The purpose of this Program is to promote reductions in carbon dioxide emissions and contribute to stronger future measures to address climate change.

2020

Ministry of the Environment,
Government of Japan

Low Carbon Technology Research, Development and Demonstration Program

環境省

Ministry of the Environment

Low Carbon Technology Research, Development and Demonstration Program

Purpose and Features

The purpose of this program is to contribute to the research, development and demonstration (RD&D) of technologies that are highly effective in reducing CO2 emissions, and to contribute to stronger measures to address climate change.

For Japan to achieve its greenhouse gas emission reduction targets (26% reduction by 2030 and carbon neutral by 2050) and targets stated in Japan's Long-term Strategy under the Paris Agreement (to realize a decarbonized society as quickly as possible), innovation is highly needed in order to facilitate greater CO_2 emission reductions in every sector and to mainstream them quickly in society. It is exceedingly important to strengthen future climate change measures by addressing technical challenges such as boosting efficiency and reducing the costs of CO_2 emission reductions, thereby creating newer and better measures and deploying them widely in the real world.

Sufficient progress is not assured in research and development of the technologies needed to reduce CO_2 emissions if these tasks are left solely to the private sector, due to the large risks associated with R&D and small incentives for industry to voluntarily bolster its own climate actions. It is therefore important for the central government to lead the way to promote the RD&D of the technologies needed in order to make the large reductions in CO_2 emissions required to achieve national policies.

This program aims to promote the RD&D of technologies that can be most effective in reducing CO_2 emissions and lead to more robust future actions to address climate change and contribute to the early realization of a decarbonized society.

Program Funded by the Special Account for Energy Policy

The program is funded by the national Special Account for Energy Policy. Specifically, it is funded by the sub-account for supply and demand of energy, under the national Special Account for Energy Policy. Legislation governing restricts the use of these funds to RD&D for technologies that can contribute to reductions in energy-derived CO_2 emissions in Japan, such as renewable energy and energy conservation.

Thus, examples of projects ineligible for this program include RD&D relating to reducing CO_2 emissions from non-energy sources, reducing GHG emissions other than CO_2 (e.g., methane, nitrous oxide, HFC, etc.), forest sequestration, and the carbon capture and storage. Similarly, RD&D conducted outside of Japan is ineligible.

It is expected that after project completion, the funded technologies will be quickly applied in practical applications, developed into products, and commercialized.

Technologies eligible for the program are expected to be at a level of maturity that they have the potential to be utilized quickly through practical applications, product development, and commercialization. In principle, technologies are not eligible if they are still at the basic research stage or will require further RD&D for scaling up after project completion.

Eligible Technology Areas

To realize a decarbonized society by strategically deploying and promoting leading-edge technologies in society consistent with national policies, this program uses a top-down (open innovation) approach to address local "needs," a bottom-up approach for technology "seeds," and an "awards" approach.

(1) Priority Themes ("Climate Change and Disaster Prevention") ("Climate Change and Infectious Disease Countermeasures")

These projects identify issues as priority themes that are closely inter-connected with local community needs, while also considering national policies, and implement open innovation-type initiatives where various stakeholders participate as innovation partners. The aim in this category is to achieve a smooth path to commercialization by starting as fully funded projects in the first year, with companies collaborating in different sectors through open innovation to develop multiple component technologies and integrate them as systems, and then transition to partially-subsidized projects in subsequent years.

In FY2021, in response to the intensifying natural disasters and extreme weather events of recent years, applications are invited 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 disease ("Climate Change and Infectious Disease Countermeasures").

The budget per topic for a single year is about 200 million to 700 million yen (subsidy based on project cost, 50% subsidy provided), and in principle, the project period is until the end of FY2022.

(2) Bottom-Up Area-Specific Research, Development and Demonstration Projects

This category is for RD&D to move toward a circulating and ecological economy and a decarbonized society, by leading to stronger future climate change countermeasures, where CO_2 emission reduction effects are relatively significant in each area, but due to R&D costs or other constraints insufficient progress would be made when relying only on voluntary efforts by the private sector.

