2021

CO_2

Low Carbon Technology Research, Development and Demonstration Program

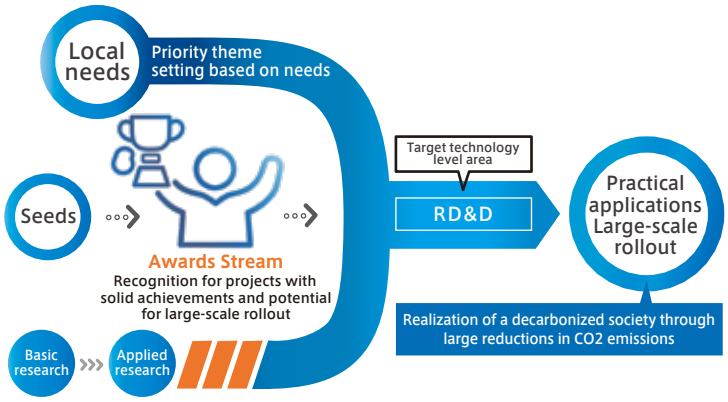
Ministry of the Environment, Government of Japan

Low Carbon Technology Research, Development and Demonstration Program

When it comes to technology research and development to help reduce CO2 emissions, there is no assurance of sufficient progress if R&D is left to the private sector, due to the large risks involved and small incentives for industry. Therefore, under this program the government takes the lead in promoting the R&D of technologies for the large reductions in CO2 emissions needed to achieve national policies, with the aim being to promote 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 RD&D for technologies that can contribute to reductions in energy-derived CO2 emissions in Japan, such as renewable energy and energy conservation. Furthermore, this program is aimed at technologies that are at a level of maturity and have a reasonable expectation to be applied practically, developed into products, and be viable for business soon after project completion.

Eligible Technology Areas

To realize a decarbonized society by strategically deploying and promoting leading-edge technologies in society, this program has a top-down stream (priority themes) to address local needs while also considering national policies, in parallel with a bottom-up stream based on technology seeds, and an awards stream, all aiming for the rapid application of technologies that can reliably contribute to significant CO2 emission reductions.



1. Priority Themes Category

These projects identify issues as priority themes that are closely connected with local needs while also considering national policies, and carry out open innovation-type initiatives in which a variety of stakeholders participate as innovation partners. In FY2021, responding to the intensification of natural disasters and extreme weather events of recent years, projects are being implemented on two themes: mitigation measures that will help reduce future disaster risks ("climate variability and disaster prevention"), and considering the situation of the spread of the COVID-19 pandemic, mitigation measures that will also help control infectious diseases ("Climate Change and Infectious Disease Countermeasures").

* Budget: 200 million to 700 million yen per year per project
(subsidy based on project cost, 50% subsidy provided)
* Project period: Until end of FY2022

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

Projects are implemented in the following two areas for RD&D to build a circular and ecological economy and to move toward a decarbonized society, by leading to stronger future climate actions, where CO2 emission reductions are relatively significant in each area, but due to development risks or other constraints, insufficient progress would be made if relying only on voluntary efforts of the private sector.

* Budget: 30 million to 500 million yen per year per project(subsidy based on project cost, 50% subsidy provided)
* Project period: Until end of FY2022

■Social Transformation Area ("Climate Change and Social Transformation")

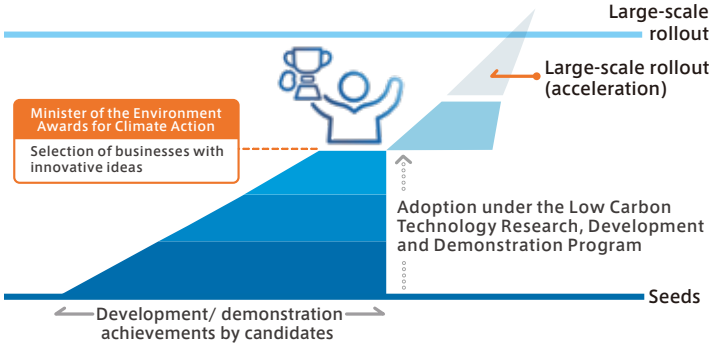
The aim is to foster innovation that leads to major reductions in energy consumption, not just in vehicles and individual buildings, but also through optimization of social infrastructure and societal systems as a whole, including transportation, energy, and structures.

