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Kyuden Group

Carbon Neutral Vision 2050

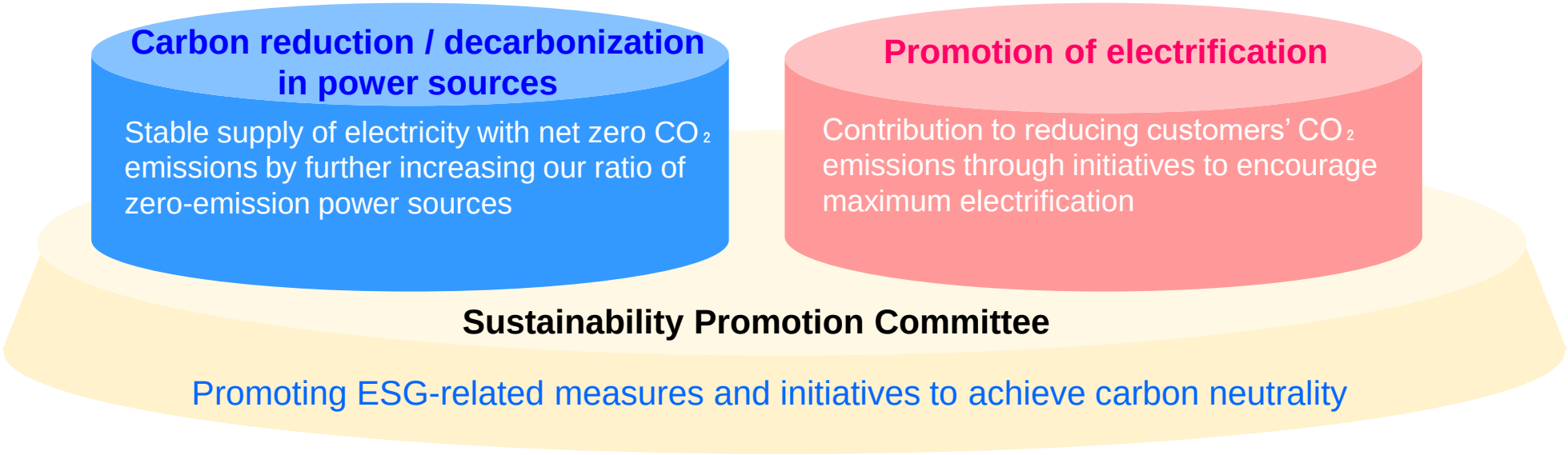
— Starting from Kyushu, the Kyuden Group will lead the way to Japan's decarbonization —

KYUDEN GROUP

The Kyuden Group aims to achieve carbon neutrality by the year 2050

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

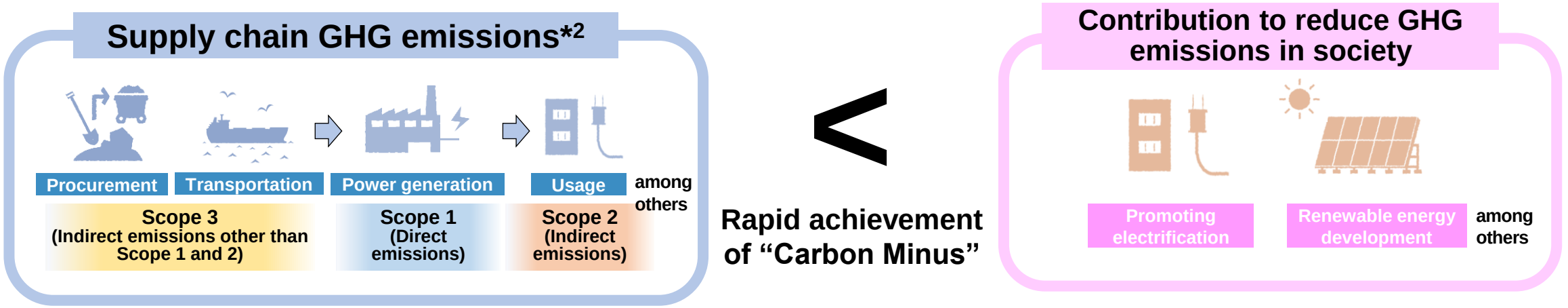
- We aim to become the corporate group that leads the decarbonization of Japan from Kyushu as the front-runner in carbon reduction / decarbonization efforts, seizing our response to global warming as an opportunity for corporate growth.
- We set two pillars for efforts on both the supply and demand sides of energy, continuing to challenge "carbon reduction / decarbonization in power sources" and "promotion of electrification".
- Under the leadership of the "Sustainability Promotion Committee", chaired by the president, we will promote ESG-related measures and initiatives for achieving carbon neutrality.



The Kyuden Group aims to achieve carbon neutrality by the year 2050 and "Carbon Minus"*1 as early as possible before 2050 , by reducing GHG emissions in its supply chain and contributing to the reduction of emissions across society

- We will reduce greenhouse gas (GHG) emissions throughout our supply chain to net zero through our business activities.
- We will contribute to the reduction of GHG emissions in society by promoting the maximum possible electrification and ensuring the stable delivery of environmentally friendly energy.
- Through these efforts, the Kyuden Group will achieve "Carbon Minus"*1 as early as possible, before 2050.

*1 By promoting electrification and developing renewable energy, we aim to create a reduction effect that exceeds the GHG emissions of the Kyuden Group. This state called, "Carbon Minus", we seek to offset supply chain emissions by reducing the overall GHG emissions of society through our business activities.

