electrification ➡ P11

-Promote all-electric homes and electrification of equipment such as air conditioning, hot-water supply, kitchen appliances for commercial facilities (household & business)

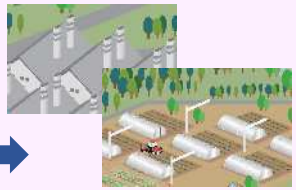
-Technological research on energy conversion equipment; promote electrification for heat demand of various temperature ranges (industry)

-Provide services or businesses to promote EVs (transport)

-Research business potential of hydrogen supply, etc.

Household & business

Industry



Transport

Local power sources

Together with local communities create a zero-carbon society ➡ P13

-Contribute to the development of regional energy systems

-Value adding developments to urban and rural areas

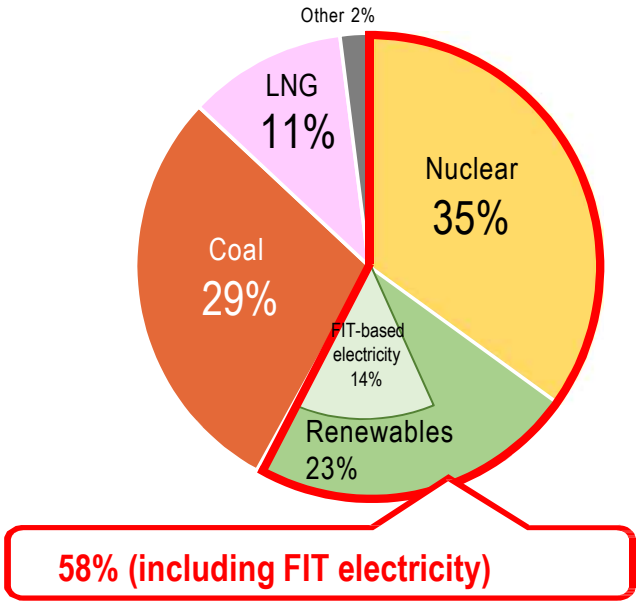
Decarbonizing / Lowering the Carbon Intensity of Energy Sources (supply side)

A stable supply of net-zero emission electricity by expanding the ratio of zero-carbon energy sources

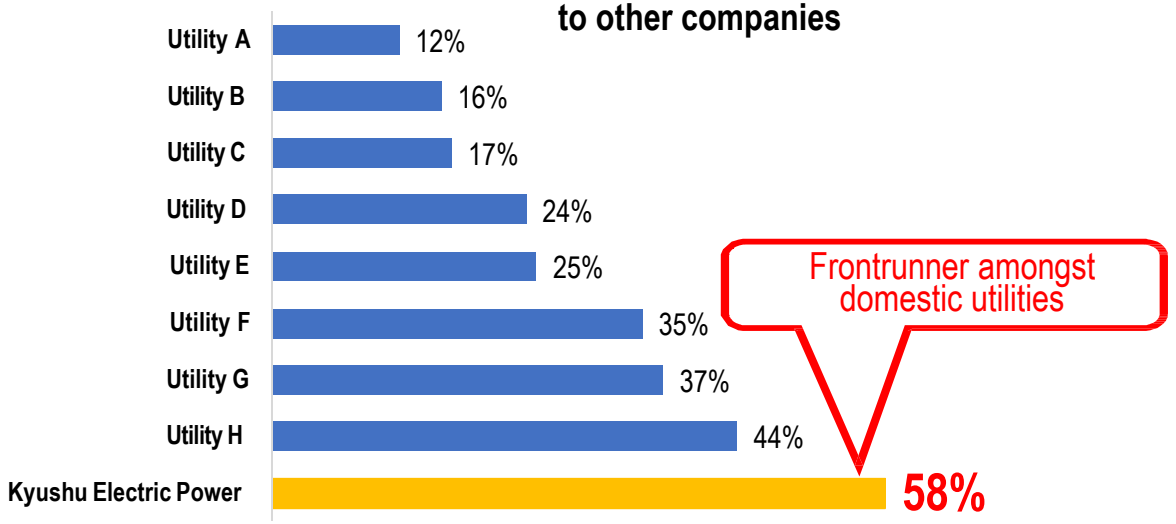
- We are **leading domestic firms** with a **roughly 60% zero-emission/FIT energy source ratio*** (FY2019), by expanding the introduction of renewables and safe, stable nuclear power generation.

Total investment made over the past five years (FY2016–2020): Approximately ¥800 billion

Our zero-emission/FIT power source ratio* (FY2019)



Zero-emission/FIT power source ratio* compared to other companies



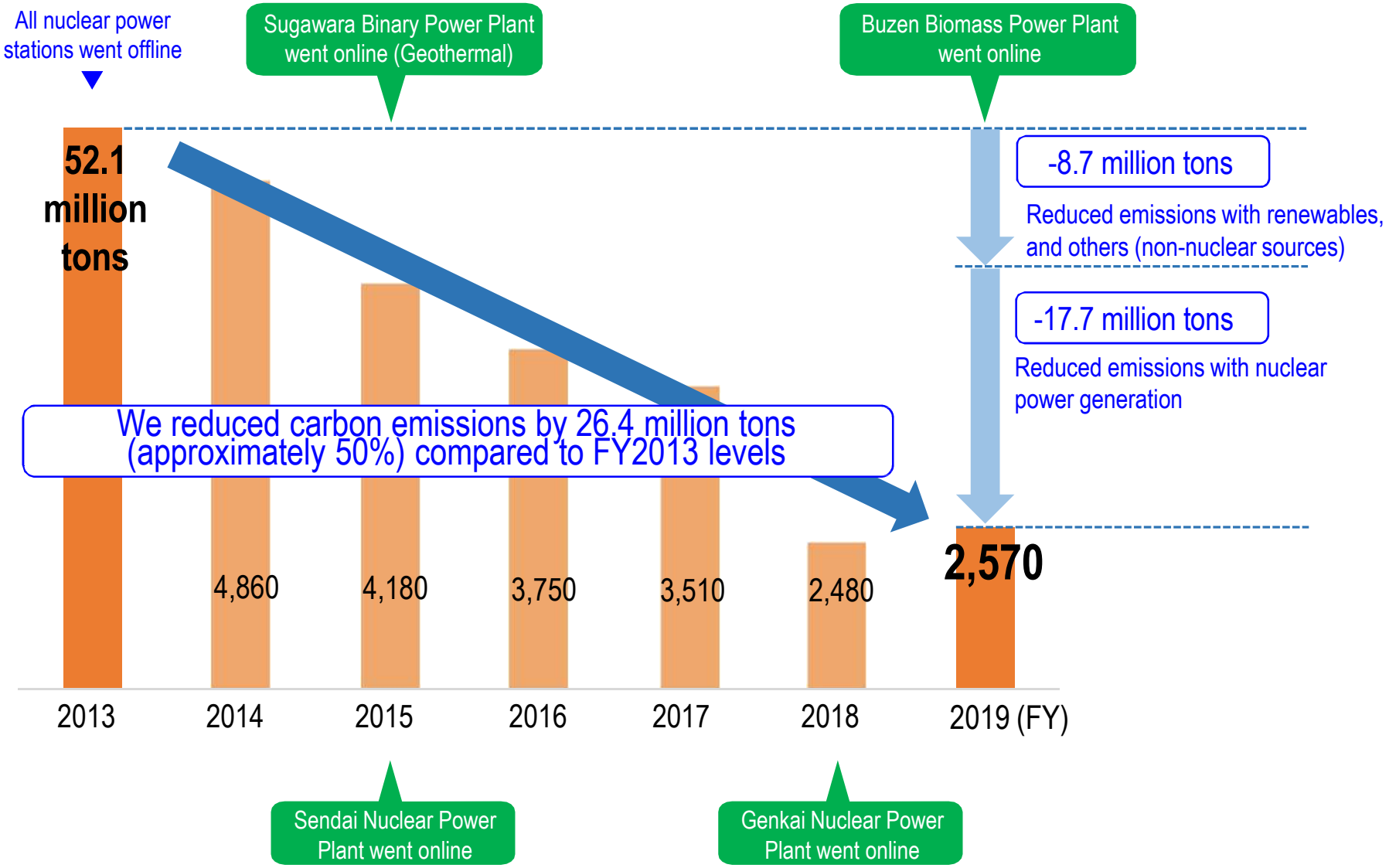
(Source) Data derived from each company's website
- Comparison with eight major utilities in Japan
- FY2019 results

