

Carbon Neutral Technology Research and Development Program

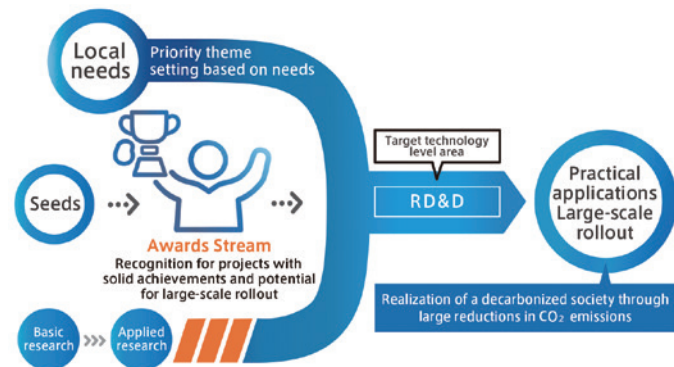
— 2022 —



Ministry of the Environment

What is the Carbon Neutral Technology Research and Development Program?

When it comes to technology research and development to help reduce CO₂ emissions, there is no assurance that sufficient progress will be made if R&D is left to the private sector, due to the large risks and other factors involved. Therefore, the government is playing a leadership role in promoting the R&D of technologies for the large reductions in CO₂ emissions needed to achieve national policies, with the aim of promoting the R&D of technologies that can most effectively reduce CO₂ emissions and result in more robust future actions to address climate change and contribute to the early realization of a decarbonized society. Funding for this program comes from the Special Account for Energy Policy (sub-account for energy supply and demand) so it can only be used for research, development, and demonstration (RD&D) of technologies that can contribute to reductions in domestic energy-derived CO₂ emissions, such as renewable energy and energy conservation. Furthermore, it is aimed at technologies that are at a level of maturity and have a reasonable expectation of finding practical applications, being developed into products, and being widely used after project completion.



Local Co-Creation and Cross-Sectoral Themes

Under this program, themes are determined based on national policies and linked to the needs of local communities and initiatives of government ministries and agencies, and various stakeholders participate as partners in innovation to implement local co-creation and cross-sectoral initiatives. In the 2022 fiscal year (ending March 31, 2023), the program focuses on the following themes.

“Climate Change + Buildings”

This theme focuses on supporting the development and demonstration of technologies that contribute to Climate Change + Buildings, such as further expanding the introduction of renewable energy, reducing energy consumption such as by developing energy-saving renovation technology for the existing building stock, developing high-efficiency energy-saving equipment, introducing energy management systems for houses and buildings, and developing buildings that contribute to the greater use of local renewable energy.

“Climate Change + Agriculture”

Aiming for a complete transition to fossil-free indoor horticulture, this theme focuses on supporting the development and demonstration of technologies that contribute to Climate Change + Agriculture, such as reducing energy consumption by improving thermal insulation technology and environmental control, achieving zero emissions of heat supply equipment, and developing renewable energy power generation equipment that contributes to the sound development of agriculture.

“Climate Change + Local Transportation”

This theme focuses on supporting the development and demonstration of technologies that contribute to Climate Change + Local Transportation, such as energy saving and zero emissions technologies, including operational aspects and infrastructure development for rail, aircraft, ships, etc. They are essential parts of transportation infrastructure that support economic activities and people’s lives as crucial means of transportation for the movement of local residents.

Bottom-Up Stream - Area-Specific RD&D Category

Projects are implemented targeting RD&D to build a circular and ecological economy and to realize a decarbonized society, by leading to stronger future climate actions, where CO₂ emission reductions are relatively significant in each sector, but where development-related risks or other constraints would limit progress if only voluntary private sector efforts were relied upon.

Awards Stream - Innovation Discovery and Acceleration of Large-scale Rollout Category

Through implementation of feasibility studies, research, development and demonstration, this stream aims to bring to reality the ideas of organizations that have been awarded under the Minister of the Environment’s Award for Climate Action (Innovation Discovery and Acceleration of Large-scale Rollout Category), in order to promote the rollout of technologies that can contribute to significant CO₂ emission reductions. (These are organizations that have innovative ideas that can help achieve the Ministry of the Environment’s aim of realizing a decarbonized society, and are highly promising in terms of commercialization and market creation.)