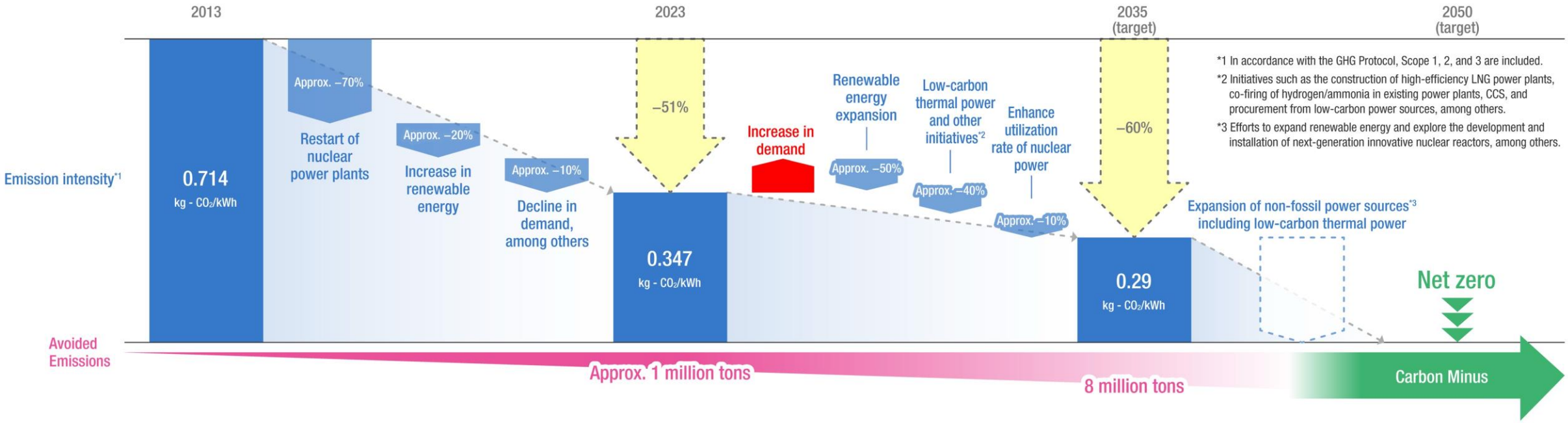


(Source) Created by Kyuden Group based on the "Calculation of Supply Chain Emissions" from the Ministry of the Environment

*2 Following the GHG Protocol, which is the international standard for calculating and reporting GHG emissions, emissions are calculated for three different scopes (categories) of emission types.

Roadmap to 2050

(Note) The achievement of carbon neutrality by 2050 and the environmental targets for 2035 outlined in this roadmap are contingent upon the establishment of national policy support and technological advancements. This roadmap may be subject to revision based on changing circumstances.



		to 2035	to 2050
Reduce GHG emissions in the supply chain	Thermal / Nuclear	Develop high-efficiency LNG power plants, Co-firing of hydrogen/ammonia, Partial implementation of CCS	Increase the co-firing ratio of hydrogen/ammonia, transition to dedicated combustion, Practical implementation of CCS/CCUS
		Enhance utilization rates by extending periodic inspection intervals, replace steam turbines, Explore the development and installation of next-generation innovative reactors	
Contribute to reducing society-wide GHG emissions	Renewables / Power storage	Develop solar power, geothermal power, battery storage	Develop next-generation power storage* and solar power*, and deep geothermal power*
		Develop fixed offshore wind power, pumped-storage power	Develop floating offshore wind power, EEZ offshore wind power, tidal power*
	Electrification	Conversion of residential and commercial heat sources, Industrial heat pumps, EV buses	Electrification of ports*, construction machinery, and smart agriculture*
	CO_2 absorption & sequestration	Forest cultivation*, Advanced forest management, Promotion of wood utilization	DACCS*

* See page 4 for an overview of efforts toward future social implementation

Topics: Efforts Toward at Future Social Implementation

Renewable energy/Power storage

Tidal power generation

- Utilization of untapped marine energy
- Early practical application on remote islands, ,among others

Next-generation power storage

- Demonstration testing and practical application of all-solid-state batteries
- Establishment of evaluation methods and monitoring control technology for next-generation batteries

Deep geothermal power generation

- Assessing the feasibility of geothermal power technology*1 using deep artificial reservoirs (3 km or deeper), with demonstration projects planned both domestically and internationally

Next-generation solar cells

- Research and performance assessment for demonstrations and practical implementation of high-efficiency quantum dot solar power technology*2
- Consider its use when replacing existing solar panels

Electrification

Smart agriculture

- Conversion to temperature-adjustable heat pumps, optimal production environment management through sensors and AI, and the creation of high-added-value agricultural products
- Labor-saving through the use of self-driving tractors and harvesting robots

Electrification of ports

- Power supply to ships at berth and electrification of port facilities, such as cargo handling machinery
- Electrification of ship propulsion systems

CO_2 absorption and sequestration

Forest absorption

- Effective management of owned forests
- Enhancement and support of J-Credit projects utilizing forest resources
- Expansion of forestry business

DACCS

- Demonstration testing and practical implementation of technology for direct capture of CO_2 from the atmosphere (regardless of location)
- Site/technical assessment for the demonstration and practical implementation of technology for CO_2 underground storage

*1 By creating artificial reservoirs at depths of 3 km or more, geothermal power generation becomes feasible regardless of location (in Kyushu, high-temperature layers are relatively shallow). Under high-temperature and high-pressure (supercritical) conditions, this approach enables higher efficiency and greater output compared to conventional geothermal power generation.

*2 High-efficiency solar power generation using quantum dots with a broader light absorption spectrum than conventional solar panels. When adopted during solar panel replacement, it enables approximately twice the power generation from the same surface area.