* If a non-fossil fuel certificate is unavailable, FIT power is considered neither as renewable energy nor as a source of zero carbon-emission energy but is treated as a form of electricity that emits Japan's national average level of carbon emissions, consisting of thermal and other energy sources.
Some 8% of the non-fossil value based on FIT energy sources (numbers in the achievement plan for the Act on Sophisticated Methods of Energy Supply Structures) are attributed to us. The calculation is based on the quantity of electricity we generated and procured from other companies (outlying islands are excluded).

An overview of CO2 Emissions

≪Reference material≫

- The Japanese government aims for a 46% reduction (compared to FY2013) in greenhouse gas emissions by FY2030. We have already **nearly halved our carbon emissions (FY2019 results)**.



Decarbonizing / Lowering the Carbon Intensity of Energy Sources (supply side)

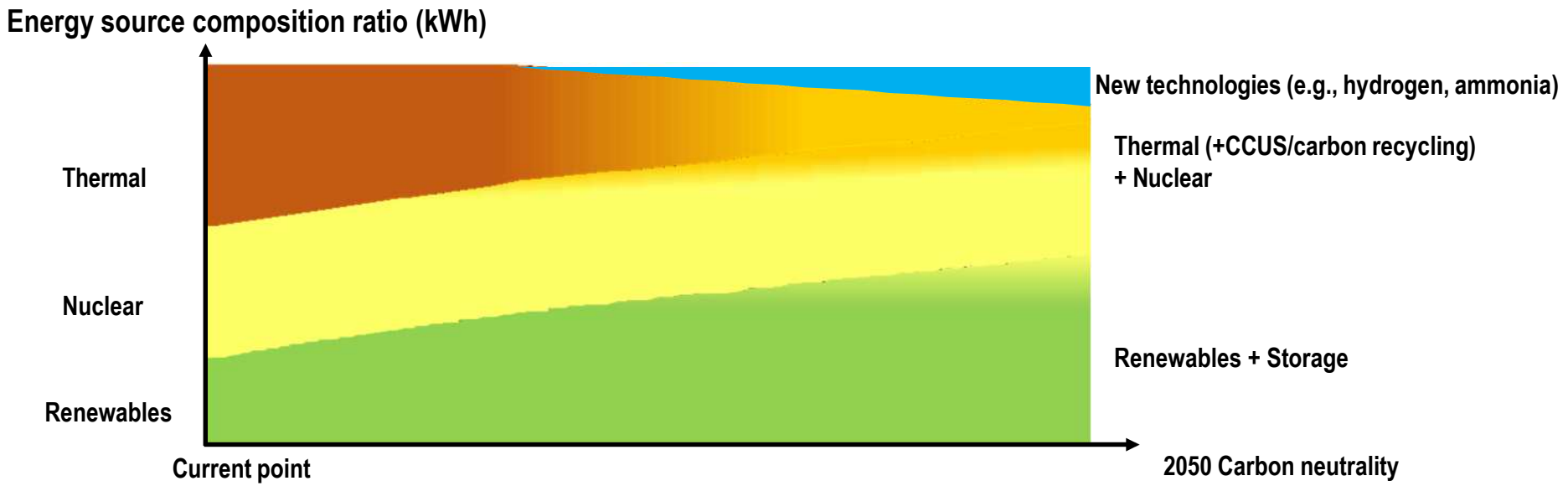
- **We will aim to further decarbonize energy sources** by expanding the ratio of zero-carbon energy sources.

Total investment for the coming five years (FY2021–2025): approximately ¥500 billion

Primary efforts

- **Making renewables a main energy source** and as a Group promote the development of renewables
- In dialogue with local communities and prioritizing safety, we will make maximize the **use of nuclear power**
- **Achieving net-zero emissions in thermal power** by further streamlining thermal power generation and adopting new technologies (e.g., hydrogen, ammonia)

Example of decarbonization/ lowering of the carbon intensity of energy sources



Renewables as a Main Energy Source

Renewables + Storage

- In addition to developing **geothermal** and **hydropower generation —**one of the strengths of the Kyuden Group**—** we will promote the development of **offshore wind energy**, which has great potential, and **biomass energy**.
  [target renewable energy development in and outside Japan: 4,000MW by 2025; 5,000MW by 2030]
- By using flexibility sources like thermal power generation and storage, such as pumped-storage, we will contribute to adopting renewables to the fullest extent possible.
- We will establish a **control technology for integrated distributed energy resources**, which includes former FIT energy sources of which the FIT-based purchase term has expired and EV, and accordingly roll out an Aggregation Business.

