

Materiality **3** **Carbon Neutral**
Values we embrace (5) Carbon Neutral

Contributing towards achievement of carbon neutrality and resolution of climate change issues with a view to a sustainable society through co-creation based on partnering

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au Energy Holdings Corporation President, Representative Director **Koichiro Nakagiri**



— **What tasks will KDDI address in connection with the common global issue of climate change?**

Yoshimura: Climate change is an issue common to the human race that the whole world must deal with. KDDI acknowledges the importance of carbon neutrality for reducing our business risks because the telecommunications business can be affected by typhoons and other natural disasters. As a telecommunications operator, we have a mission of offering communication services as social infrastructure to customers. The 5G services require more base stations than conventional 3G and 4G services do. As base stations consume a huge amount of electric power for transmitting radio waves, it creates a dilemma in which we would end up consuming more electricity if we were to offer a new world based on 5G technologies to customers. We are aware that it is a big task for KDDI to achieve both expansion of our service areas while both reducing electricity consumption and achieving carbon neutrality.

— **What tasks does au Energy Holdings Corporation address as an operator of the energy business?**

Nakagiri: The energy crisis has sparked a global race for power sources and energy. For example, Russia's invasion of Ukraine brought about an energy shortage in Europe, leading to the reversion to coals which emits a huge amount of CO₂. I think we need to first overcome this energy crisis, and strive towards carbon neutrality to create a sustainable society.

It is quite difficult for an electricity retailer to realize a carbon-free society. As au Energy Holdings has a limited independent power generation capacity, it will be important that we shift to supplying electric power produced from low-carbon or renewable energy. We will work to provide renewable energy first for customers and then for our communication facilities with a view to achieving decarbonization. In addition, we believe that it is our mission for achieving carbon neutrality in society to offer more energy efficient solutions to our corporate customers.

— **What strengths does each company have in their efforts to achieve carbon neutrality?**

Yoshimura: KDDI excels in collaborating with corporate partners in

the aspects of technologies and business, and we place great importance on partnering to achieve carbon neutrality. For example, in a demonstration trial with Intel Corporation for lowering the power consumption of communication servers, we used artificial intelligence (AI) for the first time in Japan to verify that power consumption was reduced by up to 20%. With the aim of commercializing the system around 2024, we are studying its feasibility. Another example is a demonstration trial with Mitsubishi Heavy Industries, Ltd. and NEC Networks & System Integration Corporation using a liquid immersion cooling system, which uses liquid for cooling information technology (IT) equipment. This trial achieved a 43% reduction in power consumption from the level of conventional data centers, and we are continuing the study towards commercialization.

As for base stations, we conducted a demonstration trial with Nokia Solutions and Networks Japan G.K. and confirmed that AI control reduced power consumption by up to 50%. After verifying the safety of the system, we will work on commercialization to meet the growing demand for the additional servers and expansion of data centers.

And one of the benefits of partnering is that new technologies verified can be used within the KDDI Group. I think it is a great



advantage to be able to work towards carbon neutrality in a business covering all sections, or specifically from base stations to customers.

Nakagiri: au Electricity has a customer base of around 3.38 million in FY22.3, and its advantage lies in contacts with customers chiefly through au Shops. For corporate customers with high demand for carbon neutrality and decarbonization, we will provide decarbonized options and solutions through a subsidiary, ENERES Co., Ltd (hereafter referred to as "ENERES"). KDDI and ENERES have been commissioned by the Ministry of Economy, Trade and Industry to implement a demonstration project with a virtual power plant*1 (hereafter referred to as "VPP") since 2016, and we have a great advantage in our accumulation of VPP technologies and knowledge. Multiple communication connections and low latency, which are the characteristics of 5G technologies, are important to control the VPP. With the use of our strengths in advanced technologies we have as a telecommunications operator, we achieved advancement of the VPP in the project. Technological integration between the telecommunication business and the electric power business has produced major synergies. In addition, we believe we can further promote carbon neutrality using VPP technologies through installation of solar panels and storage batteries in idle spaces around base stations.