Technology development aimed at the mid and long term

Kyuden Group Initiatives for Carbon Neutrality by 2050

Carbon reduction / decarbonization in power sources (supply side)

Renewable energy + power storage

Main Power Source ... P6

- Accelerate development and investment in renewable energy, including pumped storage and storage batteries, within Kyushu, across Japan, as well as internationally
- Expand sales volume of renewable energy + maximize value

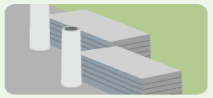
Solar

Wind

Geothermal

Hydroelectric

Biomass



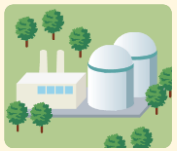
Storage batteries/ pumped storage

Nuclear power

Maximum Utilization ... P7

- Maintain and enhance utilization rate
- Explore the development and deployment of next-generation innovative reactors
- Examine potential for hydrogen production

Nuclear power



Thermal power + new technologies

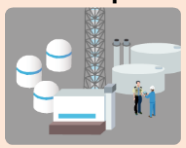
Net Zero CO_2 Emission ... P8

- Further improve efficiency
- Hydrogen and ammonia co-firing, with dedicated firing in the future
- Strive for practical application of CCS/CCUS*

CCS/CCUS*

CO_2

Thermal power



*CO_2 capture, utilization and storage

Electricity

Non-fossil fuel electricity

Heat

Grid

Advanced Transmission and Distribution Network ... P9

- Operate the transmission and distribution network on a cross-regional basis
- Advance technologies for demand-supply management and grid stabilization

Electricity

Promotion of electrification (demand side)

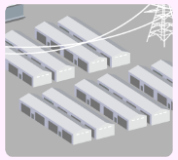
Electrification in each sector

Maximum Electrification ... P10,11

- Promote all-electric homes and electrification for air-conditioning, hot water supply and kitchen equipment at commercial facilities (residential and commercial sectors)
- Conduct research on technologies for converting heat sources and electrify heating needs at a wide range of temperatures (industrial sectors)
- Promote the widespread use of EVs (transport sector) by provision of businesses and services
- Research the business potential of hydrogen supply and others

Residential/commercial

Industrial



Transport

Hydrogen

Procurement

Regional energy

Creating a Zero-Carbon Society with Local Communities ... P12

- Contribute to the development of regional energy systems
- Enhance the added value of cities and local communities
- CO_2 absorption through effective forest management
- Promote the use of ships powered by low- and zero-carbon fuels

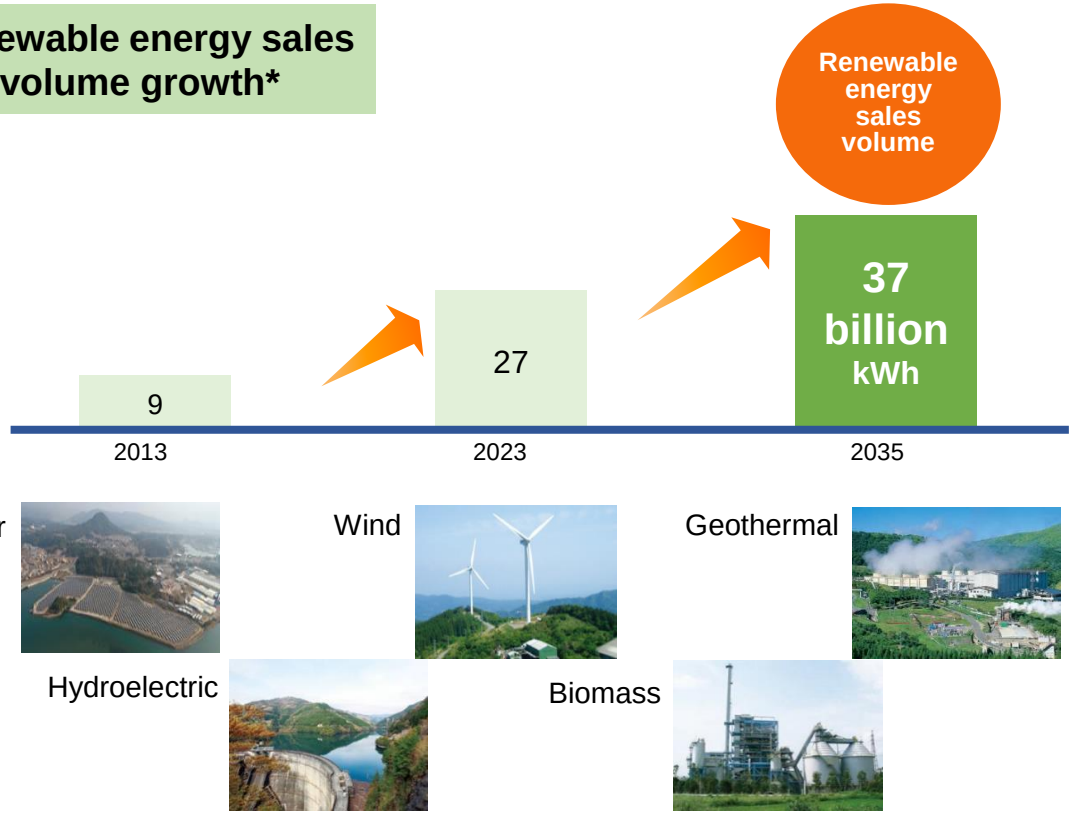
Transitioning to Renewables as the Main Power Source

Renewable energy + power storage

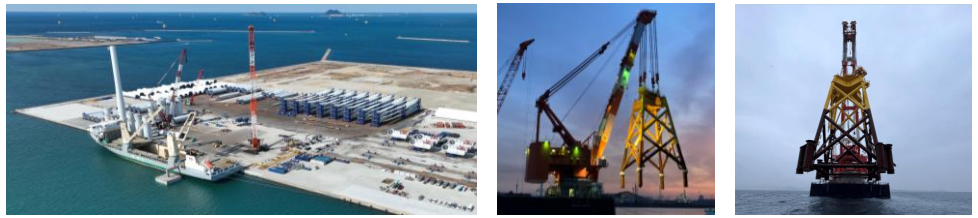
- To achieve carbon neutrality, the Kyuden Group will accelerate development and investment in the five main renewable energy sources*1 as well as storage batteries, pumped storage, and other solutions that have power adjustment functions.
- We will expand the sales volume of renewable energy not only through our own domestic development but also through procurement from other companies and promotion of renewable energy development internationally.
- We will also work to create more advanced aggregation and trading*2, develop solutions, and deploy next-generation energies such as green hydrogen to maximize value and achieve renewable energy independence.