The budget per topic for a single year is about 30 million to 500 million yen (subsidy based on project cost, 50% subsidy provided), and in principle, the project period is until the end of FY2022.

(a) Social transformation for a decarbonized society ("Climate Change and Social Transformation")

The aim here is to foster innovation that leads to major reductions in energy consumption by optimization (increased efficiency) in not just vehicles and individual buildings but also social infrastructure and societal systems such as transportation, energy, and building structures.

(b) Local resource use and circular economy for a decarbonized society ("Climate Change and Circular Economy")

The aim here is to foster innovation that contributes to the establishment of a circulating and ecologically-sound economy that also leads to regional revitalization, by having each region make the best use of its unique resources and form self-reliant, decentralized communities within which resources circulate, while also coexisting with neighboring regions, and utilizing technologies such as AI and IoT to complement and effectively utilize regional resources through wide-area networks.

(3) Award-type innovation discovery and social mainstreaming acceleration projects (new in 2021)

The Global Environment Bureau Director's Award will be given for projects that are based on innovative concepts, have made significant achievements, and are seen as promising in terms of commercialization, market creation, and contributing to the realization of a new decarbonized society as envisioned by the Ministry of the Environment. Award recipients will be expected to take steps (provisional adoption of the technology) over the course of a year, including securing rights to conduct feasibility studies, preliminary studies and 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.

The purpose of this approach is to rapidly apply technologies that have a high likelihood of contributing to significant CO_2 emission reductions. For current year, applications are being invited under the theme of "Proven technologies and ideas to utilize renewable energy for base load electrical power sources that can accelerate the transition to a decarbonized and decentralized society and also strengthen resilience."

Selection Process

Applications will be screened and selected after a review process by the CO_2 Emission Reduction Countermeasures Technology Evaluation Committee comprised of outside experts, and also by a sub-committee in each specialty. For multi-year proposals, annual performance targets will be established and a progress review conducted at the end of each year to review achievements, after which development plans and funding allocations will be reassessed (including possible increases or decreases in R&D budgets, and a decision on whether or not the project will continue).

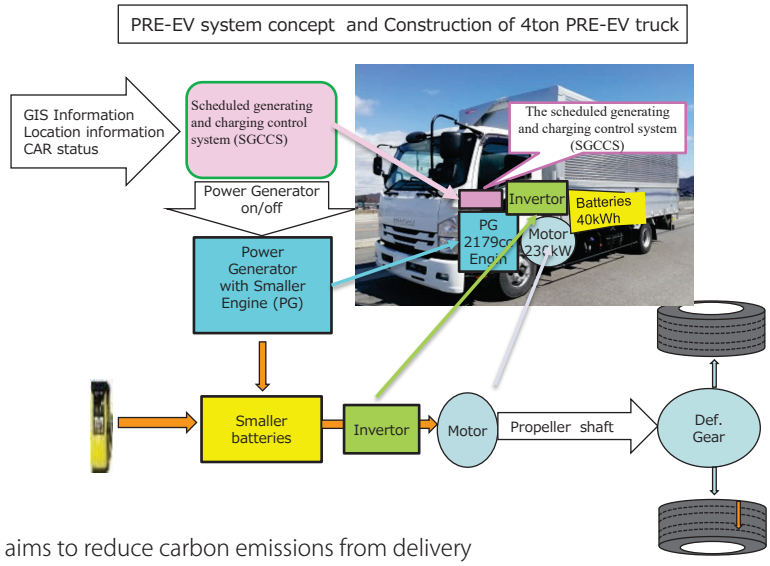
Technologies to improve performance and reduce costs of electric vehicles (EV) and fuel cell vehicles (FCV), etc., technologies to improve energy efficiency in non-automotive transportation sectors (rail, ship, aircraft, etc.); and technologies to decarbonize infrastructure and/or operations of the traffic systems needed to realize practical applications for these technologies.