— **What specific actions are you taking for carbon neutrality?**

Yoshimura: KDDI has moved up the target date of net zero CO₂ emissions in our business activities, from fiscal 2050 to fiscal 2030. To achieve carbon neutrality, we must work to reduce CO₂ emissions by 1.09 million tons per year. Base stations, data centers and other communication facilities must account for 98% of this reduction, and base stations alone must be responsible for 60%. We carried out 3G suspension at the end of March 2022, and as a result, power consumption from 3G facilities was reduced. It is an example of reduction achievements. Our existing data centers are currently shifting to electric power generated from renewable energy, and those in Europe already completed a 100% shift to renewable energy. When any new data center is built, it will be designed on the basis of a 100% use of renewable energy. In addition, for lowering power consumption of base stations, we are taking a range of actions towards carbon neutrality. They include sharing base stations with SoftBank Corp., employing AI to conserve power in communication servers, introducing liquid immersion technologies for cooling IT equipment, and investing in a start-up that develops perovskite solar cells*2, characterized in that they are thin and can be folded with light force. We are doing this investment with the help of the KDDI Green Partners Fund*3, which is a corporate venture capital (CVC) fund aimed at supporting companies working on climate issues.

Nakagiri: For individual customers, we offer the au Electricity "Eco Plan," which supplies electric power derived from net 100% renewable energy with net-zero CO₂ emissions. Amid the ESG trend, our corporate customers are accelerating their actions towards carbon neutrality. Accordingly, we are required to provide more renewable energy. Also for the purpose of achieving carbon neutrality in the entire KDDI Group, we believe it is important to play our role as an electricity retailer.

— **What is your aspiration towards carbon neutrality and what do you expect from a carbon-neutral society?**

Yoshimura: KDDI sent out a message through the KDDI VISION 2030. It reads, "The creation of a society in which anyone can make their dreams a reality, by enhancing the power to connect." The telecommunication business constitutes a foundation of the society that we seek to create. Electric power is essential to advancing telecommunication, and it is a tremendous challenge as well as a very dream-inspiring job to achieve both an evolution of telecommunication and carbon neutrality. We hope to have a high spirit in serving society as well as the global environment, and we do not think it is impossible to do this. As remote work spread during the COVID-19 pandemic, human movements for commuting and other purposes have been on the decrease. The use of telecommunications has contributed to this, and we will be able to better serve the global environment if we can provide telecommunication services using renewable energy. We hope to change the era where telecommunication consumes a huge amount of power and to create a virtuous circle for the global environment by moving ahead with energy conservation.

Nakagiri: When we look to the future, carbon neutrality is a very big business opportunity. We are sure that the pursuit of carbon neutrality will drastically change the conventional heavy supply chains of electric power built for thermal, nuclear and hydraulic power generation. As the spread of solar panels, electric vehicles and other types of storage batteries to households, it will become commonplace for electric power produced in the day to be consumed at households and for surplus power to be sold. If the power trading market is closer to individuals, they may earn money through power trading. Further expansion of renewable energy will bring about a paradigm shift in businesses surrounding energy and create a huge business opportunity. If we overcome the energy crisis and accelerate the shift to distributed power supplies and renewable energy, we can create a clean world that people find comfortable to live in. This cannot be realized by us alone. With the help of the KDDI Group and partner companies, we will work together to establish carbon neutrality and to resolve climate issues.

*1 A virtual power plant is an integration of small-sized power plants and power demand control systems with the use of IoT and other technologies to control them as if they were a single power plant.

*2,3 KDDI Green Partners Fund →P71



Values we embrace (5)

Carbon Neutral

[Mid-Term Sustainability Targets (FY23.3-FY25.3)]

Carbon Neutral*

- Fiscal **2026** (data centers)
- Fiscal **2030** (KDDI non-consolidated)
- Fiscal **2050** (KDDI Group)

Percentage of corporate contracts supplied with renewable energy

Over 60%

Providing next-generation renewable energy solutions

- EV station installation**
- Virtual power plants (VPP)**
- IoT-based renewable energy infrastructure maintenance**