*1 Solar, wind, geothermal, hydroelectric, and biomass
*2 Aggregation (bundling electricity) and trading (electricity transactions based on optimal demand-supply management plans)

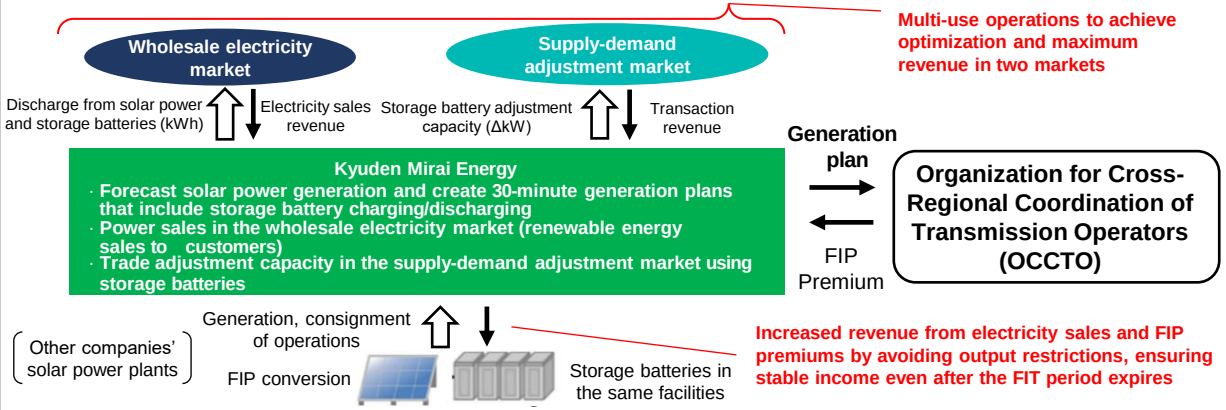
Renewable energy sales volume growth*



Offshore wind power project in the Hibikinada Sea near Kitakyushu



New renewable energy business model



*Includes FIT electricity without non-fossil certificates (which does not have value as renewable energy or as a zero-emission power source, but is treated as electricity at the national average CO_2 emission level and includes thermal power)

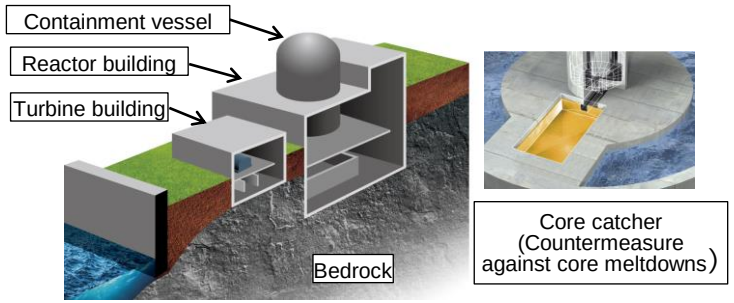
Maximum Utilization of Nuclear Power

Nuclear power

- Nuclear power is a stable source of energy that features high energy density, emits no CO_2 during electricity generation, and is unaffected by weather or climate*.
- Prioritizing safety and in dialogue with the local community, we will continue to maximize the use of existing reactors by enhancing their utilization rates.
- In the future, we plan to explore the use of next-generation innovative reactors that offer high levels of safety, including next-generation light water reactors, SMRs, and HTGRs, as well as leveraging nuclear energy to produce hydrogen.

*High-level radioactive waste generated from the reprocessing of spent fuel will be ultimately disposed in stable geological formations deep underground by the Nuclear Waste Management Organization of Japan (NUMO), an authorized corporation by the Ministry of Economy, Trade and Industry

Innovative light-water reactor (example: SRZ-1200)

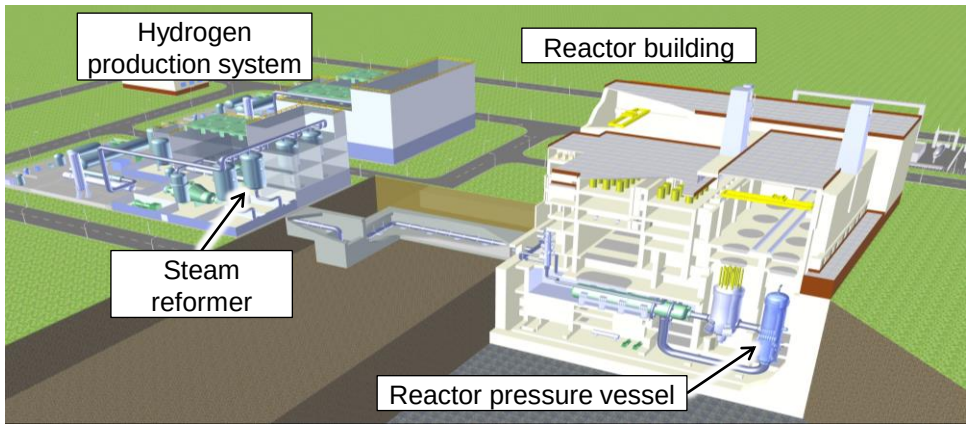


(Image source) Mitsubishi Heavy Industries, Ltd.

- Increased resistance to earthquakes, tsunamis, and other natural disasters
  ➡ Building embedded in bedrock, watertight construction of buildings
- Increased core cooling and containment of radioactive materials
  ➡ Core catcher installed, increased redundancy, diversity, and independence of safety systems

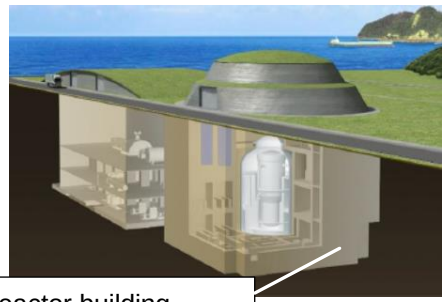
HTGRs + Hydrogen production (Example)

- 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.