■Local Resource Use and Circular Economy Area ("Climate Change and Circular Economy")

The aim is to foster innovation that contributes to the establishment of a circular and ecological economy that also leads to regional development, by having each region make the best use of its unique resources and form self-reliant and decentralized communities within which resources circulate, while also having synergies with surrounding regions, and utilizing technologies such as AI and IoT to complement and effectively utilize resources through broader regional networks.

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

Businesses that receive the Minister of the Environment Awards for Climate Action (those that have made significant achievements in the development and demonstration of technologies that can contribute to the reduction of CO2 emissions, and are promising in terms of product development, market creation, and contributing to the realization of a new decarbonized society as aimed for by the Ministry of the Environment) benefit from measures (provisional adoption) over the course of a year, including the right to conduct feasibility studies, preliminary studies and early development, and after evaluation through a stage-gate process in the second half of the adoption period, to implement the proposed RD&D starting the subsequent year. This year the theme of the awards is "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."



*Minister of the Environment Awards for Climate Action (2021) https://www.env.go.jp/earth/ondanka/min_action_award/index.html

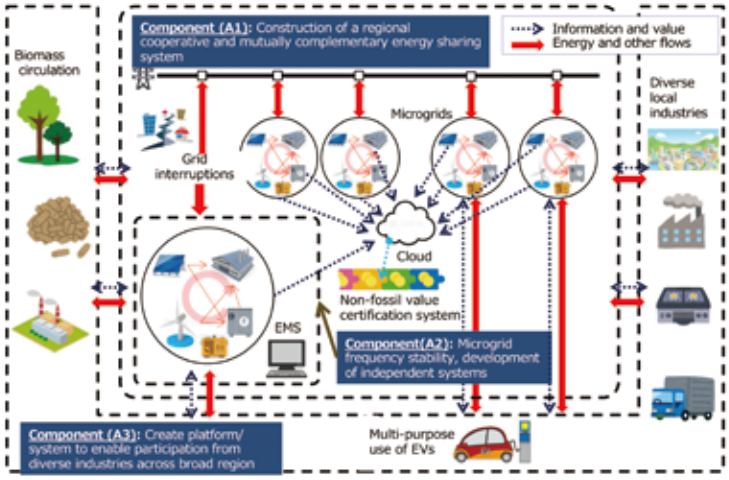
Example: Priority Themes Category

RD&D and technologies for cost reduction to build a decarbonized energy value chain by effectively utilizing a wide variety of local resources to create a circular and ecological economy; and to help make primary (resource) industries as a whole carbon-neutral

Strengthening systems to produce and consume energy locally through inter-regional cooperation and complementarity

Contractor : IHI Corporation (with project partners Tohoku University)

Duration : FY2020 – 2021



Strengthening systems to produce and consume energy locally through inter-regional cooperation and complementarity
Contractor : IHI Corporation(with project partners Tohoku University)
Duration : FY2020 – 2021