Renewable energy development (as of end of FY2020)

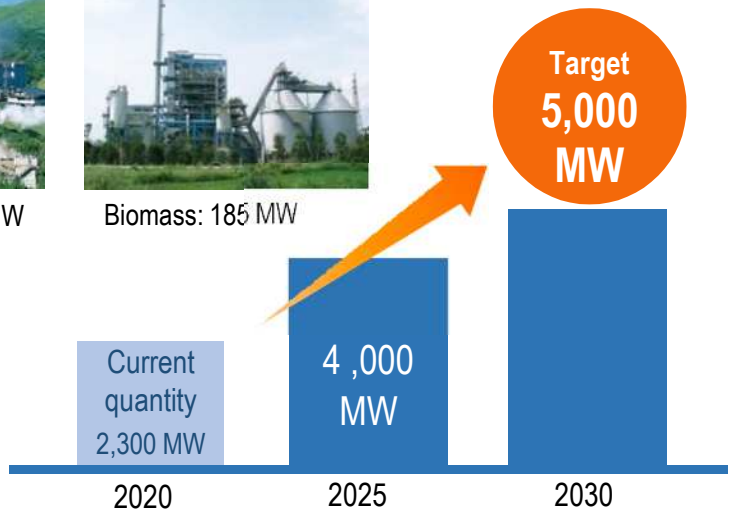
Solar: 94 MW

Wind: 179 MW

Hydro: 1,286 MW
(Excluding pumped-storage hydropower)

Geothermal: 553 MW

Biomass: 185 MW

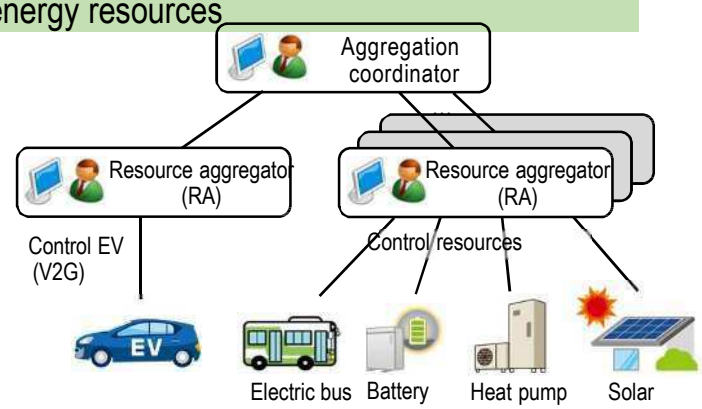


Hibiki-nada Offshore Wind Power Generation
(Images are examples of development)

Image source: City of Kitakyushu

Photo source: Vestas Offshore Wind A/S

Control technology for integrated distributed energy resources



Maximizing the Use of Nuclear

Nuclear

- Nuclear power is a stable source of energy that features high energy density, **emits no CO_2 while generating electricity**, and is unaffected by weather or climate*1.
- In dialogue with local communities and prioritizing safety, we will maximize **the use of nuclear power**, by **enhancing the capacity factor** of existing reactors.
- We will consider using advanced reactors that offer high levels of safety, including **next-generation light water reactors**, **SMRs***2, and **HTGRs**, as well as leveraging nuclear energy to **produce hydrogen**.

*1 The high-level radioactive waste from fuel reprocessing is planned for final storage in stable, deep underground strata.

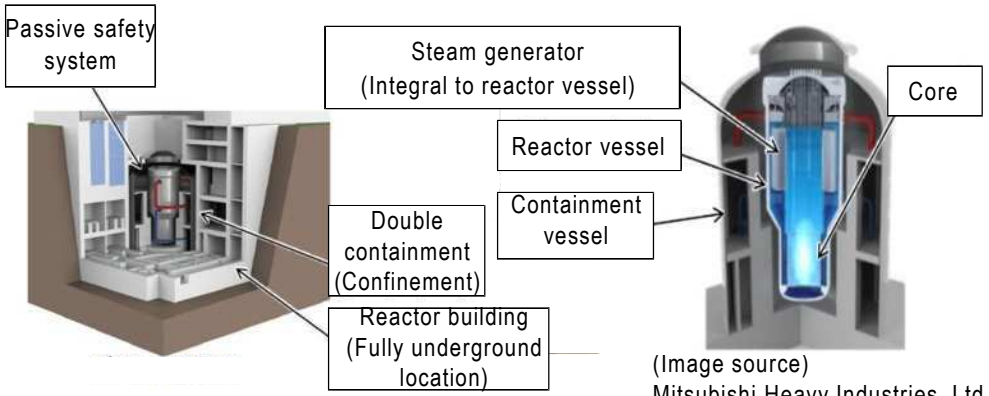
*2 Small Modular Reactors

SMRs

-Features passive safety system that does not require external energy sources in the event of an accident
-Features reactor with integral steam generator and natural circulation for core cooling combined ➡Theoretically, this eliminates the possibility of loss of coolant and other accidents

Bird's eye view of plant

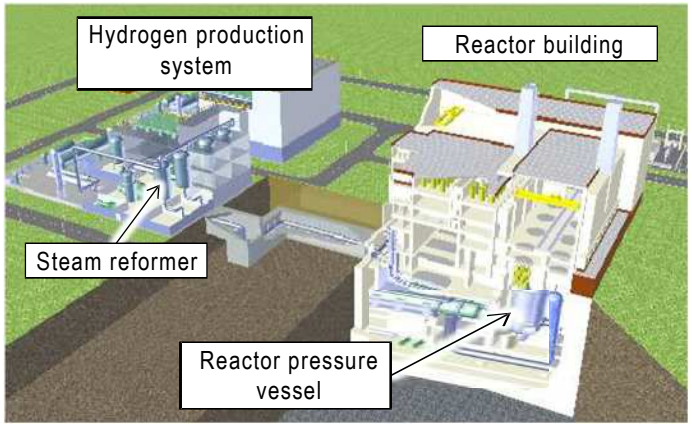
Overview of reactor



(Image source)
Mitsubishi Heavy Industries, Ltd.

HTGRs + Hydrogen production (Example)

-Uses highly heat-resistant graphite core/ceramic-coated fuel, and helium gas coolant that is stable at high temperatures
➡ The heat can be used in non-power generation sectors, such as hydrogen production
-Can cool the core with natural circulation of outside air and heat discharge
➡ Loss of coolant will not damage core



(Image source) Mitsubishi Heavy Industries, Ltd.