SMRs



- Features passive safety system that does not require external energy sources in the event of an accident
- Features integrated reactor with natural circulation cooling and built-in steam generator
  ➡ Designed to inherently eliminate the risk of accidents such as coolant loss

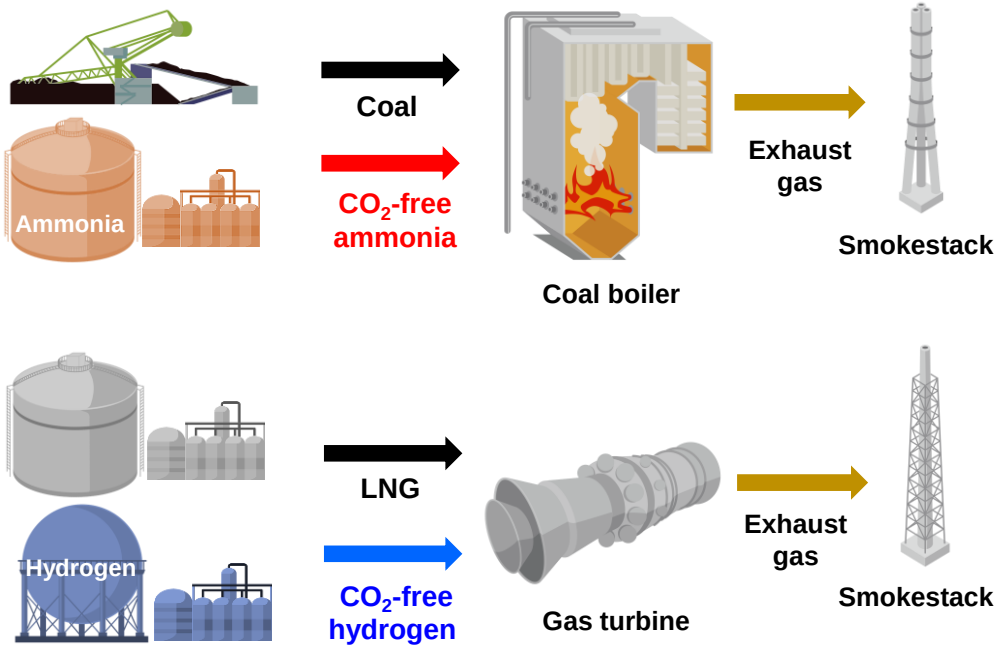
(Image source) Mitsubishi Heavy Industries, Ltd.

Net Zero CO_2 Emissions from Thermal Power

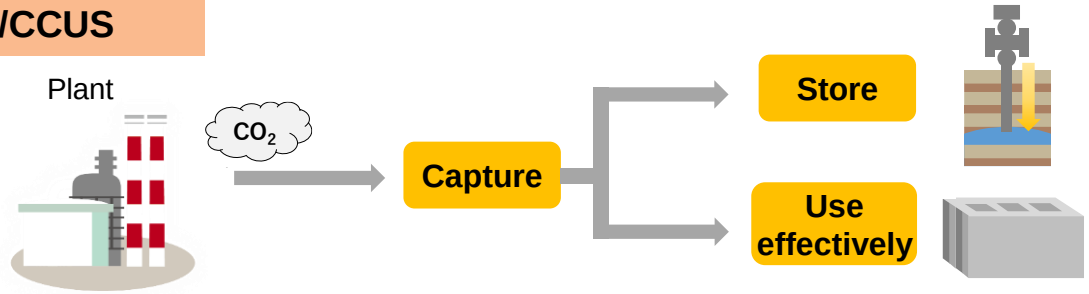
Thermal power + new technologies

- Thermal power remains crucial for balancing the expansion of renewable energy and ensuring stable supply by adjusting for fluctuations in renewable energy output.
- We will continue working toward even higher efficiency as well as on hydrogen and ammonia co-firing and eventually dedicated firing, as these fuels produce no CO_2 during combustion.
- We will also strive toward the practical application of CCS/CCUS for CO_2 capture and storage, explore manufacturing CO_2-free hydrogen and ammonia using surplus renewable energy, and build supply chains.
- We will aim to phase out inefficient coal power plants by 2030, taking into account supply capacity, energy supply costs, and local circumstances.