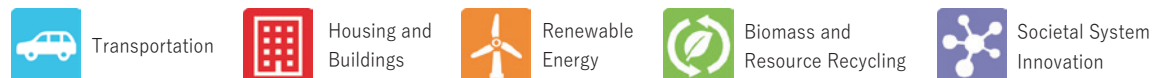
Budget and Project Period

The budget for each project in a single fiscal year (April to March) is 30 - 500 million yen (subsidies are for a maximum of 50% of total project cost, so subsidies could be 15 - 250 million yen). The implementation period for each project is, in principle, a maximum of three years.



Research, Development and Demonstration Program for Local Co-Creation and Cross-Sectoral Carbon Neutral Technologies

Sector icons



Examples of Local Co-Creation and Cross-Sectoral Category

Renovation of existing buildings using Net Zero Energy Building model for realization of a circular and ecological economy

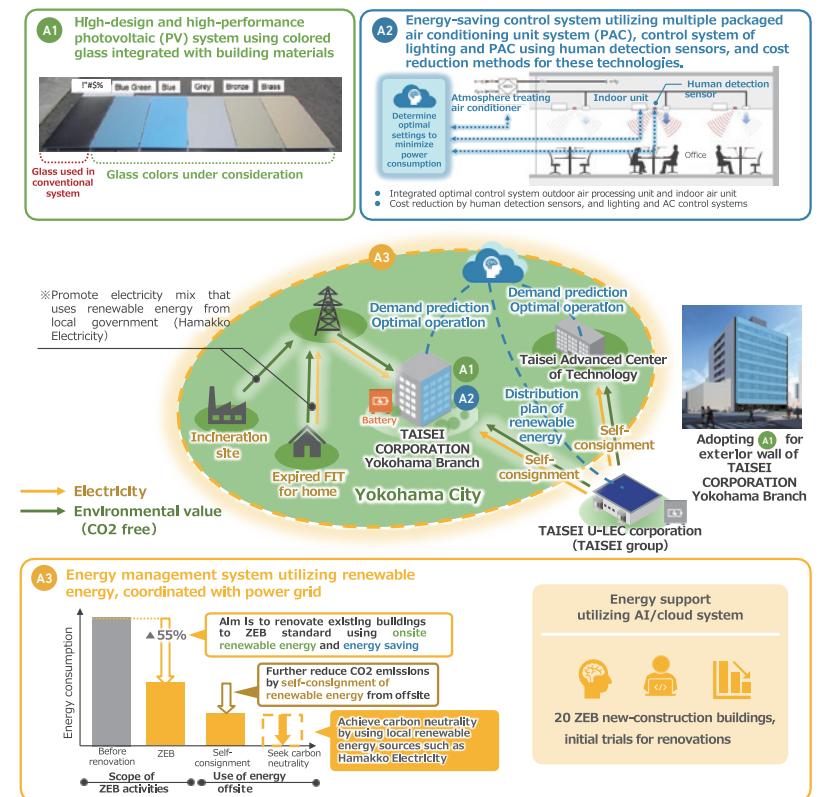
TAISEI CORPORATION

2022 - 2024

Japan’s Sixth Strategic Energy Plan has indicated the aim of achieving energy efficiency at the level of Net Zero Energy House (ZEH) and Net Zero Energy Building (ZEB) standards for the average housing and building stock in Japan by 2050. Accordingly, besides new construction, promoting ZEB by renovating existing buildings is seen as an important effort to achieve carbon neutrality.

In this project, we will develop and demonstrate the following ZEB technologies for renovating existing buildings.

- A1** High-design and high-performance photovoltaic (PV) system using colored glass integrated with building materials.
 - A2** Energy-saving control system utilizing multiple packaged air conditioning unit system (PAC), control system of lighting and PAC using human detection sensors, and cost reduction methods for these technologies.
 - A3** Energy management system utilizing renewable energy and coordinated with the power grid.
- By demonstrating and promoting these technologies, we aim to help speed the realization of a carbon-free society.