* Scope 1+2

- [Concrete Actions]
- ▶ **Shift of data centers to electric power derived from renewable energy**
 - ▶ **Sharing of base stations with other communications operators**
 - ▶ **Power conservation of communication servers with the use of artificial intelligence (AI)**
 - ▶ **Liquid immersion technologies for cooling IT equipment**
 - ▶ **KDDI Green Partners Fund for supporting start-ups tackling climate issues**
 - ▶ **Offering of an Eco Plan in the au Electricity service for supplying electric power derived from net 100% renewable energy with net zero CO₂ emissions (to personal customers)**
 - ▶ **Offering of decarbonized options and solutions (to corporate customers)**

- [Strengths]
- **Technological and business collaboration with partner companies**
 - **Application of verified new technologies within the KDDI Group**
 - **A rich customer base and contacts with customers through au Shops and others**

[Risks]

- Increase in power consumption due to expansion of 5G service areas
- Negative impact of typhoons and other natural disasters arising from climate change on the communication business

[Opportunities]

- Business growth through construction of environmentally friendly base stations and provision of ICT-based services that lead to energy conservation and environmental impact reduction in different countries and regions

- [Social Issue]
- Emergence of various risks from intensifying global warming and climate changes
 - Energy crisis following international conflicts and similar events

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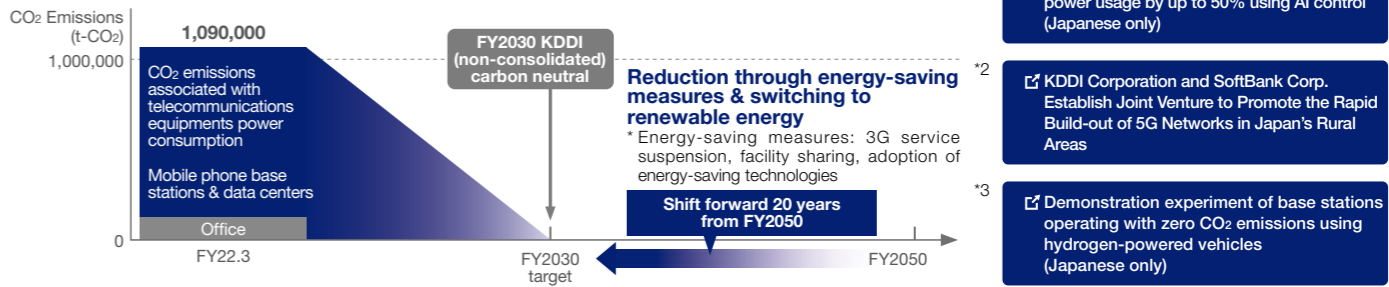
Aim to Achieve Net-Zero CO₂ Emissions in Our Business Activities by fiscal 2030

KDDI aims to achieve net-zero CO₂ emissions in its business activities by fiscal 2030. The KDDI Group as a whole aims to achieve net-zero CO₂ emissions by fiscal 2050.

Efforts to reduce CO₂ emissions

- Switching to renewable energy to supply the electricity used at base stations and telecommunications facilities (including the use of non-fossil certificates)
- Use of renewable energy in KDDI offices
- Installation of solar power generation equipment at base stations
- Introduction of energy-efficient technologies at base stations and telecommunications facilities*¹
- Shared use of base stations with other companies*²
- New energy-efficient telecommunications facilities
- Optimization of air conditioning efficiency in data centers
- Use of hydrogen-powered vehicles during disasters and other emergencies*³
- Investment in environmentally-friendly initiatives through the KDDI Green Partners Fund

Roadmap Toward Net-Zero CO₂ Emissions



Aim to Achieve Carbon Neutrality in Worldwide Data Centers* by Fiscal 2026

As a telecommunications carrier, KDDI believes that the provision of its telecommunications services can improve broader operational efficiency, thereby contributing to a general reduction in CO₂ emissions and revitalizing society.

In terms of reducing the burden caused by its own power consumption, KDDI will significantly accelerate previous emissions reduction targets through energy-saving measures and

technological innovation in renewable energy. Our data centers, which we operate globally under the TELEHOUSE brand name, will be among the first to achieve carbon neutrality by fiscal 2026.