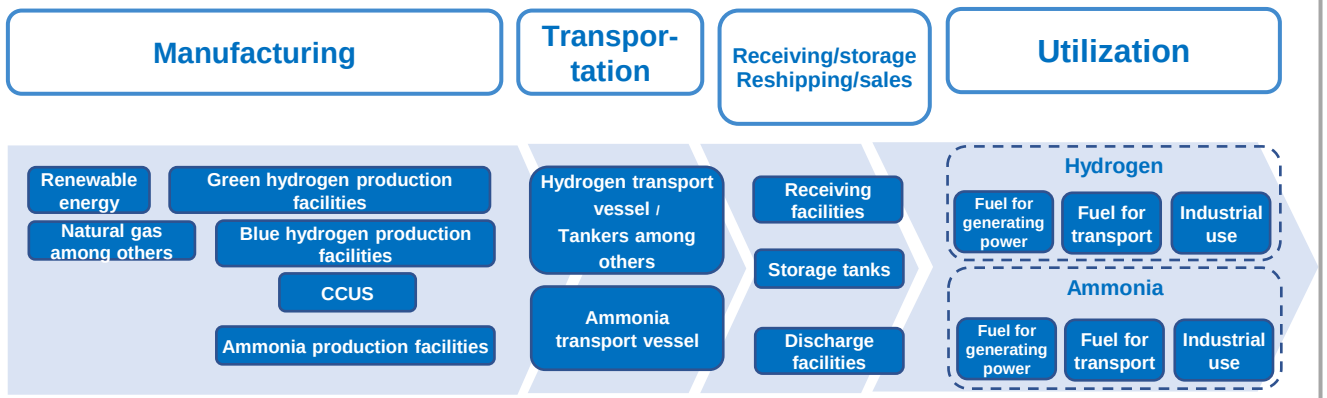
Hydrogen and ammonia co-firing



CCS/CCUS



Hydrogen and ammonia supply chain

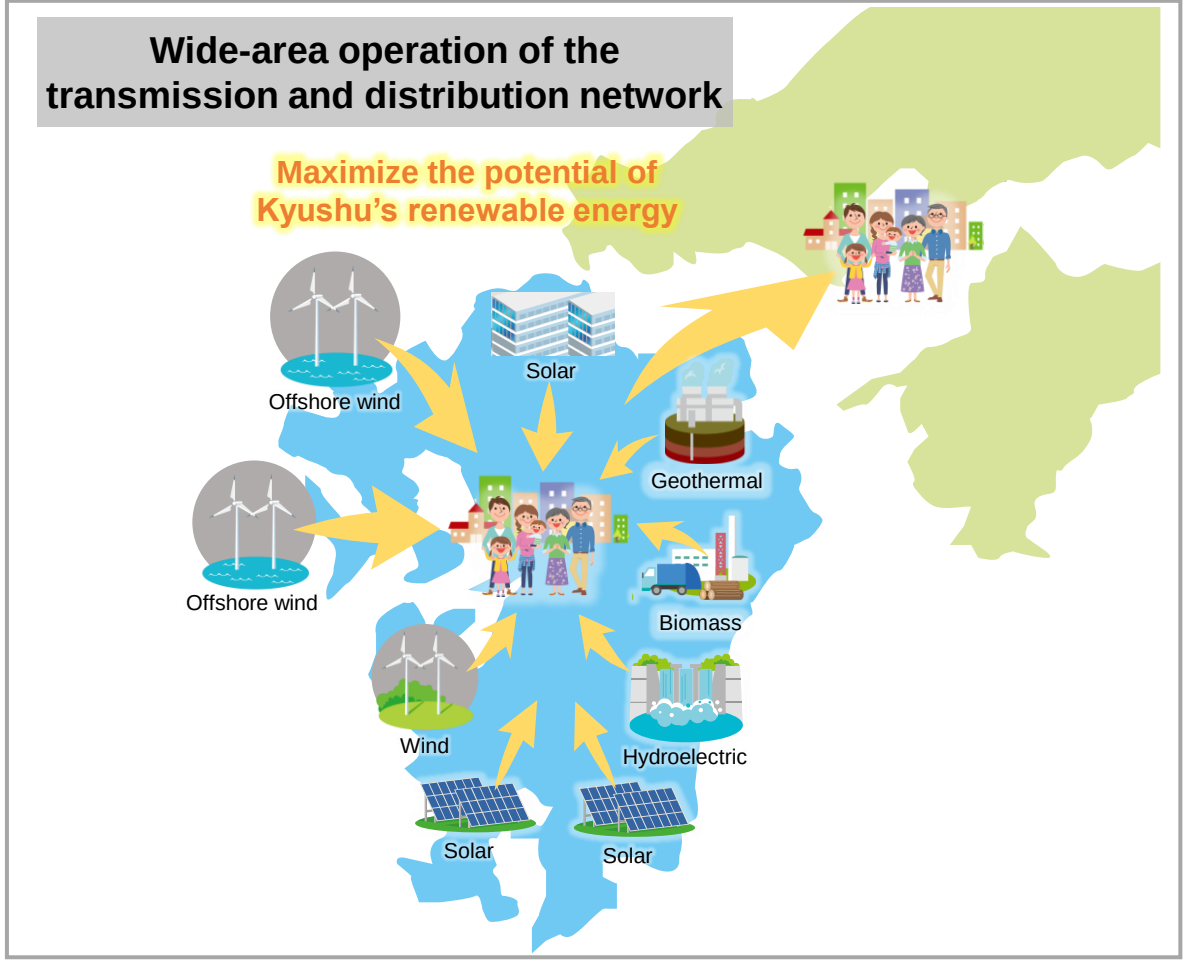


Advanced Transmission and Distribution Network

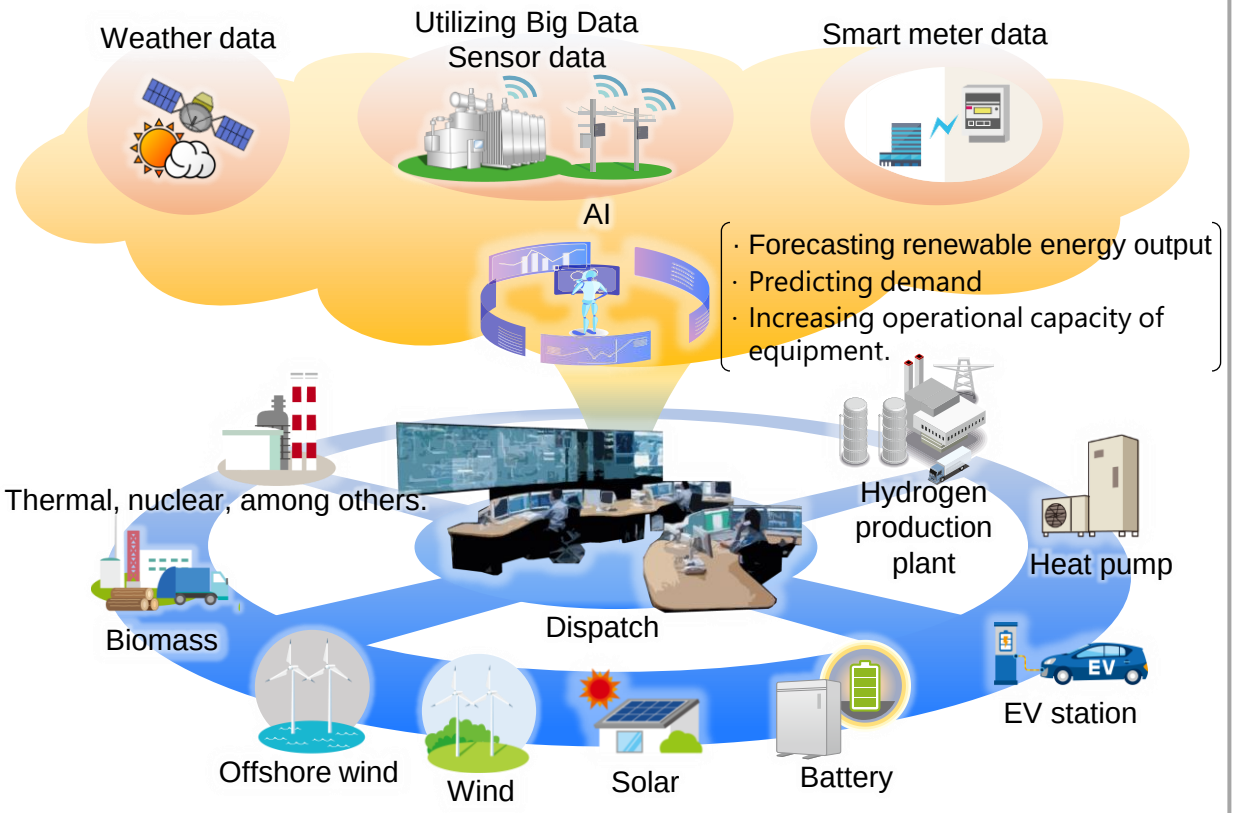
Grid

- To fully utilize renewable energy potential in Kyushu, we will focus on optimizing transmission capacity and enhancing inter-regional transmission lines and core power grids, guided by the national government's master plan. This will support the cross-regional operation of the transmission and distribution network.
- We will work on advanced technologies for demand-supply management and grid stabilization using digital technology to balance the large-scale adoption of renewable energy while maintaining power quality.

Wide-area operation of the transmission and distribution network