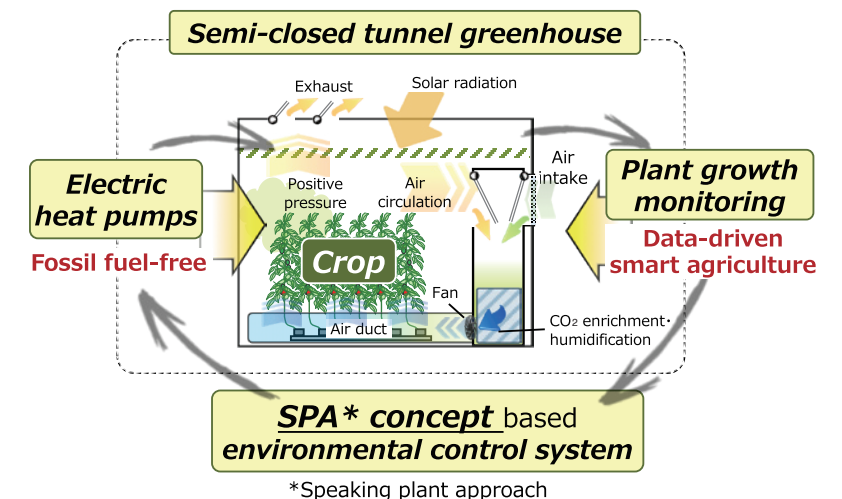
Semi-closed/all electric tunnel greenhouse with “speaking plant approach” environmental control system

Toyohashi University of Technology

(with project partners Watanabe Pipe Co., Ltd., Ehime University, Toppan Inc., Plant Data Co., Ltd., Kyowa Co., Ltd.)

2022-2024

The speaking plant approach (SPA) refers to sensor-based plant diagnostic techniques used to monitor plant physiological status to optimize growth conditions. In this project, we develop a “semi-closed/all electric tunnel greenhouse” with the SPA environmental control system combined with electric heat pumps to achieve fossil fuel-free horticulture by 2050 for the growing of products such as vegetables and flowers. The tunnel type of greenhouse accounts for 96% of all greenhouses in Japan. The highly airtight structure and fully controlled ventilation and air circulation design to be developed in this project will improve the accuracy of environmental control in tunnel greenhouses. Precise air-conditioning by using electric heat pumps based on the real-time monitoring of plant physiological statuses such as photosynthetic rate, transpiration rate, and daily growth will reduce fossil fuel use and improve the productivity of horticultural crops.



Examples of Priority Themes Category (themes used until 2021)

Energy self-sufficient unit

SEKISUI CHEMICAL CO., LTD.

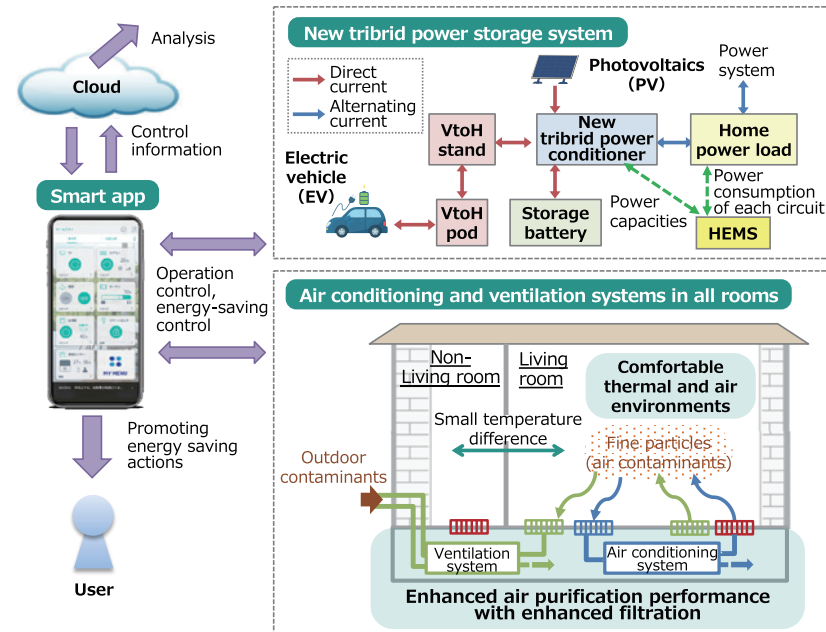
(with project partners The University of Tokyo, Central Research Institute of Electric Power Industry (CRIEPI), NICHICON CORPORATION)

2021 - 2022

Households are responsible for 21% of Japan's greenhouse gas emissions.*1 Greater energy self-sufficiency in households help could significantly reduce the nation's CO₂ emissions.

This project aims to do so by improving household energy self-sufficiency through integrated research and development of residential energy solutions, such as photovoltaic power generation systems, storage batteries, electric vehicles, and green air conditioning/ventilation systems. We aim to achieve an average energy self-sufficiency rate of 60% and a reduction in annual CO₂ emissions of 6.93t/building (compared with typical households in 2013). In addition, during a disaster, the combination of advanced unit construction methods, strong structures, and resilience methods, can make it possible to evacuate at home and avoid exposing people to the three Cs (closed spaces, crowded places, close-contact settings) at evacuation centers. The technology developed will be installed into housing modules and promoted broadly to verify effectiveness.