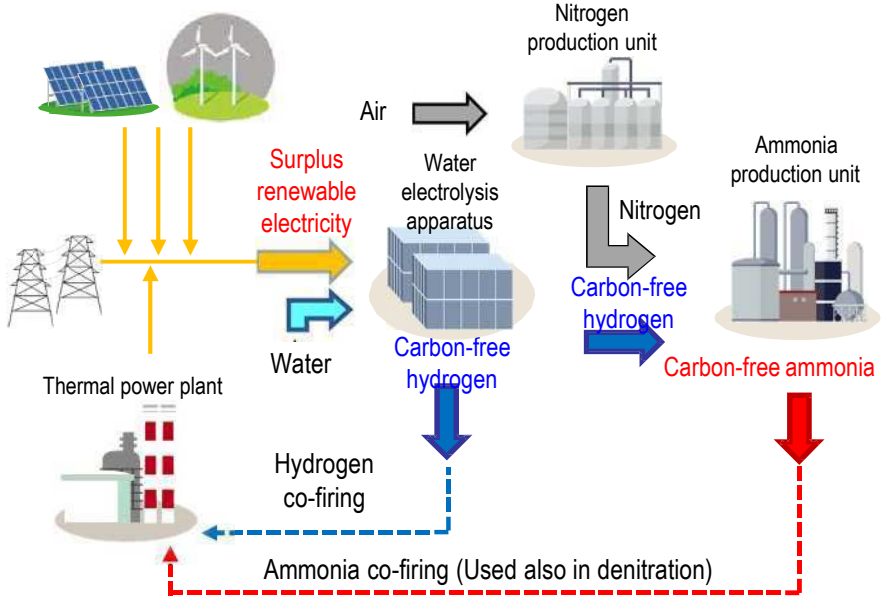
Net-zero Thermal Emissions

Thermal & New Technology

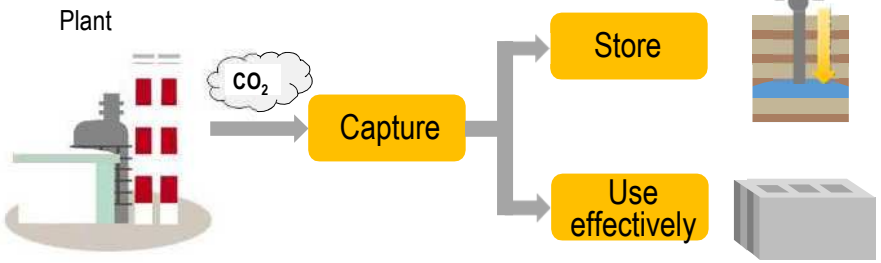
- Continue to further improve the efficiency of thermal power generation.
- We intend to phase out inefficient coal-fired power by 2030, factoring in supply capacity, supply cost, and circumstances of communities where coal-fired plants are located.
- Study the production and co-firing of carbon-free hydrogen and ammonia using surplus electricity from renewable energy sources. In the future, we will aim to increase the co-firing rate and shift to single-fuel firing. In addition, we will study the establishment of a supply chain for hydrogen and ammonia procurement.
- Adopting **CCUS*/carbon recycling** technologies, as well as using **forest carbon sinks** and carbon credits.

* Carbon dioxide Capture, Utilization and Storage

Hydrogen/Ammonia production and co-firing



CCUS/Carbon recycling



Forest carbon sink (Kyushu Rinsan: Kyuden Group)

Carbon absorption by proper forestry

- Forest area owned by Kyushu Electric: 4,447ha
  (630 times the size of PayPay Dome, a baseball field in Fukuoka)
- Number of trees managed (as of late FY2019): 4.21 million (Only artificial forests)
- Quantity of carbon fixation (FY2019): 1.295 million tons [Contribution to achieving carbon neutrality]

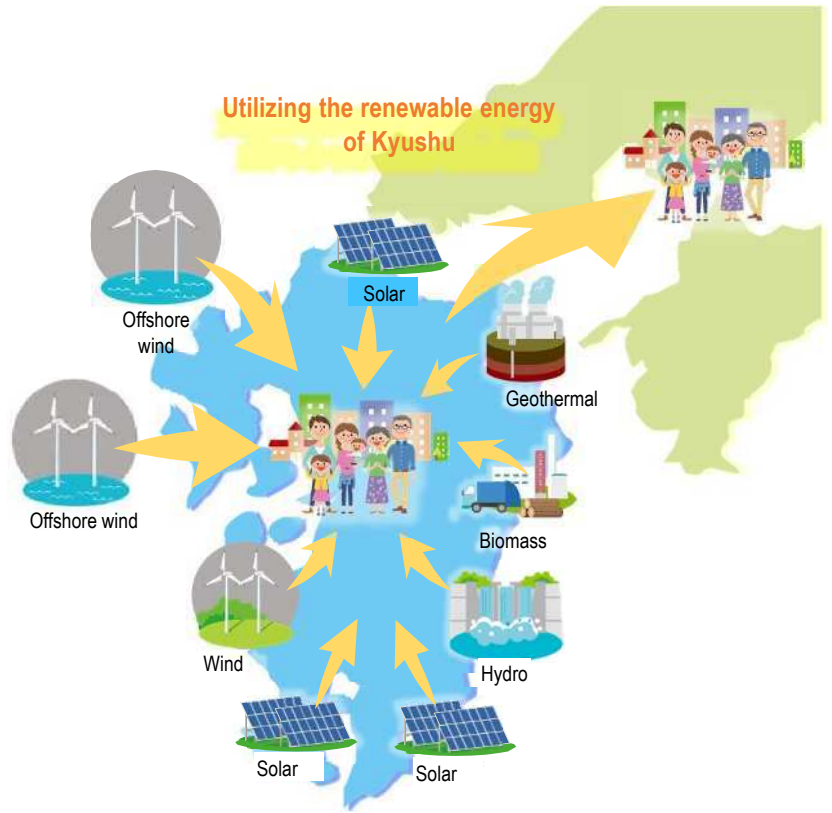
Company-owned forest (Yamashita-ike forest in Oita Prefecture)