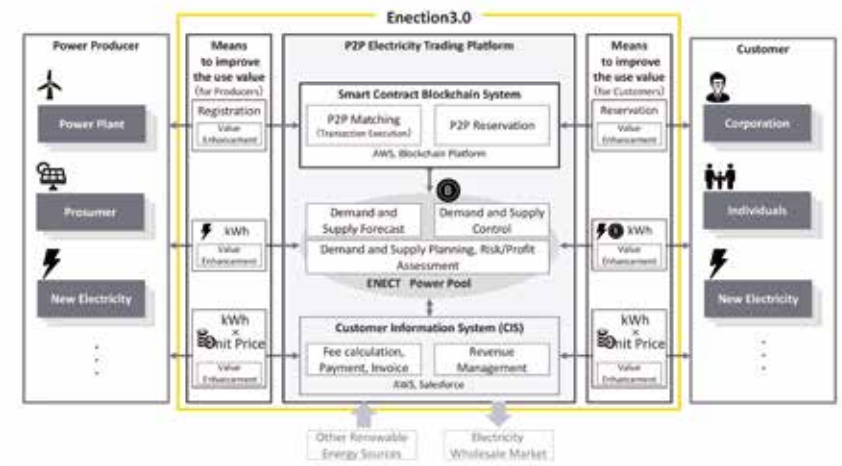
Project Overview
To achieve the goal of carbon neutrality by 2050, the share of renewable energy in Japan' s electricity mix urgently needs to be increased. However, there are some problems with renewable energy: surplus power once generated cannot be supplied to the grid unless there is demand for it; frequency fluctuations must be suppressed in order to contribute to local demand using private power lines; and challenges with effective use of renewable energy value. This project aims to address these issues by developing three components: (A1) a blockchain-based energy sharing system in which renewable energy sources and adjustable power sources are coordinated and complementary over a wide area; (A2) a resilient frequency-stabilized micro-grid system that combines renewable energy equipment, batteries, and generators; and (A3) a platform system in which diverse industries can participate and transact in renewable energy and renewable energy value. Then the project will develop an energy system for local production and local consumption by linking A1 to A3 to lower the hurdles for the introduction of renewable energy and contribute to reductions in CO2 emissions.

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

Power traceability system using SaaS type P2P trading platform functions

Contractor : UPDATER, Inc.

Duration : FY2021 - 2023



Project Overview
The adoption and expansion of renewable energy as a means of supplying electricity is essential for reducing CO2 emissions. To achieve this, stable revenue sources are needed to enable renewable energy development without relying on public funding after Japan' s feed-in tariff (FIT) system ends. This project is developing the Enection3.0 electricity traceability system, equipped with a SaaS-type P2P trading platform, using blockchain technology for power purchase agreements (PPAs) between power producers and customers, to mitigate purchase price variability risks (i.e., risk of not recouping investment), and to increase the number of contracts by satisfying the user' s need for diversity in renewable energy choice. The project will also demonstrate that this system can create new markets where energy consumers can independently support producers and contribute to the expansion of renewable energy without placing a burden on public funds.

Examples: Bottom-Up Stream - Area-Specific RD&D Category (Social Transformation)

Technologies for energy storage using hydrogen, batteries, capacitors, thermal storage, etc.; technologies for innovation to promote decarbonization by improving societal systems such as energy and information infrastructure by using IoT, AI, and big data analysis, etc., to increase self-sufficiency and decentralization, efficiency, and/or resource conservation, etc.; technologies to promote human behavioral changes leadingto innovation to decarbonize lifestyles; technologies to promote zero emissionssuch as by using EVs and other electric vehicles as mobile storage batteries

Production method of low-cost high-efficiency multi-stacked neodymium-iron-boron magnets for traction motors for EVs and FCVs

Contractor : NDFEB Corporation (with project partners e-Gle Co.,Ltd.)

Duration : FY 2019 - 2021

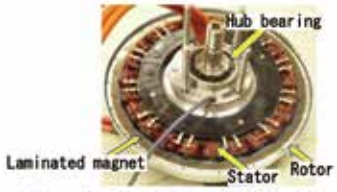
Project Overview

Vehicle electrification is being promoted to help realize a decarbonized society, but there are resource constraints on the large quantities of heavy rare earth materials needed to boost heat resistance of the neodymium magnets used in EV drive motors. The purpose of this project is to develop low-priced, high-efficiency neodymium magnets for EV traction motors with the minimum use of heavy rare earth materials. We proposed multi-stocked neodymium magnets consisting of 2 mm thick component magnets in EV motors to minimize eddy current loss. Heat resistance of the magnets is enhanced by realizing the grain boundary diffusion effect in which a small amount of heavy rare earth powder placed between component magnets before lamination is diffused internally during hot pressing, followed by heat treatment of the multi-stacked magnets. To minimize cost, we developed a hot press process to produce multi-stacked magnets directly from magnet powder without machining. Thus, we have been able to develop neodymium magnets for EV traction motors with less concern about the availability of heavy rare earth materials, having higher magnetic properties and lower costs than the existing neodymium magnets.