*1 Fiscal 2021 White Paper on the Environment (Japan Ministry of the Environment)



Zero-emission agriculture with cogeneration, using ammonia-fueled micro gas turbine

TOYOTA ENERGY SOLUTIONS INC.

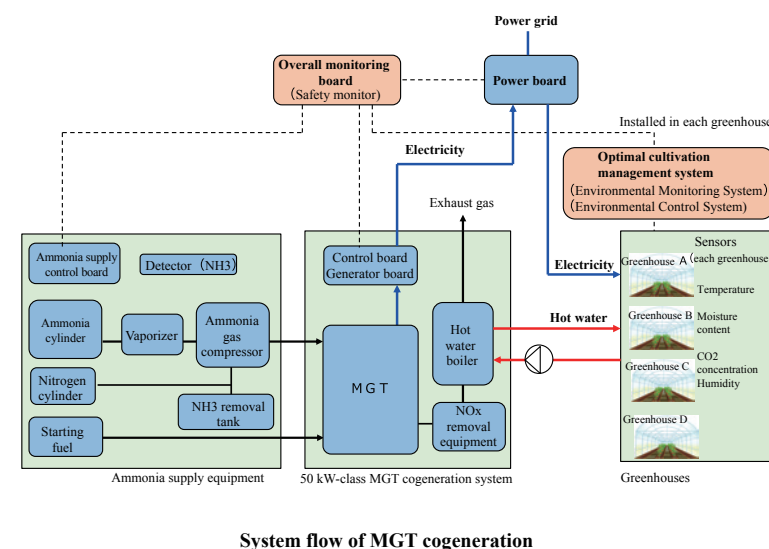
(with project partners Akita Agricultural Sales Co., Ltd., Japan Coal Frontier Organization, Akita Prefectural University, National Institute of Advanced Industrial Science and Technology, Tohoku University)

2021 - 2022

Fuel ammonia is an important component of Japan's Green Growth Strategy Through Achieving Carbon Neutrality in 2050. Japan has been a leader in related technological development.

In agriculture, the idea of promoting year-round cultivation has been discussed as a way to stabilize employment and profitability, but one problem is the CO₂ emissions that would result from the consumption of kerosene and electricity for heating and cooling.

To optimize year-round cultivation and reduce CO₂ emissions, this project will demonstrate the potential of zero-emission agriculture by utilizing an ammonia-fueled micro gas turbine (MGT) that does not emit CO₂. We will grow tomatoes and strawberries in four greenhouses using a demonstration system consisting of ammonia supply equipment (vaporizer and compressor for ammonia from a cylinder), a 50 kW-class MGT, space heating/cooling and hot water supply components. Our aim is to improve agricultural productivity and contribute to efforts to make agriculture carbon neutral.



Examples of Bottom-Up Stream - Area-Specific RD&D Category

Ammonia-fueled small internal combustion engines for decarbonization in various industries

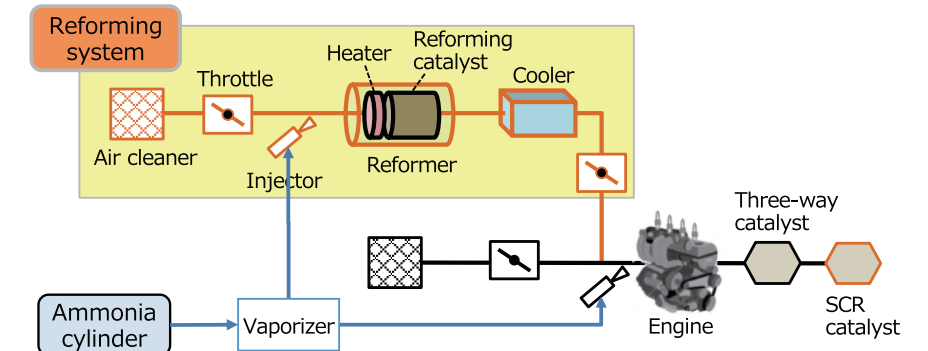
Toyota Industries Corporation

(with project partner Osaka Gas Co., Ltd.)