Scheduled generating and controlled charging system (SGCCS) for large electric commercial vehicles

Contractor：Sanics Incorporated (with project partners AC Technologies Corporation, Daiichi Freight System, Inc., Yamagata University)
Duration：FY2019 - 2021

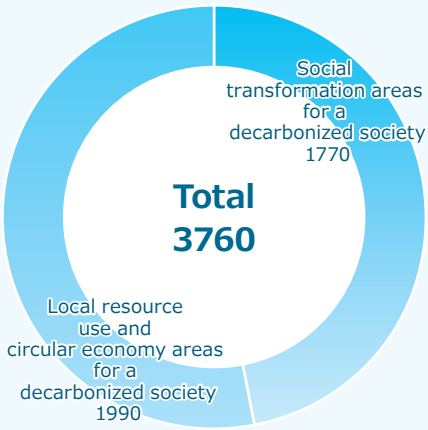
Project Overview

The use of electric vehicles (EV) for large commercial buses and trucks has being considered as a way of reducing carbon emissions. However, commercial adoption has lagged behind diesel vehicles due to limited charging availability, short driving range, and high costs. Series-hybrid EVs utilize large generators and can reduce the need for expensive batteries, but are not suited to large commercial vehicles due to the large size of generators required. To reduce the number of batteries needed and the size of generation equipment, this project is developing a scheduled generating and controlled charging system (SGCCS) that sequentially calculates the drive energy required based on load conditions from trip start to end point. A 4-ton Plug-in Range Extended Electric Vehicle (PRE-EV) truck equipped with this system will be built and operated to evaluate its effectiveness in delivering loads in Yamagata Prefecture, known for its winter weather and mountainous driving conditions. The project aims to reduce carbon emissions from delivery services in both urban and rural areas. This technology will also be applicable for fuel cell vehicles.

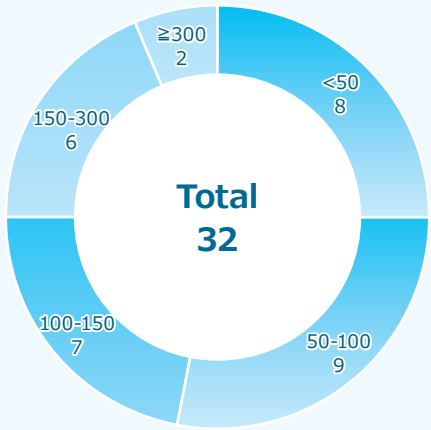


Statistics on Ongoing Projects in FY2020

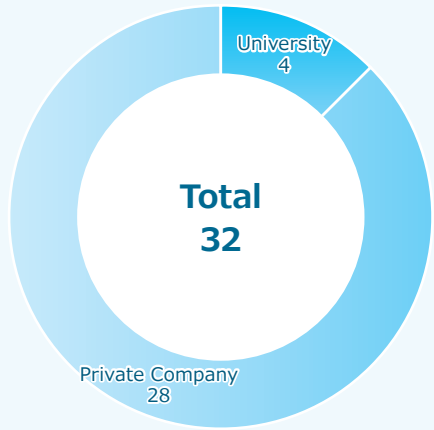
Budget allocation for each field (million yen)



Number of projects by budget size (million yen)