A low-cost high-performance laminated neodymium magnet

B_r(kG)	J_s(kG)	H_{cJ}(kOe)	$(BH)_{max}$ (MGOe)	B_r/J_s(%)	H_k/H_{cJ}(%)
14.3	14.8	24.8	49.7	97.1	95.2

Magnetic properties of a laminated neodymium magnet (no heavy rare-earth elements in base magnets)



Example of an EV main motor with laminated magnet (in-wheel motor by e-Gle Co., Ltd.)

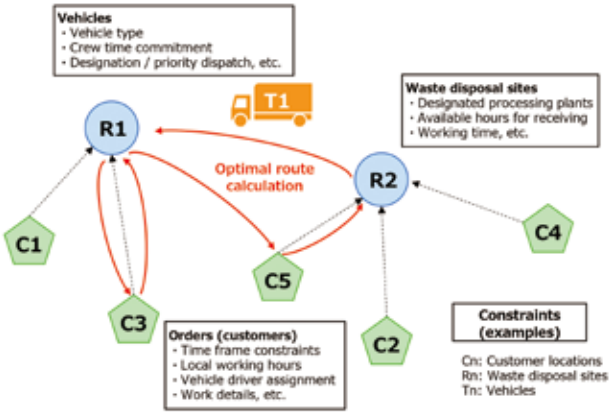
Automatic dispatching system for waste collection and transport vehicles using AI and IoT

Contractor : DAIEI KANKYO CO., LTD. (with project partners EII, Inc.)

Duration : FY2019 – 2021

Project Overview

The project developed an AI-based vehicle allocation algorithm that can reduce CO2 emissions by at least 5% by optimizing industrial waste collection and transport routes. Because about 80% of CO2 emissions from industrial waste collection and transport vehicles are attributed to driving, optimization of driving routes can greatly contribute to CO2 emission reductions. In a route optimization problem in the waste treatment sector as illustrated in the figure, the optimal route must satisfy complex industry-specific constraints, and the solution must be calculated quickly and provide real-time understanding of the situation. The project applied the Monte Carlo Tree Search (MCTS) method used to analyze the traditional board game Go to develop a vehicle allocation algorithm that outperforms the results of manual allocation, with added benefits of reduced fuel-derived CO2 emissions and calculation time. The systematization of vehicle dispatch operations with this algorithm is expected to have multiple benefits compared to conventional analog methods using whiteboards and paper, such as improving operational efficiency, preventing human error, reducing the burden of dispatch work, and equalizing the workload of crew members.



Design of an automatic dispatch system with an algorithm that quickly and automatically calculates optimal routes while satisfying industry-specific constraints and outperforming manual calculation

Examples: Bottom-Up Stream - Area-Specific RD&D Category (Social Transformation)

Technologies to achieve zero emissions and improve energy efficiency of homes and offices by introducing energy saving and renewable energy for building equipment and facilities.

Enhanced manufacturing techniques for low CO2 emission concrete construction materials

Contractor : Nakagawa Humepipe Industry Co., Ltd. (with project partners Central Research Institute of Electric Power Industry, JAPAN COAL FRONTIER ORGANIZATION)

Duration : FY 2018 - 2020

Project Overview

Cement concrete is widely used as the main material in buildings and civil engineering structures. However, cement, which serves as a binder, generates about 760 kg-CO2/ton of production. This project established geopolymer concrete mass production technology that can reduce CO2 emissions by 70% by effectively utilizing a large amount of industrial by-products such as coal ash instead of cement. By eliminating the use of water glass, this project also improved manufacturability and cost of geopolymer concrete. Since this concrete has higher chemical durability compared with conventional concrete, this technique enables the extension of the service life of concrete structures. In terms of the entire life cycle of civil engineering and building structures, this product can significantly reduce total costs and CO2 emissions, thereby contributing to sustainability and carbon neutrality in the construction industry.