Upgrading the Transmission & Distribution Network

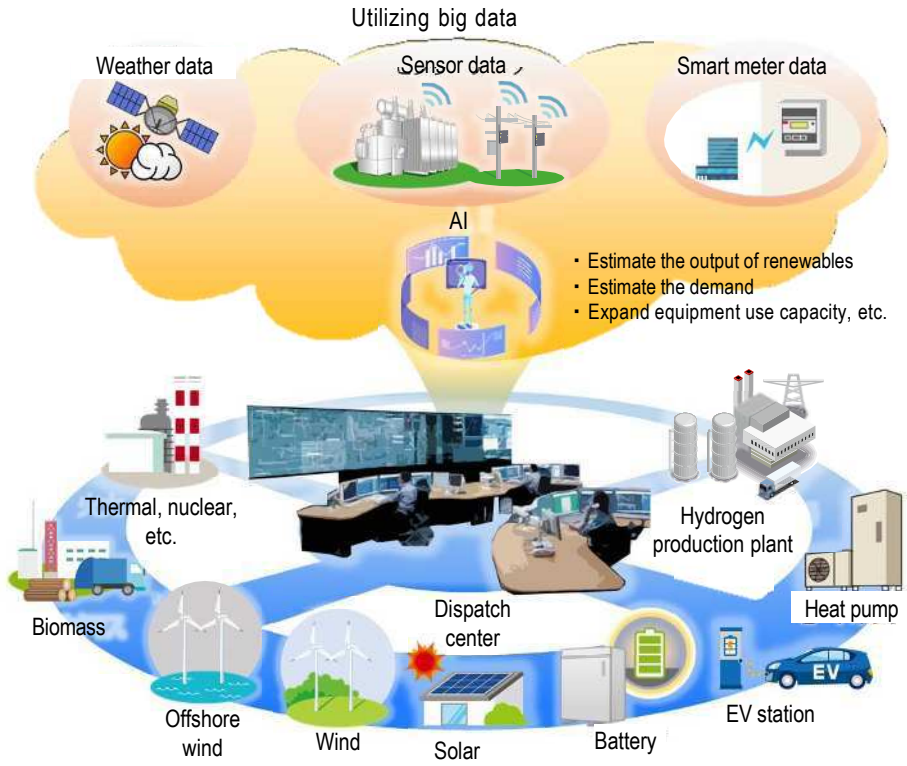
Grid

- In order to utilize the renewable energy potential of Kyushu to the maximum extent, we will **work on the wide-area operation of power transmission and distribution networks**, including the development and reinforcement of interconnection lines and backbone systems, make full use of transmission capacity and undertake other initiatives based on the master plan of the Japanese government.
- To achieve both the large-scale introduction of renewables and the maintenance of power quality, we will utilize digital technology to **improve supply-demand balance and grid-stabilizing technologies.**

・Using transmission/distribution network across wide area



・Improving supply-demand balance and grid-stabilizing technology



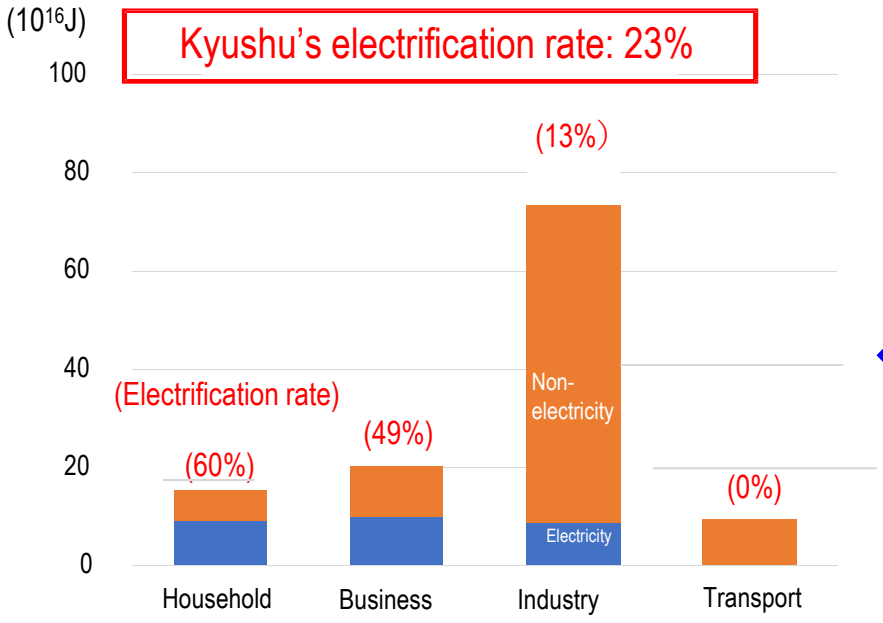
(Note) Kyushu Electric Power Transmission and Distribution Co., Inc., a wholly-owned subsidiary of Kyushu Electric and is responsible for the transmission/distribution business since April 2020 to further secure the neutrality of the power transmission and distribution sector.

Electrification (demand side)

To electrify energy consumption and to contribute to the reduction of emissions on the demand side

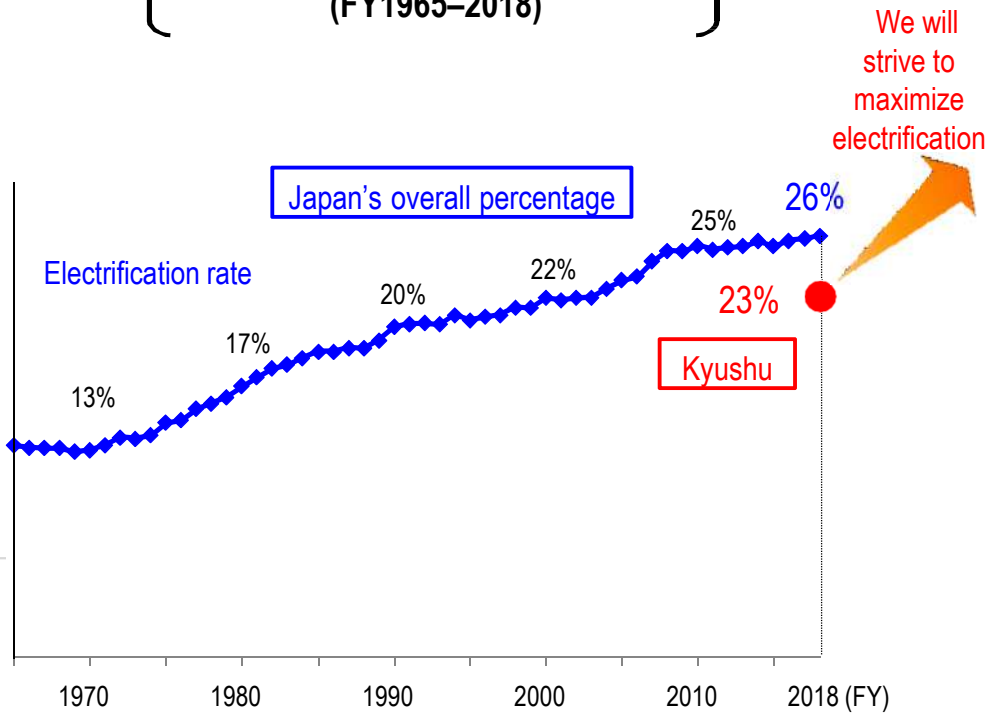
- Combining eco-friendly energy and the resources of the Kyuden Group, we will **strive to electrify sectors to the fullest extent possible** particularly within Kyushu, which is a region that has great potential for going electric.