Advancing technologies for demand-supply management and grid stabilization



Maximum Electrification

Residential sector

Commercial sector

- We will contribute to achieve 100% electrification rate 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 plans.

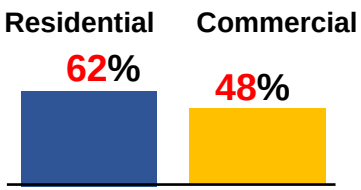
[Residential sector] Through the use of IoT, AI, and other technologies based on all-electrification, we help customers realize a safe, comfortable, energy-efficient and economic lifestyle.

[Commercial sector] We propose various optimal heat-efficiency heat pump systems based on the operational status of the customer's facility and energy usage.

Improved electrification rate

<Electrification rate in Kyushu*>

(Current state)



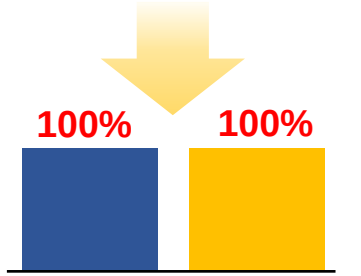
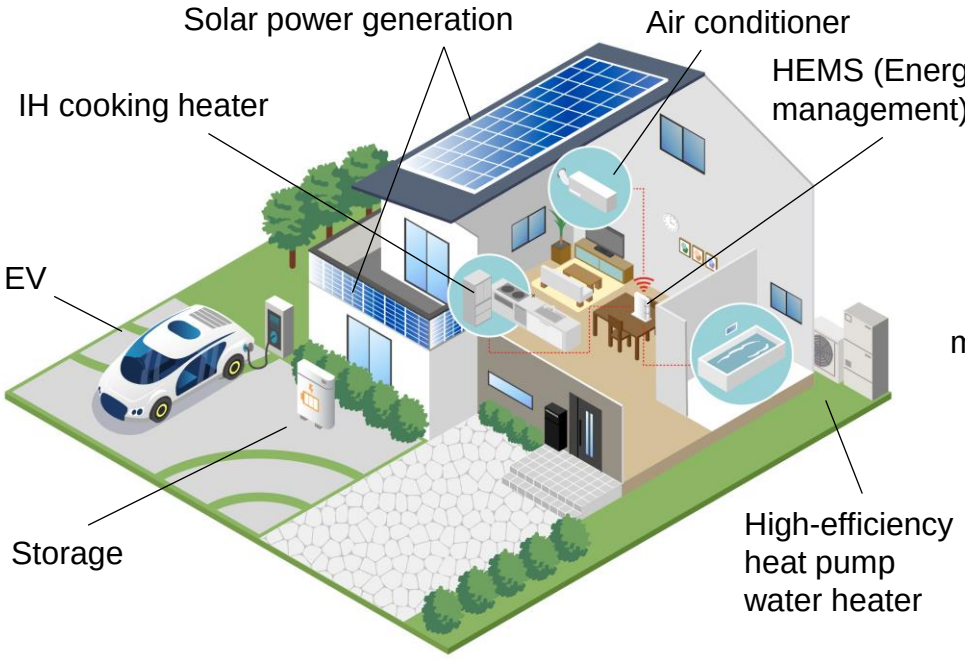
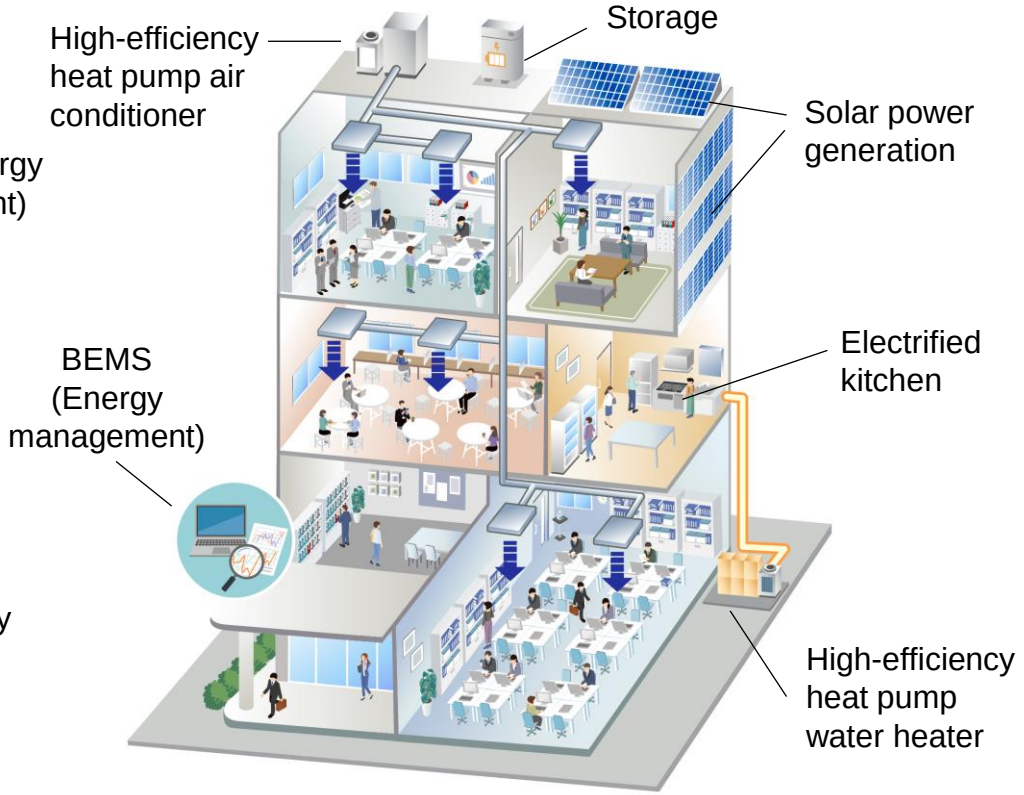