Number of projects by type of representative organization



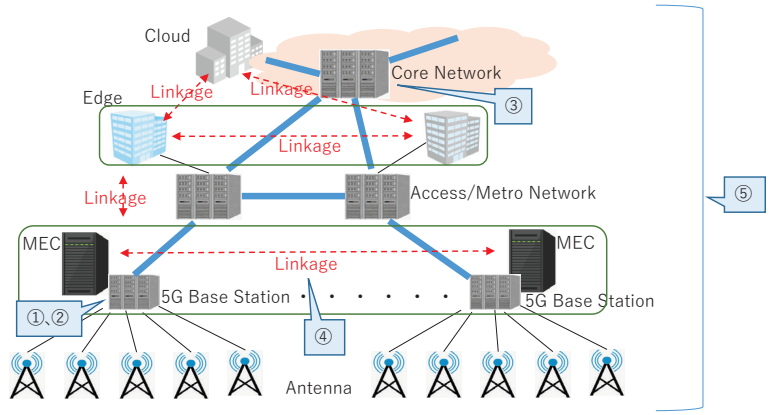
Energy storage technologies that use hydrogen, batteries, capacitors, and/or thermal storage, etc.; system innovation technologies for decarbonization by making societal systems such as energy infrastructure and information infrastructure autonomous and decentralized, highly efficient, and/or resource saving, etc., by using IoT, AI, and big data analysis, etc.; and system technologies that promote human behavioral changes leading to innovation to decarbonize lifestyles.

Major Energy Saving Technologies for Wide Area Distributed Edge Systems Using 5G Base Stations

Contractor: Nippon Telegraph and Telephone West Corporation (with project partners EEC Research Institute, FUJITSU LIMITED)
Duration: FY2018 - 2020

Project Overview

The Internet of Things (IoT) has arrived with the introduction and growth of 5th-generation mobile communication systems (5G), and significant expected growth in edge systems and multi-access edge computing (MEC) to process smartphone and sensor data. Energy-saving technologies are needed to significantly reduce power consumption in wide area distributed information and telecommunication systems. Energy savings are needed not only through energy efficiency in each system component, but also by optimizing energy utilization efficiency through the linking of system components and layers. This project is developing three energy-saving technologies for system components, namely (1) water cooling of base stations, (2) integration of MEC packet processing functions into base stations, and (3) immersion cooling technology for communication devices. It is also developing two technologies for optimizing energy utilization among components and layers through the use of simulations and machine learning, namely (4) dynamic handover prediction among MECs, and (5) technology to achieve optimum allocation of information processing tasks. These technologies are expected to contribute to energy-savings for wide area distributed 5G and IoT information and telecommunication systems.



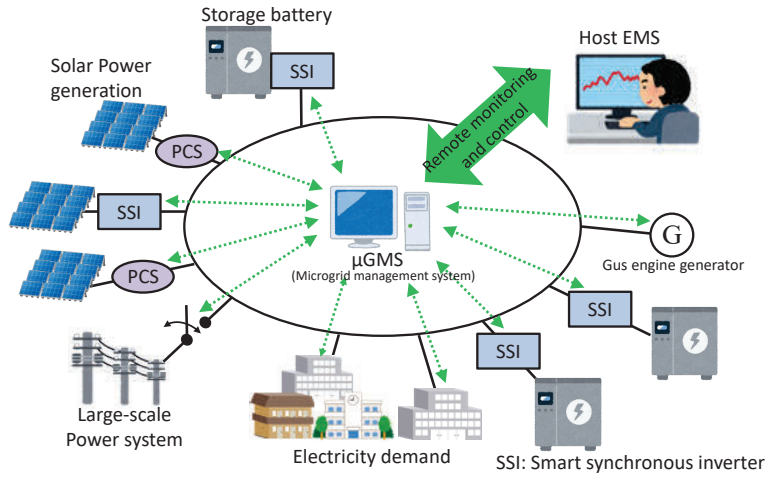
※ Numbers in figure correspond to description.