2021-2022

In an attempt to reduce CO₂ emissions, technologies are being developed for direct use of ammonia in large-scale power plants (in large gas turbines, etc.). However, it is difficult to electrify some small and medium-sized motive power sources in the industrial sector due to constraints of application, usage environment, and infrastructure, etc. These kinds of uses require low cost and high convenience.

The purpose of this project is to develop an engine system that runs on ammonia single fuel, for use in small and medium-sized industrial machines, and demonstrate its effectiveness, in order to promote the use of ammonia and accelerate decarbonization in uses where electrification is difficult. Because ammonia has poor combustibility, our group aims to develop 4-cylinder inline spark-ignition type small industrial engines with an on-board reforming system, for co-firing of ammonia with hydrogen reformed partially from ammonia.



Low-carbon approach to heavy truck logistics using a distributed network of small-scale LNG filling stations

Mitsubishi Corporation

(with project partner Air Water Inc.)

2021 - 2022

Mitsubishi Corporation and Air Water Inc. have jointly developed Japan's first compact LNG filling facility for large LNG-powered trucks in Japan.

Unlike trucks powered by electric batteries or fuel cells, LNG trucks have ranges in excess of 1,000 kilometers, and have load capacity and filling time similar to diesel-fueled trucks. These next generation LNG trucks can also cut CO₂ emissions by more than 10% compared to diesel-fueled trucks. By creating a distributed network of small-scale LNG filling stations to provide an efficient fuel supply system for the LNG trucks, this project aims to help move toward a low-carbon or decarbonized society.

From 2022, we began filling facility test operations in Tomakomai City and Ishikari City in Hokkaido, as well as trial operations of LNG trucks manufactured by Isuzu Motors Ltd..



Examples of Bottom-Up Stream - Area-Specific RD&D Category

Low-voltage wind turbine system

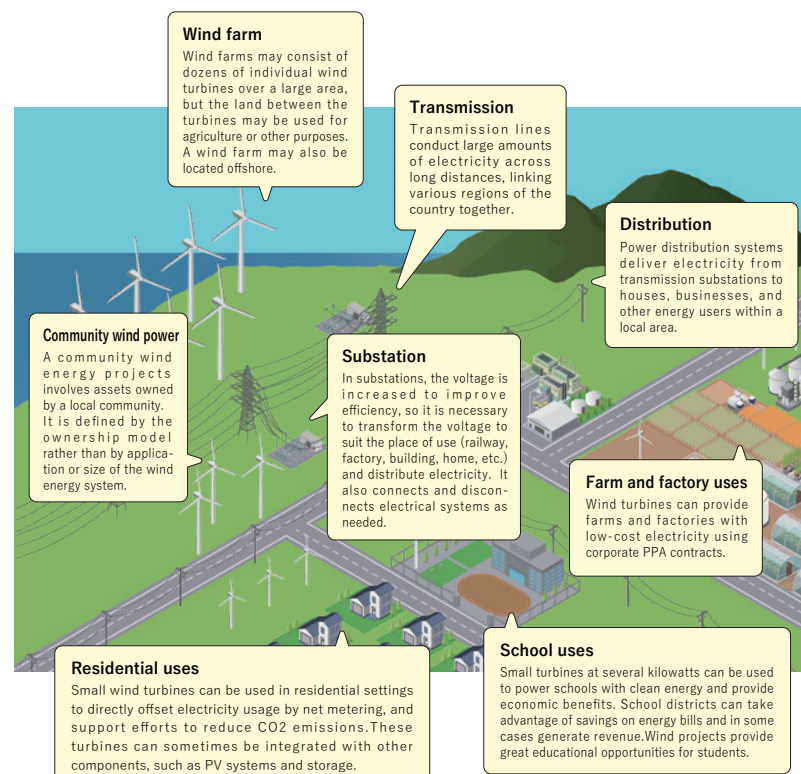
Zephyr Corporation

(with project partners JATCO Ltd., Ricoh Japan Co., Ltd., Daiki Axis Sustainable Power Co., Ltd.)



2020 - 2022

Companies today are being encouraged to install their own renewable energy sources and consume the energy onsite. Problems in attempting to use photovoltaic power generation alone include daytime/nighttime and weather-related fluctuations in the amount of electricity generated, significant investment needed for power storage equipment, and insufficient electricity output if solar panels are installed only on factory roofs and facilities. To maximize the introduction of renewable energy into low-voltage grids and minimize the need for expensive batteries, there is a need to develop quiet, socially-acceptable, cost-effective wind turbines. Wind turbine design is complex and requires parallel processes to verify and evaluate the data obtained from simulations and field tests. This project will develop cost-effective wind turbines by testing and using parts from the automobile industry.