Kyushu's energy consumption (FY2018)



(Source) Calculated by Kyushu Electric, based on data from the Agency for Natural Resources and Energy's "Energy Consumption Statistics by Prefecture"

Change in electrification rates (FY1965–2018)



(Source) based on the data from the Agency for Natural Resources and Energy's "Comprehensive Energy Statistics" and "Energy Consumption Statistics by Prefecture"

Maximizing Electrification

Household and businesses

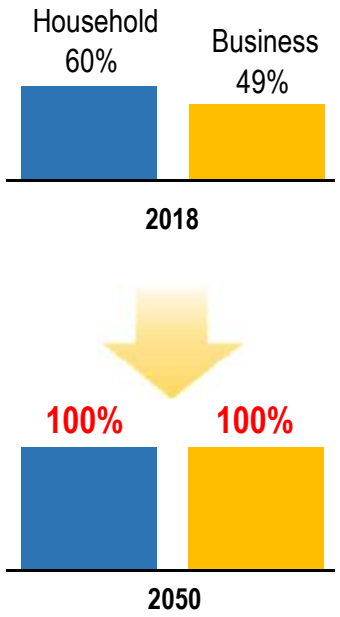
- **We will contribute to going fully electric by 2050** by promoting all-electric homes in the residential sector and electrification of air conditioning, hot water supply, and kitchen equipment in the commercial sector, while enhancing our electricity rate menu.

  Residential sector: through the use of IoT, AI, and other technologies based on all-electrification we propose “a lifestyle that is both smart, safe, comfortable, economical, and environmentally friendly”.

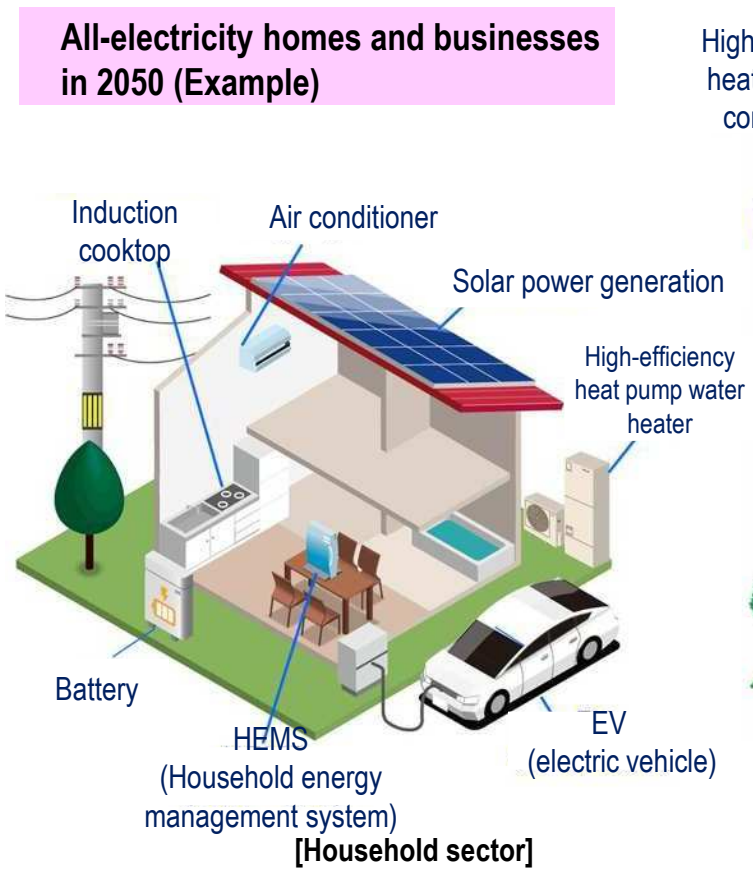
  Industrial sector: propose a heat pump system that is energy efficient and can handle various temperature ranges based on the facility operation and energy usage.

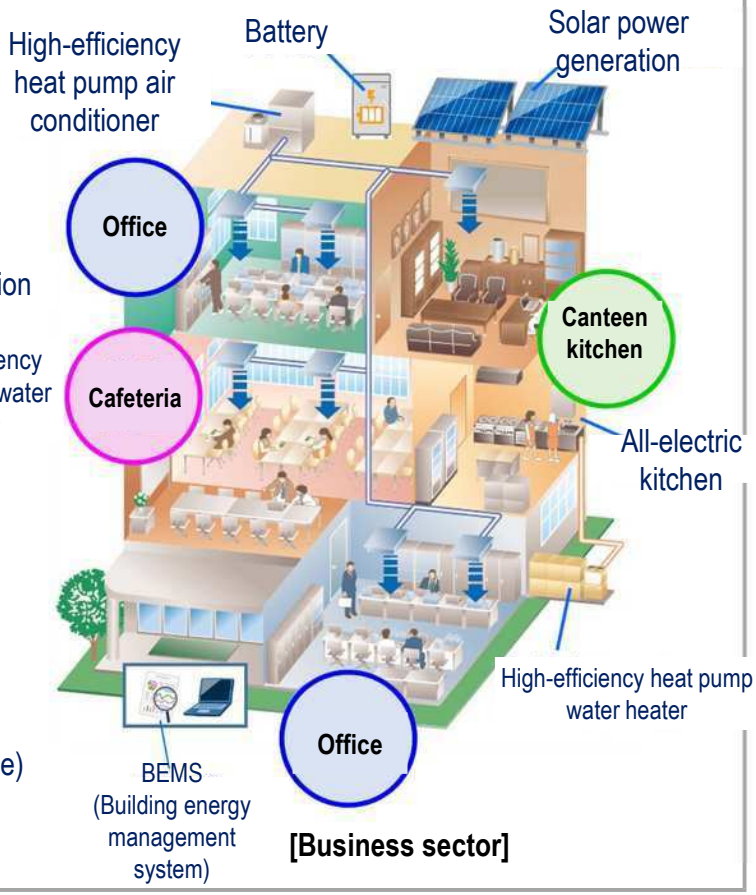
Improvement of electrification rate

Kyushu’s electrification rate



All-electricity homes and businesses in 2050 (Example)





Maximizing Electrification

Industry and transport sectors

- For the industry sector, research technologies of energy conversion equipment such as heat pumps and endeavor to electrify the heating demand in production processes across **various temperature ranges (e.g., hot water, steam, heating)**.
- Conduct on-site surveys and studies with customers, and promote energy-saving proposals to improve efficiency.
- Consider business potential in such areas as hydrogen supply for heat demand.
- In the transport sector, we will provide businesses and services that are aimed at promoting EVs. Examples include **EV-sharing services, charging infrastructure, and EV energy management**.