The Smart Synchronous Inverter (SSI) and its control systems based on virtual synchronization with power grids to utilize power from multiple renewable energy sources

Contractor: Pacific Power Co., Ltd.
Duration: FY2019 - 2021

Project Overview

To realize a low-carbon society, renewable energy sources such as solar and wind power need to be promoted as alternatives to the combustion of fossil fuels for power generation. Electrical power supplied by renewable energy varies significantly depending on weather conditions, so two key issues need to be solved to enable the large-scale introduction of renewable energy for micro-grids: (1) maintaining a stable electrical frequency in the grid, and (2) effectively managing power supplied from multiple sources. This project will develop new inverter control technologies and systems to realize frequency synchronization and inertia effects comparable to conventional thermal power generators. It will also develop an energy management system to effectively control grid power, renewable energy sources, and storage batteries, in response to power demand from consumers. These technologies are expected to help realize a low-carbon society by encouraging the widespread use of micro-grids, which have attracted attention for their environmental benefits and role in disaster preparedness.



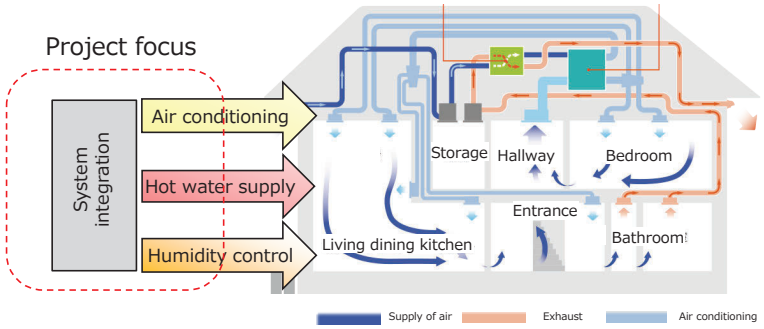
Technologies to achieve zero emissions and improve energy efficiency of homes and offices by introducing energy saving and renewable energy for building equipment and facilities.

High-efficiency air conditioning and hot water supply system using natural refrigerant heat pumps

Contractor: Denso Corporation (with project partners The University of Tokyo, Central Research Institute of Electric Power Industry)
Duration: FY2018 - 2020

Project Overview

The 2016 amendment to the Montreal Protocol requires industrialized countries including Japan to gradually reduce the production and consumption of HFC refrigerants by 85% by 2036, and to achieve targets in the Paris Agreement significant reductions in greenhouse gas emissions are required by 2050. To do so, it is necessary to improve the airtightness and thermal insulation of housing and to further reduce the power consumption of residential building equipment. This project will develop an ejector for heat pumps with significantly improved performance using natural refrigerants, and a two-stage compression scroll compressor for injection cycles. It will also develop a transcritical cycle that can be applied in air conditioning and hot water supply, with the aim of matching or exceeding the performance of conventional equipment. By developing hot water supply and humidity control functions to effectively utilize unused thermal energy from heat pumps, this project aims to conserve energy and contribute to carbon emission reductions.



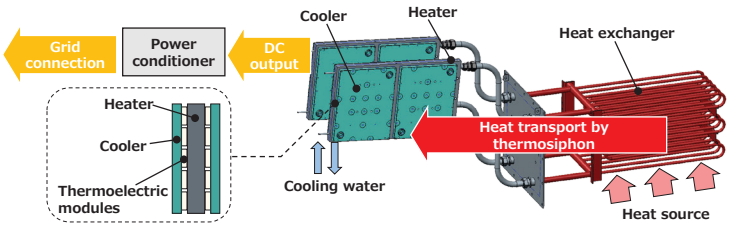
Integrated system to achieve energy saving, comfort, and healthy living space

Compact thermoelectric generation system with thermosiphon heat exchanger

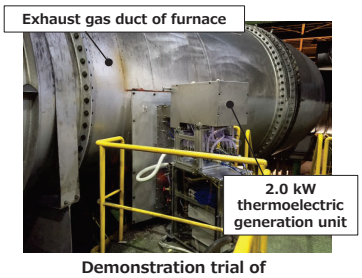
Contractor: Yanmar Holdings Co.
Duration: FY2018 - 2020