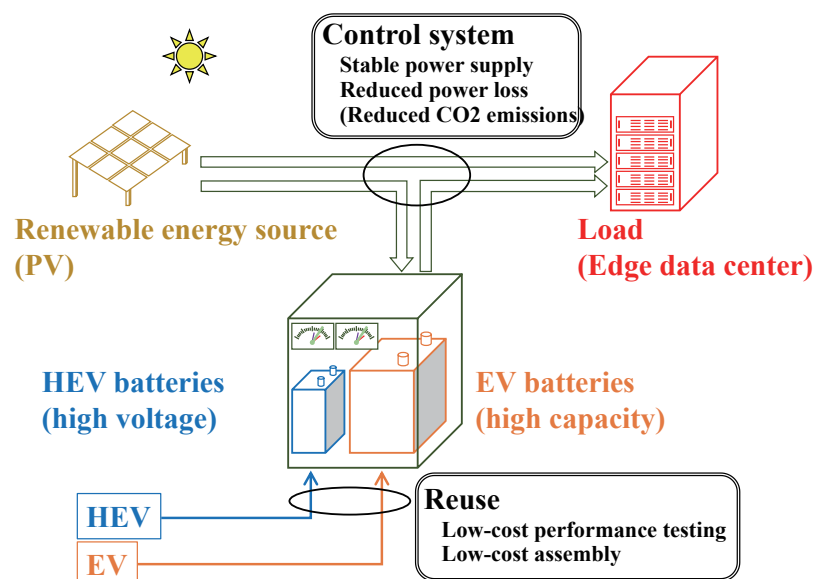
Circular-type energy storage system for edge data centers

Ricoh Company, Ltd.



2021 - 2022

Electricity consumption by data centers (DCs) is expected to grow dramatically with rising digital communications speeds and information flows, and the expansion of related infrastructure. There is a need to develop carbon-neutral technologies to supply electricity to DCs without the use of power generation from fossil fuels, which emit CO₂. This project will develop a storage system to provide electricity to DCs from photovoltaic power generation (PV). Used lithium-ion batteries (LIBs) from hybrid electric vehicles (HEVs) and electric vehicles (EVs) will be repurposed to store surplus electricity generated by PV and supply it as needed to DCs. The aim of this project is to develop and establish control technologies for LIBs of varying input and output parameters in order to reduce power loss in storage systems, as well as LIB testing technologies to reduce costs, and technologies to provide a stable supply of electricity to DCs that can reduce carbon emissions at a target cost of 8,000 yen/t.



Examples of Bottom-Up Stream - Area-Specific RD&D Category

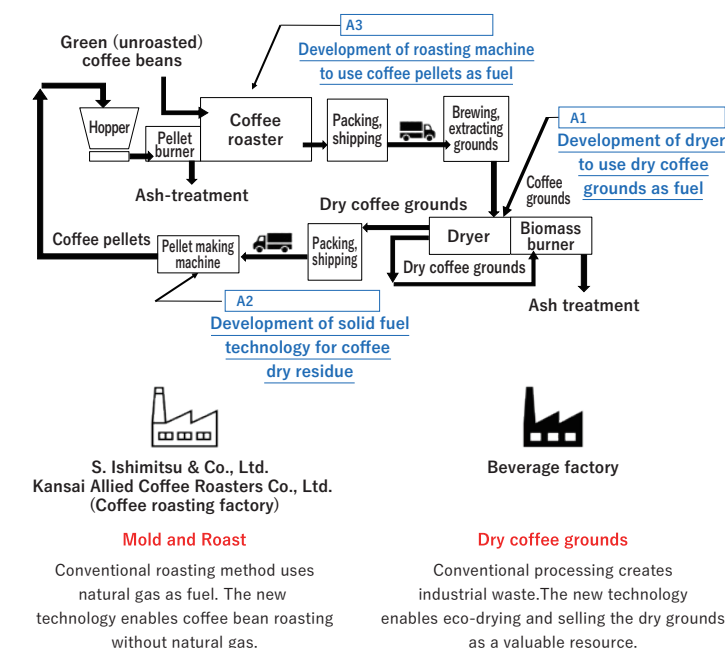
Creating solid fuel from coffee grounds and developing green roasting technology for coffee beans

Kansai Allied Coffee Roasters Co., Ltd.