High-efficiency low-cost gas differential pressure power generation equipment package

Contractor : TOHO GAS CO.,LTD.

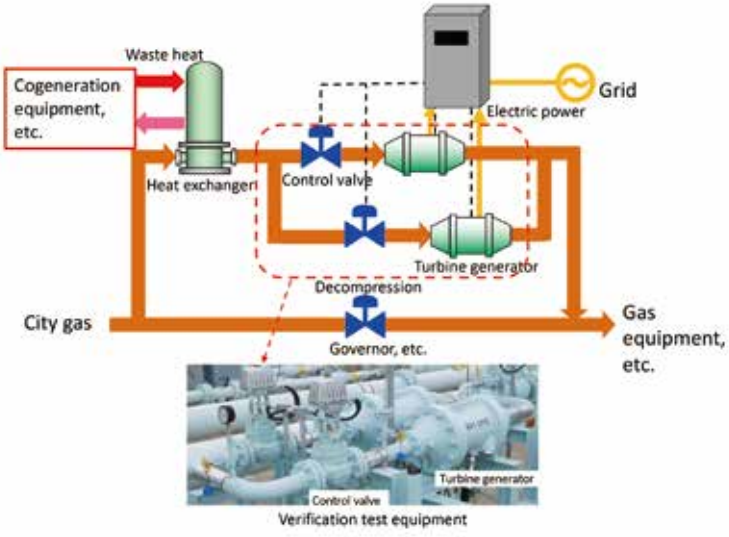
Duration : FY2019 – 2021

Project Overview

City gas is pressurized so it can be transported through pipelines. Gas pressure must be lowered before reaching the customer. Governors are typically used to throttle pressure, but they waste energy. This project focuses on using the energy to spin a turbine and generate electricity as it lowers gas pressure.

Generation equipment using this technology can provide stable electrical output at a high operating rates. However, the widespread use of conventional power generation equipment can be limited by installation costs, maintenance costs, and space availability.

This project aims to develop a system that uses compact turbines directly coupled to generators to utilize the differential pressure, in order to create high efficiency, significantly reduce installation and maintenance costs, and minimize space requirements. Packaging the technology this way will promote the use of this differential pressure power generation equipment and contribute to CO2 emission reductions.



Examples: Bottom-Up Stream - Area-Specific RD&D Category (Local Resources and Circular Economy)

Technologies to reduce overall system costs, from the collection to the utilization of wastederived biomass

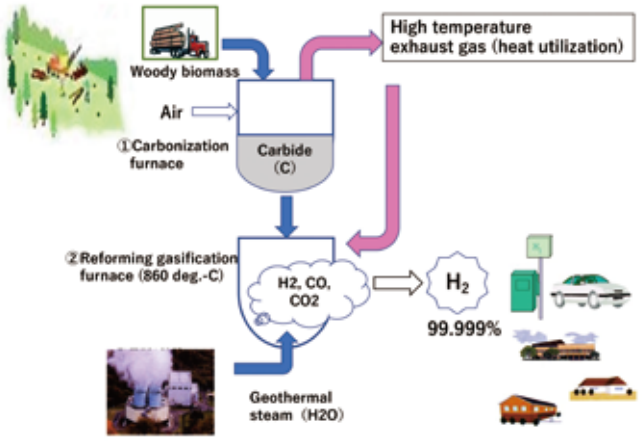
Low-cost low-carbon hydrogen production utilizing geothermal and biomass resources

Contractor : SHIMIZU CORPORATION (with project partners Enecycle Inc., DAINICHI Machine and Engineering Co., Ltd., HYDRONEXT Inc., ICHIKAWA OFFICE Ltd.)