Further electrifying the production process (Industry sector)

Electrifying heating demand across a wide range of temperature zones

100°C 1,000°C 10,000°C

Hot water/steam → Heat

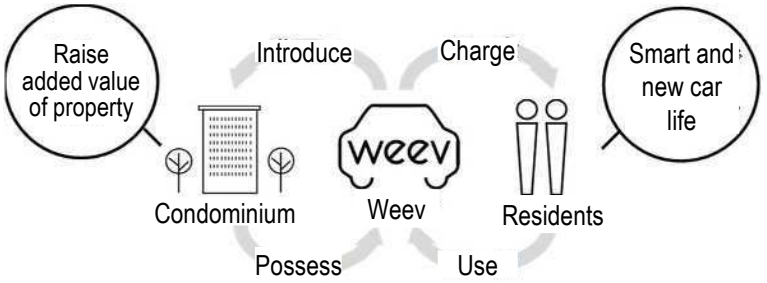
Production process

Raw material → Use hot water → Use steam → Use heat → Product complete

(Boiler) **Electrify** (Industrial HP/Electric heating equipment)

Popularizing EVs (Transport sector)

<EV-sharing service dedicated to condominium residents>



<EV-sharing station>

Service station on our company site, using Nissan's "e-share mobi" EV sharing service

<Dual-port rapid charger>

Electricity

Electricity

(Manufactured by Kyuden Technosystems Corporation)

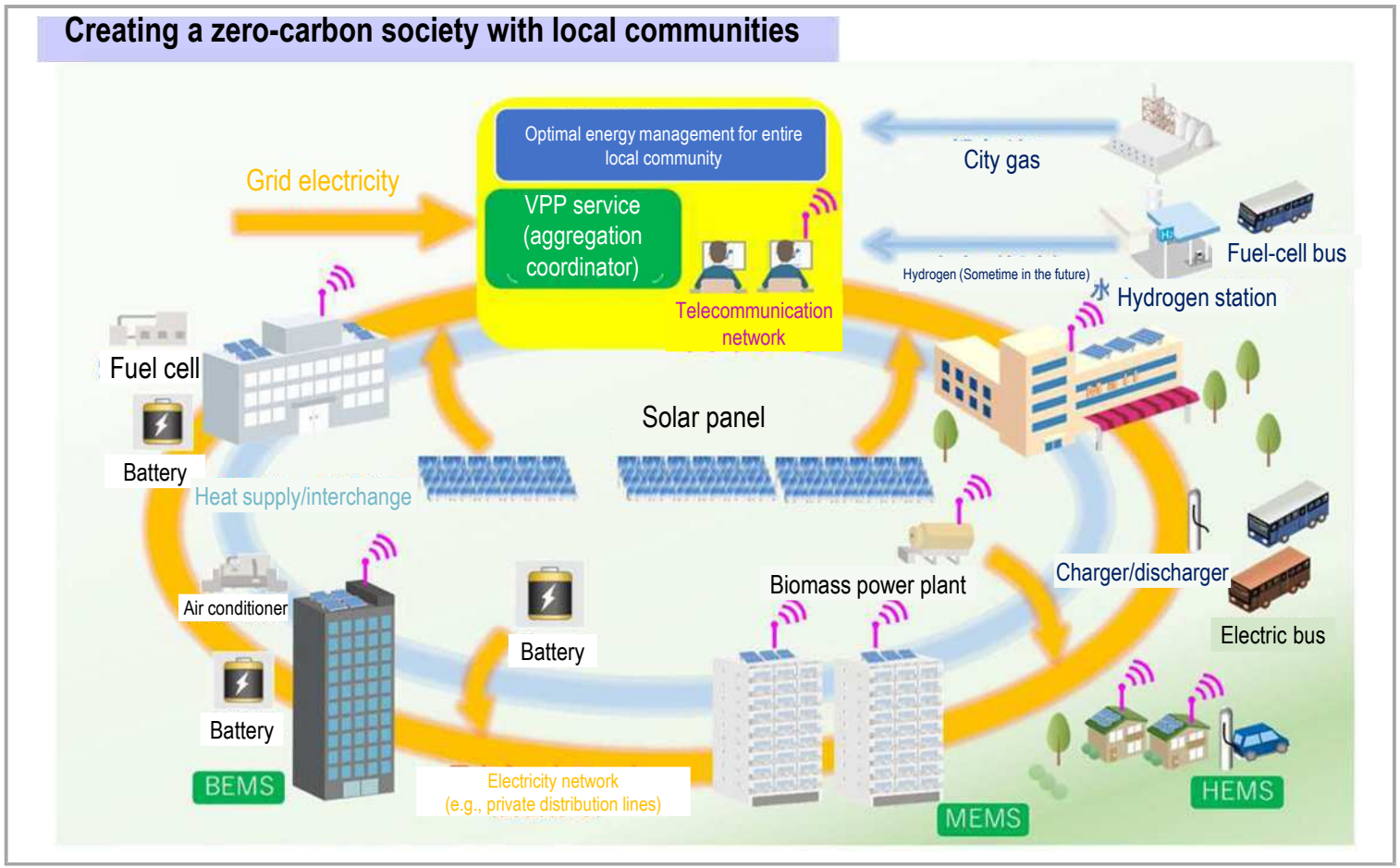
<Electric bus>

Demonstration of electricity supply-demand balance adjustment, using an electric bus (*Joint review by Kyushu Electric, Kyuden Technosystems Corporation, and Nishi-Nippon Railroad)

Together with Local Communities create a Zero-carbon Society

Local energy sources

- Strive to **create a zero-carbon society with local communities,** by contributing to the construction of a regional energy system that optimally manages and controls energy by combining grid power, local and urban renewable energy sources, and storage batteries.
- By maximizing the use of the Kyuden Group's strengths in energy, real estate, information and communication technologies, we will work **to enhance the added value of cities and regions**, such as carbon neutrality, improvement of energy resilience, development of smart cities, and other efforts.