* Refers to data centers where the KDDI Group owns the buildings and facilities; excludes the data center facilities that provide services by borrowing some of other companies' facilities and equipment.

Obtained SBT Certification, an International Initiative for Climate Change

In February 2022, the KDDI Group obtained SBT certification under the international Science-Based Targets initiative (SBTi). In addition to the CO₂ emissions reduction targets set by KDDI on a non-consolidated basis (in Japan), the KDDI Group as a whole will further promote measures to address climate change by setting new targets. To reduce CO₂ emissions, we will promote energy efficiency and shift to renewable energy for cell phone base stations and telecommunications equipment.



About this goal

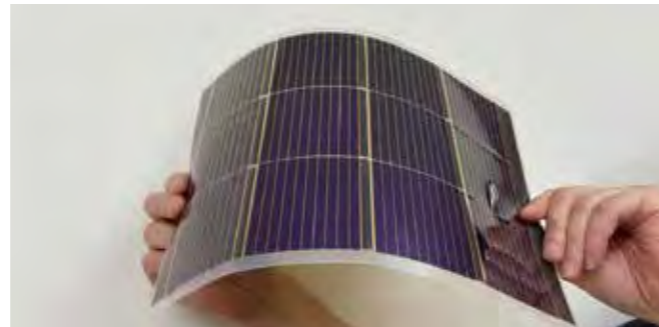
Target Items		Targets (group)
Scope 1	Direct GHG emissions from their business activities	By fiscal 2030, reduce CO ₂ emissions by 50% compared with fiscal 2019
Scope 2	Indirect GHG emissions from the use of electricity, heat, and steam supplied by other companies	
Scope 3	Indirect GHG emissions other than Scope 2 (emissions by others related to business activities)	By fiscal 2030, reduce CO ₂ emissions by 14% compared with fiscal 2019

✔ KDDI's CO₂ Emission reduction Targets obtain approval from SBT Initiative

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KDDI Green Partners Fund

In November 2021, we established the “KDDI Green Partners Fund” to invest 5 billion yen over 5 years to support startups working to address climate change issues. The slogan of the KDDI Green Partners Fund is “Connecting a prosperous planet to the future.” KDDI believes that innovation through co-creation that transcends corporate and organizational frameworks will be a major driving force toward achieving carbon neutrality. We provide funding to startup companies that address climate change issues through this fund. By utilizing KDDI’s various assets as growth opportunities for portfolio companies, we will work together to promote technological innovation and the diffusion and expansion of new technologies in the environmental field. As our first project, in March 2022 we invested in Ene-Coat Technologies Co., Ltd., a developer of next-generation solar cells. More solar power generation facilities are required to achieve carbon neutrality, but in Japan, where flat land is scarce, there is expected to be a shortage of suitable sites for solar power generation facilities. As a solution to this problem, the anticipated next-generation solar cells can be installed in places where the existing technology does not permit this. The perovskite solar cells developed by EneCoat Technologies combine “thin,” “lightweight,” and “bendable” properties with high power generation efficiency and are expected to be applied to building walls and roofs with low load-bearing capacity. They also offer



high power generation efficiency in medium and low-illumination areas, such as under cloudy skies and indoor lighting, where existing photovoltaic systems have been unable to achieve sufficient power generation efficiency. In terms of both area and illumination, these advances are expected to resolve the installation constraints of existing technologies. KDDI is planning to conduct demonstration experiments with Enecoat Technologies on renewable energy generation at cell phone base stations and hopes to install the system at base stations in the future.

🔗 KDDI Green Partners Fund (Japanese only)

🔗 Investment in Enecoat Technologies, a Developer of Next-Generation Solar Cells (Japanese only)

Contributing to the Carbon Neutrality of Society through the Energy Business

On September 1, 2021, the KDDI Group launched the au Electricity “eco Plan,” an environmentally friendly electricity service with virtually 100% renewable energy for individual customers. Under this plan, a portion of the electricity charges is donated to environmental conservation activities, allowing customers to contribute to environmental conservation by subscribing to this plan. The donations will be used for environmental conservation activities such as afforestation and reforestation through the Organization for Industrial, Spiritual and Cultural Advancement (OISCA), an international cooperation NGO that conducts environmental conservation activities and rural development, mainly in the Asia-Pacific region.