Duration : FY 2020 - 2022

Low-cost low-carbon hydrogen production utilizing geothermal and biomass resources
Contractor : SHIMIZU CORPORATION (with project partners Enecycle Inc., DAINICHI Machine and Engineering Co., Ltd., HYDRONEXT Inc., ICHIKAWA OFFICE Ltd.)
Duration : FY 2020 - 2022

Project Overview
This project will demonstrate low-cost, low-carbon technology to produce hydrogen by utilizing woody biomass and geothermal steam. We have developed a green hydrogen production technology that reduces costs to less than one-third that of renewable energy-based water electrolysis technology. Wood chips are dry-distillated in a carbonization furnace to make carbides. A reformed gas (a mixture of H2, CO, CO2) is obtained by high-temperature reaction of carbide (C) and geothermal steam (H2O) in a reformed gasifier. The innovative technology uses a steam reaction to convert the reformed gas into hydrogen (H2) that can be used in fuel cells. We will construct a 50 Nm3/h hydrogen production plant using this technology in Oita Prefecture' s Kokonoe Town, which has abundant biomass resources and ranks number one in Japan for geothermal power generation, and carry out demonstration tests in 2022. When the system is commercially viable, we aim to reduce CO2 emissions by at least 75% and reduce cost by at least 50% compared to market rates for hydrogen.



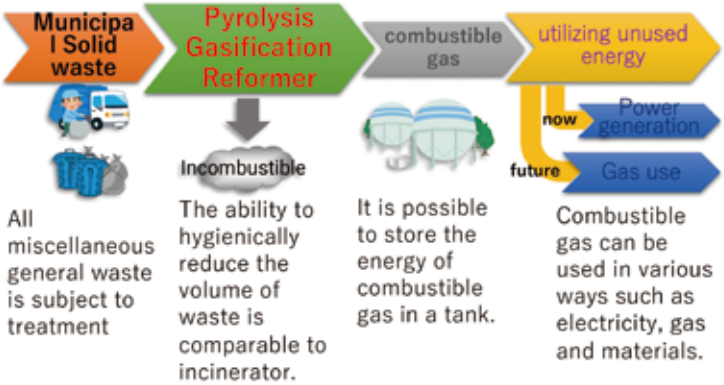
System configuration

Next-generation waste treatment system for high-efficiency energy utilization

Contractor : Hitachi Zosen Corporation

Duration : FY2020 – 2023

Project Overview
Municipal solid waste (MSW) mainly consists of household waste composed of food residue, combustible materials such as paper, cloth and plastics, and non-combustibles such as metals.
The purpose of waste to energy (WtE) treatment is sanitary waste treatment, as well as waste volume reduction. WtE can also produce electricity from MSW, although the power generation efficiency of WtE is lower than typical power plants because of corrosive components in exhaust gases. Fluctuations in power generation are unavoidable due to waste composition, and small-scale facilities are less efficient, so in many cases they are not used to generate power.
This project is developing and demonstrating a new waste treatment system using a unique "pyrolysis gasification reformer," in a high-efficiency system that converts energy derived from MSW into combustible gas.
The system has the potential to solve various waste treatment issues and if applied in small-scale facilities, it can help reduce CO2 emissions by utilizing otherwise unused energy derived from MSW.



Examples: Bottom-Up Stream - Area-Specific RD&D Category (Local Resources and Circular Economy)

Technologies for promoting the introduction of regionally-available renewable energy such as solar, wind, small hydro, geothermal, and/or wave power, etc.; technologies to improve conversion efficiency, durability, and economic viability of electricity generation from marine energy (wave power, tidal power, ocean temperature, etc.), and high-performance fuel cell technologies to generate electricity from hydrogen derived from renewable energy.

Fuel-cell portable generator and power supply truck

Contractor : Denyo Co., Ltd. (with project partners Toyota Motor Corporation)

Duration : FY2019 - 2021

Project Overview

Diesel-powered portable generators and power supply vehicles are often used outdoors where no commercial power sources are available, such as construction sites, outdoor events, and disaster areas. Although efforts are made to reduce air pollution, they still emit CO_2 emissions, which are a cause of global warming.

This project is developing technologies for fuel cell portable generators and power supply trucks using hydrogen that can be produced from renewable energy such as solar and wind power to reduce CO_2 emissions.