Image of fully electric in 2050



[Residential sector]



[Commercial sector]

* The electrification rate of Kyushu is estimated by the company based on national statistical information.

Maximum Electrification

Industrial sector

Transport sector

- For the industrial sector, we will conduct research on technologies for heat source conversion equipment, such as heat pumps, and tackle the electrification of heating needs at a wide range of temperatures (hot water, steam, heating) in production processes.
- We will promote energy-saving proposals aimed at improving energy utilization efficiency by conducting on-site surveys and studies with our customers.
- Additionally, we will explore business opportunities in hydrogen supply for high-temperature heating needs.
- In the transport sector, to accelerate the widespread use of EVs, we will offer services such as EV sharing, development of charging infrastructure and energy management utilizing EVs.

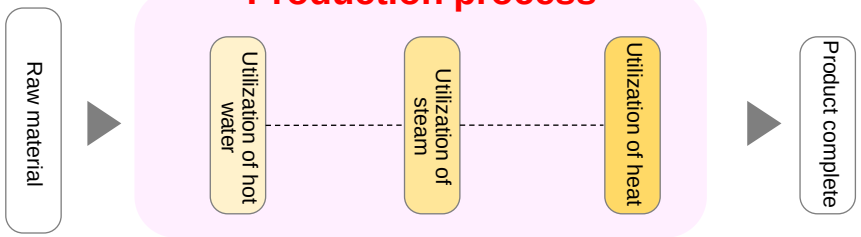
Further electrifying the production process (industrial sector)

Pursuing the electrification of heating needs at a wide range of temperatures

100˚C 1,000˚C 10,000˚C

Hot water/steam — Heating

Production process



(Boiler)

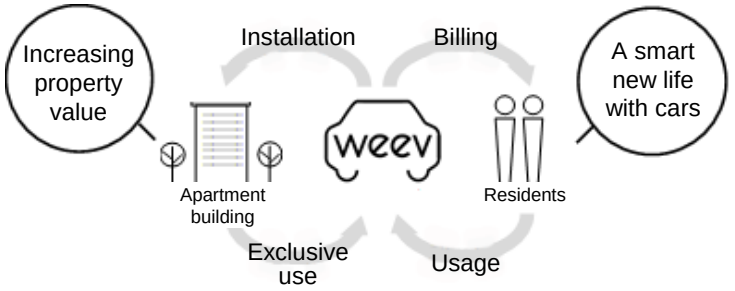
Electrification

(Industrial HP/electrical heaters)

Promoting the use of EVs (transport sector)

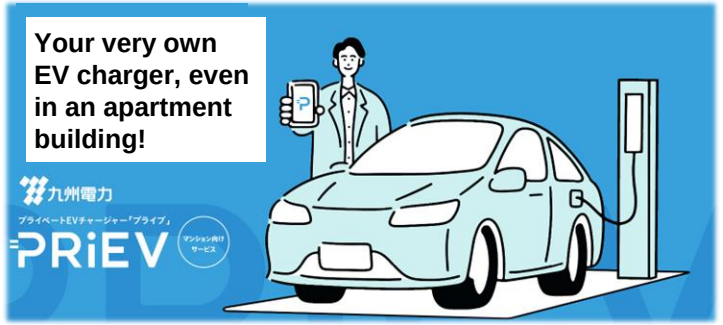
<EV sharing service (weev)>

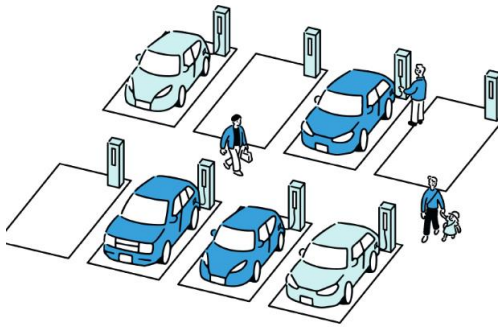
EV sharing exclusively for apartment residents



Public EV sharing

<EV charging service (PRiEV)>





Creating a Zero-Carbon Society with Local Communities

Regional energy

- We will strive to create a zero-carbon society with local communities, by contributing to the development of a regional energy systems that optimally manages and controls energy by combining grid power, local and urban renewable energy sources, and storage battery.
- 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.