2021 - 2022

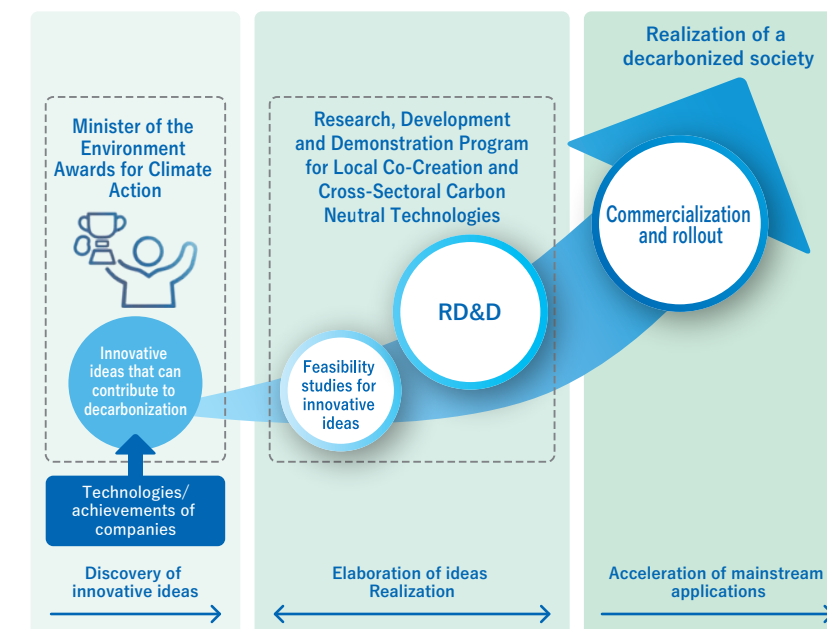
Global coffee consumption is increasing steadily, but production could decline in the future. World Coffee Research, a research institute, suggests that due to global warming, coffee may not taste as good in 2050 as it does today. Our aim is to supply coffee while also being aware of climate change and working to reduce GHG emissions. Annual coffee consumption in Japan is about 500,000 tons, and most coffee grounds produced as a byproduct of manufacturing processes are treated as municipal or industrial waste. Some coffee grounds are used as fertilizer or feed, but a better way to use them may be as fuel, due to their high calorific value. With this R&D project, we aim to realize a circular economy system by developing a method to dry coffee grounds and use them as fuel to dry the grounds and roast coffee beans. If this system is put into practical use, it will be possible to reduce GHG emissions and to reduce the amount of waste produced.



Awards Stream - Innovation Discovery and Acceleration of Large-scale Rollout Category

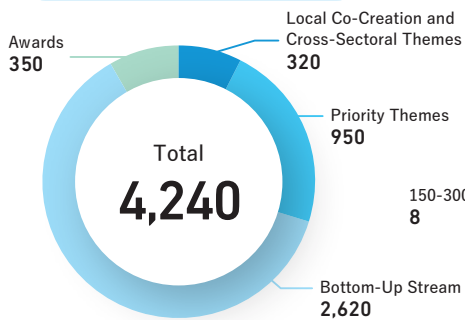
The aim of this category is to support innovative ideas that can help achieve the Ministry of the Environment's aim of realizing a decarbonized society, are highly promising in terms of commercialization and market creation, and also have a high likelihood of rapidly achieving practical application. Organizations that have received the Minister of the Environment's Award for Climate Action (Innovation Discovery and Acceleration of Large-scale Rollout Category) are eligible. In 2021, two companies received the Minister of the Environment's Award for Climate Action (Innovation Discovery and Acceleration of Large-scale Rollout Category), and feasibility studies (FS) are now under way.

In 2020, submissions were invited under the Low Carbon Technology Research, Development and Demonstration Program awards stream for "Achievements and ideas for utilizing renewable energy as a major electrical power source to strengthen resilience and accelerate the transition to a decarbonized and decentralized society." UPDATER, Inc. was selected for its significant contributions to promoting the user-driven adoption of renewable energy on the electricity demand side.