Fuel cells that use hydrogen to generate electricity do not emit CO_2. Hydrogen can be stored and transported, so it offers new possibilities for fuel cells to replace diesel-powered generators and power supply vehicles. By developing a fuel cell portable power generator and power supply truck, this project will increase opportunities to utilize hydrogen and promote renewable energy.

【Fuel-cell portable generator】

Rated output	7.0kVA
Voltage	Single Phase, 3-Wire AC 100/200 V
Frequency	50Hz or 60Hz
Dimension	L:1,800mm, W:900mm, H:1,500mm
Weight	950kg

【Fuel-cell electric generator truck】

Rated output	8.0kW	
Voltage	3-Phase, 4-Wire : AC 200V, Single Phase, 3-Wire : AC 100/200 V	
Frequency	50Hz or 60Hz	
Hydrogen capacity	Number of high-pressure hydrogen tanks	27
	Hydrogen storage mass	Approx. 65kg
Dimension	L:6,380mm, W:2,220mm, H:2,240mm	
Weight	7.265t	

Subway zero-energy air conditioning system utilizing renewable energy

Contractor : Yokohama Minatomirai Railway Company (with project partners Yokohama National University,Sustainable Smart Community Laboratory, SaN Technologuy' s Co. Ltd.)

Duration : FY2019 - 2021

Project Overview

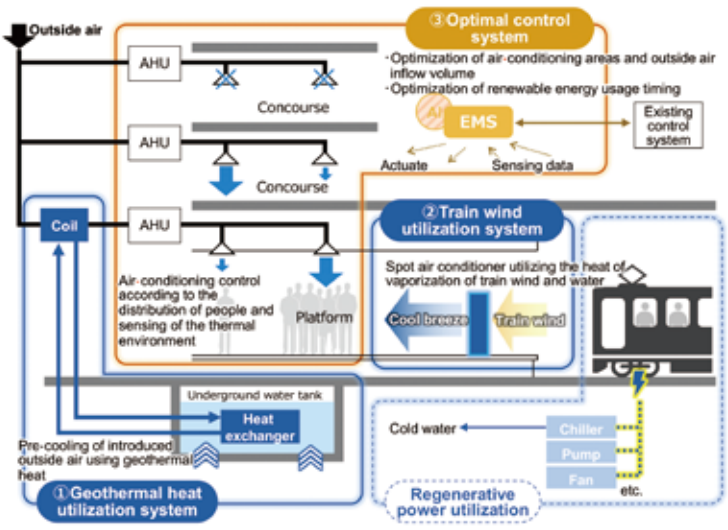
Underground subway stations are large spaces that consume much energy for cooling of air introduced from outside via tracks and ground entrances as well as heat dissipated from trains.

We are developing a new air conditioning system (with three technical elements) that utilizes renewable energy (unique to the underground station context) and digital technology for Bashamichi Station on the Minatomirai Line in Yokohama.

①. The geothermal heat utilization system cools the hot outside air introduced into the station using geothermal heat collected through an underground water tank.

②. The train wind utilization system creates cold air by the vaporization of water and diffuses it to the platform by using the train wind.

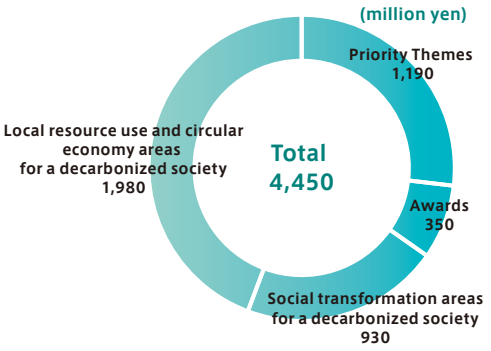
③. The optimal control system monitors the thermal environment and population density distribution to provide cooling to the right place at the right time.