The KDDI Group also participated in the Ministry of Economy, Trade and Industry’s “Virtual Power Plant Construction Verification Project” for five years from FY17.3 to FY21.3 and in the “Verification Project for Further Utilization of Distributed Energy Resources” from FY22.3 to FY23.3. In those projects, we accumulated through demonstrations technical issues related to the control of household storage batteries and the improvement of accuracy, as well as the use of 5G communications and Multi-Access Edge Computing (MEC) technologies to achieve higher speed and accuracy.

In the future, we intend to contribute to solving issues related

to the introduction of domestic renewable energy by utilizing the control technology developed through the verification experiment and mobile communications technology such as 5G, which is indispensable for control, to help maintain the balance between supply and demand of electricity.



🔗 Eco Plan (Japanese only)

Utilization of Immersion Cooling Systems and a Demonstration Experiment for the Realization of Small Data Centers

KDDI Corporation, Mitsubishi Heavy Industries, Ltd. (hereinafter referred to as “Mitsubishi Heavy Industries”), and NEC Networks & System Integration Corporation (hereinafter referred to as “NEC Nets-SI”) launched a demonstration experiment on June 21, 2021, to reduce power consumption and promote decarbonization for the purpose of global environmental conservation. The project utilizes immersion cooling systems that cool servers with liquid and has started a demonstration experiment (hereinafter referred to as “the demonstration”) with the aim of realizing a small data center by housing it in a container and implement in Japan in FY23.3.

In this demonstration, KDDI, Mitsubishi Heavy Industries, and NEC Nets-SI bring their respective strengths beyond the industry’s boundaries to house 50 kVA worth of servers and immersion cooling systems in a 12-ft container, aiming for energy efficiency below PUE 1.1 – the lowest level in the industry – while providing sufficient cooling performance. This is expected to reduce the power consumption of the data center by approximately 35%, meeting the challenge of data centers consuming enormous amounts of electricity, thereby reducing CO₂ emissions.

In addition, it will complement existing data center processing by providing more options for data center placement, greatly easing installation environments and conditions and making data centers easier to install, enabling data processing at higher speeds and with

less latency. Furthermore, the high-performance and high-density cooling mechanisms will provide a solution for larger data centers to increase the number of servers and reduce energy consumption.

The three companies will continue to contribute to the development of digital transformation (DX) in Japan as well as to decarbonization and global environmental conservation through this demonstration.



The server cooling system and the small data center

🔗 KDDI, Mitsubishi Heavy Industries, and NEC Nets-SI launching a demonstration experiment for the use of immersion cooling systems and the realization of small data centers (Japanese only)

Reduction of the Electricity Usage Using Base Station AI Control Technology and Base Station Liquid Cooling Technology

On June 18, 2021, KDDI and Nokia Solutions and Networks Japan G.K. (hereinafter referred to as “Nokia”) agreed to conduct a verification test aimed at reducing CO₂ emissions by reducing the power consumption at mobile phone base stations (hereafter referred to as the “Verification Test”). In this Verification Test, Nokia’s two technologies, namely base station AI control technology and base station liquid cooling technology, were introduced into a commercial mobile phone base station for the first time in Japan.

Base station AI control technology analyzes changes in traffic volume at each base station and dynamically stops or fires radio waves to reduce power consumption by up to 50%, while base

station liquid cooling technology aims to reduce power consumption by 70% or more for air conditioning in rooms housing base station equipment.

Based on the results from the verification of the effectiveness of each technology and the confirmation of the service impact on customers, KDDI will conduct necessary additional development and identify target base stations, aiming for full-scale introduction around 2023.

Based on the results of this Verification Test, the two companies will continue to conduct research and development on systems that enable the reduction of CO₂ emissions.

Picture of base station AI control and base station liquid cooling introduction