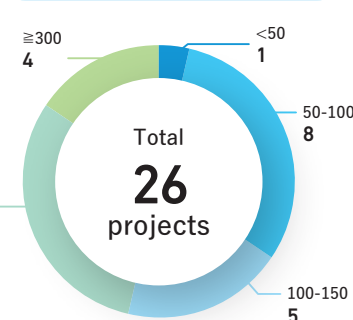


Share by Category (2022)

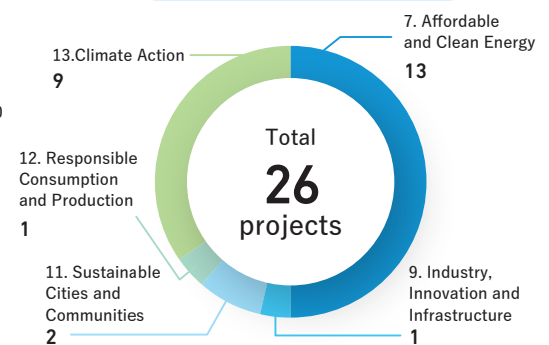
Budget allocation for each area (million yen)



Number of projects by budget size (million yen)



Sustainable Development Goals



Ongoing Projects in 2022

Local Co-Creation and Cross-Sectoral Themes				
"Climate Change + Buildings"				
	TAISEI CORPORATION	2022 - 2024	Renovation of existing buildings using Net Zero Energy Building model for realization of a circular and ecological economy	
"Climate Change + Agriculture"				
	Toyohashi University of Technology	2022-2024	Semi-closed/all electric tunnel greenhouse with "speaking plant approach" environmental control system	
	National Agricultural and Food Research Organization	2022-2024	Net zero energy greenhouse (ZEG) for the decarbonization of horticulture	
Priority Themes Category				
	SEKISUI CHEMICAL CO., LTD.	2021-2022	Energy self-sufficient unit	
	MARINE ENERGY Co., Ltd.	2020-2022	Regional circular-economy business scheme with intelligent wave power generation system	
	AIR WATER INC.	2021-2022	Liquefied biomethane regional supply chain model using unused biogas	
	Hitachi, Ltd.	2021-2022	RE100 distributed power supply utilizing food processing waste	
	TOYOTA ENERGY SOLUTIONS INC.	2021-2022	Zero-emission agriculture with cogeneration, using ammonia-fueled micro gas turbine	
Bottom-Up Stream - Area-Specific RD&D Category				
	NAIKEN R&D	2022-2023	Zero-emission agriculture with cogeneration, using ammonia-fueled micro gas turbines	
	Toyota Industries Corporation	2021-2022	Ammonia-fueled small internal combustion engines for decarbonization in various industries	
	Mitsubishi Corporation	2021-2022	Low-carbon approach to heavy truck logistics using a distributed network of small-scale LNG filling stations	
	Sharp Corporation	2022-2024	Energy storage technology using zinc to attain carbon neutrality	
	Mitsui O.S.K. Lines, Ltd.	2022-2024	Ocean thermal energy conversion utilizing deep seawater on Kume-Jima for a circular and ecological economy	
	Riamwind Co., Ltd.	2022-2024	200 kW mid-size wind lens turbine and multi-rotor system	
	TOKO TSUSHO CORPORATION	2020-2022	High-performance energy recovery type thermoelectric power generation system with new domestically-made power generation components	
	Zephyr Corporation	2020-2022	Low-voltage wind turbine system	
	Asahi Pretec Corp.	2021-2022	System development toward a green hydrogen supply chain by the effective use of by-products	
	Ricoh Company, LTD.	2021-2022	Circular-type energy storage system for edge data centers	
		Suzuki Shokai Co., Ltd.	2022-2024	Development of next-generation low-concentration aluminum dross effective utilization technology for carbon neutrality
	Sumitomo Mitsui Construction Co., Ltd.	2022-2024	Energy recovery technology using only manure from egg-laying chickens	
	Hitachi Zosen Corporation	2020-2023	Next-generation waste treatment system for high-efficiency energy utilization	
	SHIMIZU CORPORATION	2020-2022	Low-cost low-carbon hydrogen production utilizing geothermal and biomass resources	
	Kansai Allied Coffee Roasters Co., Ltd.	2021-2022	Creating solid fuel from coffee grounds and developing green roasting technology for coffee beans	
	Takenaka Corporation	2021-2022	Biogas recovery from kitchen wastewater using low-temperature UASB reactor	
	Pacific Power Co., Ltd.	2022-2024	Optimization of renewable power generation based on real-time CO ₂ emission intensity of electricity	
Awards Stream - Innovation Discovery and Acceleration of Large-scale Rollout Category				
	UPDATER, Inc.	2021-2023	Power traceability system using SaaS type P2P trading platform functions	