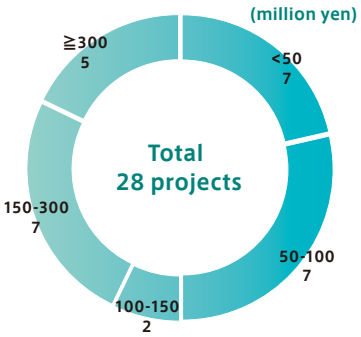
Through this technological development, we aim to reduce CO2 emissions from cooling operations by at least 50%, and in the future, utilize regenerative power from train braking to realize a "Zero Energy Station."

Share by Category (FY2021)

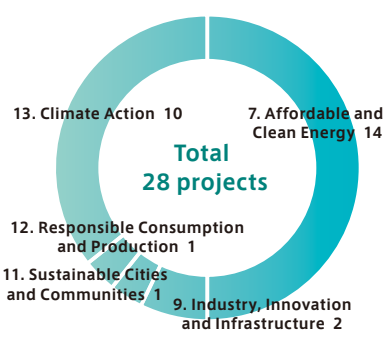
Budget allocation for each areas



Number of projects by budget size



Sustainable Development Goals



Ongoing Projects in FY2021

Priority Themes Category

	SEKISUI CHEMICAL CO., LTD.	2021-2022	Energy self-sufficient unit
	IHI Corporation	2020-2021	Strengthening systems to produce and consume energy locally through inter-regional cooperation and complementarity
	TOYOTA ENERGY SOLUTIONS INC.	2021-2022	Zero-emission agriculture with cogeneration using ammonia-fueled micro gas turbine
	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

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

Bottom-Up Stream - Area-Specific RD&D

Social transformation areas for a decarbonized society

	NDFEB Corporation	2019-2021	Production method of low-cost high-efficiency multi-stacked neodymium-iron-boron magnets for traction motors for EVs and FCVs
	Sanics Incorporated	2019-2021	Scheduled generating and controlled charging system (SGCCS) for large electric commercial vehicles
	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 network of small-scale distributed LNG filling stations
	TOHO GAS CO.,LTD.	2019-2021	High-efficiency low-cost gas differential pressure power generation equipment package
	DAIEI KANKYO CO., LTD.	2019-2021	Automatic dispatching system for waste collection and transport vehicles using AI and IoT
	Panasonic Corporation	2019-2021	Bi-directional EV charging system technology for autonomous distributed energy systems
	Pacific Power Co., Ltd.	2019-2021	The Smart Synchronous Inverter (SSI) and its control systems based on virtual synchronization with power grids to utilize power from multiple renewable energy sources

Local resource use and circular economy areas for a decarbonized society

	Denyo Co., Ltd.	2019-2021	Fuel-cell portable generator and power supply truck
	FDK Corporation	2019-2021	Metal hydride/air battery (HAB) and electricity storage systems to expand the use of renewable energy
	Yokohama Minatomirai Railway Company	2019-2021	Subway zero-energy air conditioning system utilizing renewable energy
	Panasonic Corporation	2020-2022	Compact system to generate electricity from unutilized energy in factories
	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
	Sumitomo Mitsui Finance and Leasing Co.,Ltd.	2019-2021	Fuel cell power generation system using high-purity bio methane from breweries wastewater treatment.
	SHIMIZU CORPORATION	2020-2022	Low-cost low-carbon hydrogen production utilizing geothermal and biomass resources
	Kansai Allied Coffee Roasters Co., Ltd.	2021-2022	Green roasting technology for coffee beans and general-purpose solid fuel from coffee grounds by extraction
	Takenaka Corporation	2021-2022	Biogas recovery from kitchen wastewater using low-temperature UASB reactor
	Hitachi Zosen Corporation	2020-2023	Next-generation waste treatment system for high-efficiency energy utilization

RD&D for Transportation RD&D for Buildings RD&D for Social Infrastructure Innovation RD&D for Renewable and Distributed Energy RD&D for Biomass and Recyclable Resources

Climate Change Projects Office, Climate Change Policy Division, Global Environment Bureau, Ministry of the Environment, Government of Japan
TEL:+81-570-028-341
http://www.env.go.jp/earth/ondanka/cpttv_funds/

The information in this pamphlet is valid as of November 2021.
Percentage of waste paper pulp 80%