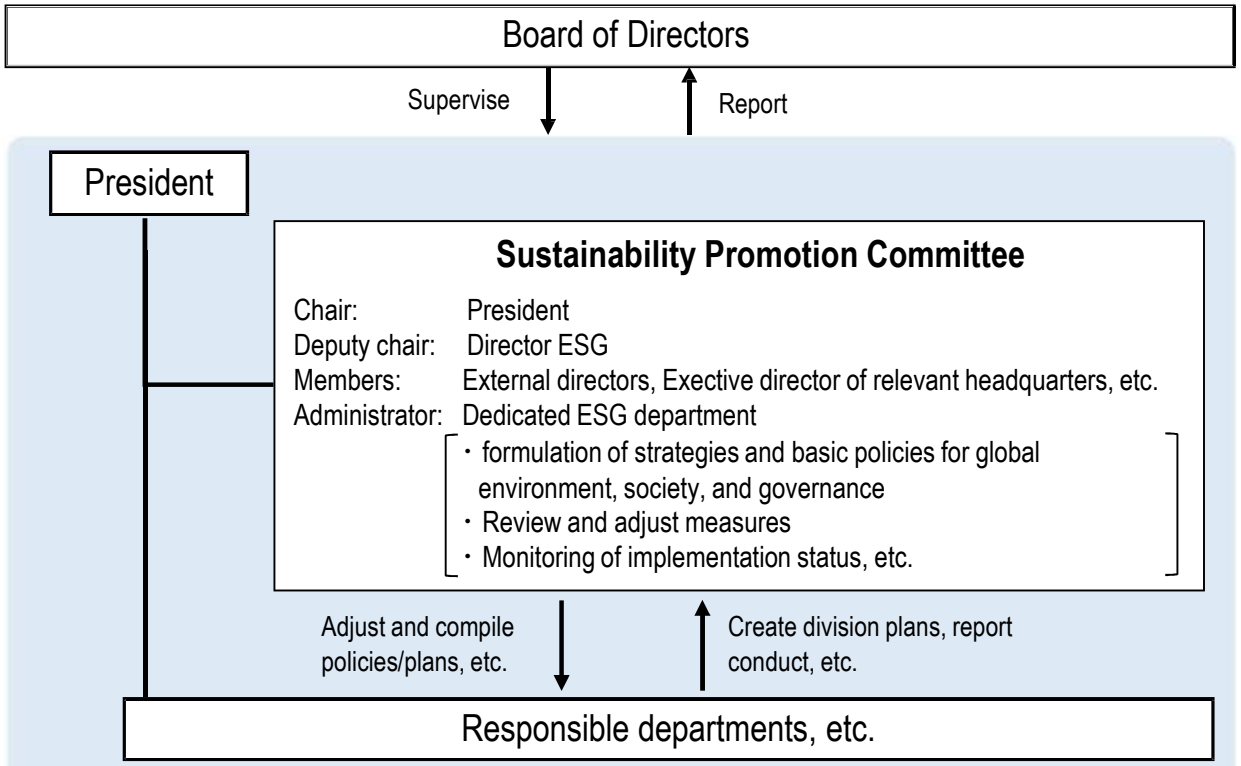


System to Promote Efforts for Going Carbon Neutral

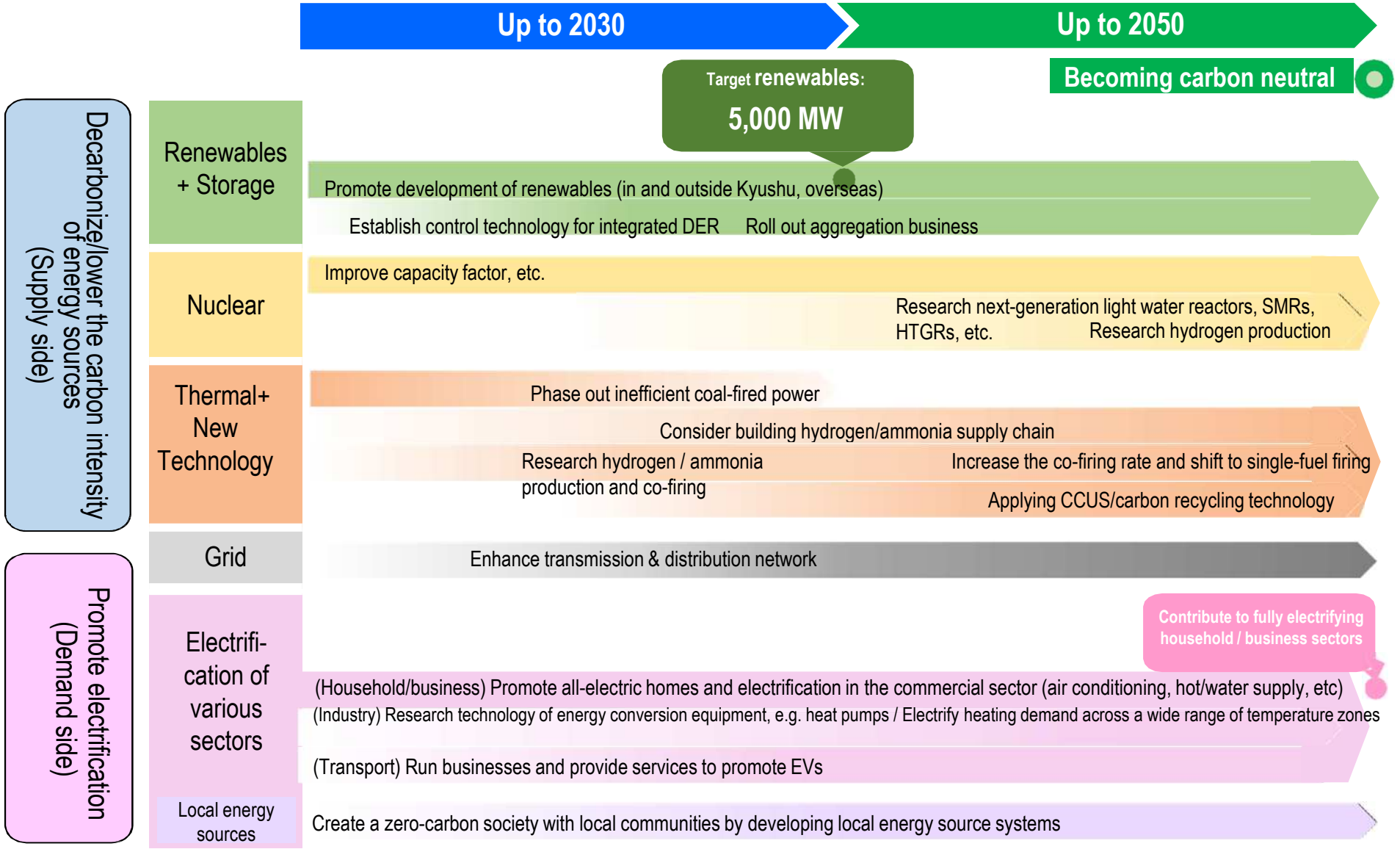
Organization

- In order to realize the Kyuden Group's "Carbon Neutral Vision 2050," we have established the "Sustainability Promotion Committee" headed by the President.
  In addition, we have established a **Director ESG and a dedicated department** to oversee and promote our overall efforts in each **ESG (Environmental, Social and Governance**) field.
- Under this structure, we will promote ESG-related initiatives, including carbon neutrality and contribute to realizing a sustainable society.

Overview of Sustainability Promotion Committee



Roadmap



(Note) This roadmap has been developed based on the Japanese government's energy policies and on the premise that there exists a balance between economic rationality and innovations that foster progressive technology. The roadmap will be reviewed appropriately if the assumptions change significantly due to future changes in circumstances.
The CO_2 reduction target for FY2030 will be discussed in the future based on the contents of the next Basic Energy Plan.