Project Overview

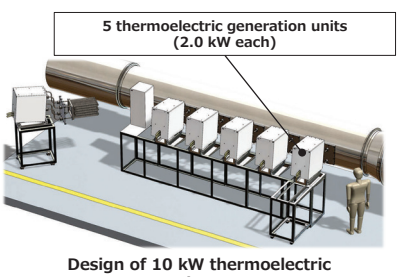
With the aim of reducing carbon emissions, this project focuses on electrical power generation using exhaust heat from various industrial processes, also known as thermoelectric generation. Various challenges for practical applications include economic efficiency, space requirements, and the ability to utilize different heat sources. To date this project has developed a compact 2.0 kilowatt thermoelectric generation unit using a thermosiphon-type heat exchanger with high heat transport capability. Next the project will build a 10 kilowatt system by linking 2.0 kilowatt units. Another challenge is manufacturing costs of the thermosiphon heat exchangers. This project also seeks to address the economic aspects of introducing thermoelectric generation equipment by increasing power output per unit and examining the costs of thermoelectric modules per unit of output power.



2.0 kW thermoelectric generation unit



Demonstration trial of 2.0 kW generation unit



Design of 10 kW thermoelectric generation system

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.

Low-cost pure hydrogen PEFC fuel cell power system for commercial and industrial use

Contractor：Toshiba Energy Systems & Solutions Corporation
Duration：FY2018 - 2020

Project Overview

This project is developing a fuel cell system that can generate several megawatts for factory use. Output of the low-cost, mass-producible 100 kW fuel cell modules starts at 100 kilowatts, and up to several megawatts can be generated by combining multiple modules. The 100-kilowatt module is 20% smaller and 15% lighter than conventional models, enabling easy transport and requiring less space for installation. The control system constantly learns the output characteristics of individual modules and controls each one to achieve high generation efficiency over a wide total output range. The modules can start up sequentially after a power outage, so the system can be used to charge small storage batteries. The polymer electrolyte fuel cells (PEFC) emit waste heat at about 60℃ , which has limited uses in factories, but the project is testing a PEFC and heat pump configuration to utilize the thermal energy in a drying oven, expected to show high energy saving. This system is expected to find applications that expand the use of zero-carbon hydrogen and can be used in factories that produce hydrogen as a by-product.

Low cost 100kW pure hydrogen fuel cell modules (two modules)

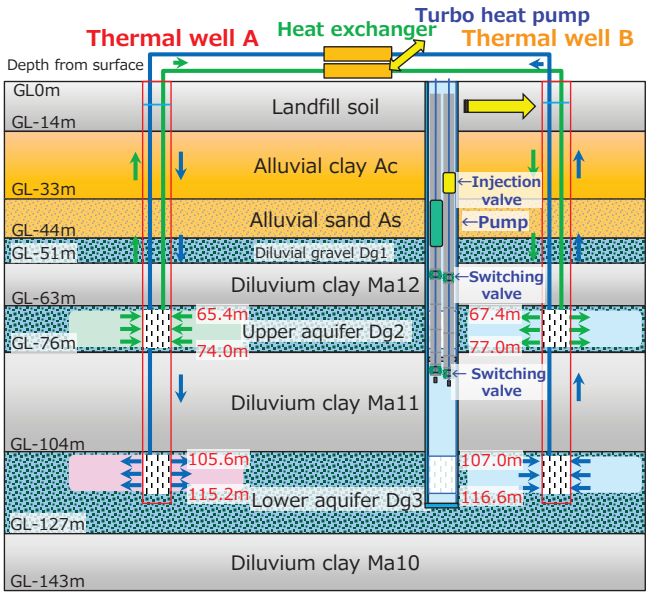
MW class fuel cell power system

Thermal energy from multiple aquifer layers for commercial building HVAC systems in high-density urban areas

Contractor：Mitsubishi Heavy Industries Thermal Systems (with project partners Morikawa Sakusen Industry Inc, Kansai Electric Power Co., Osaka City University)
Duration：FY2018 - 2020

Project Overview

Some renewable energy technologies to supply thermal energy on demand in urban areas can utilize heat from river water and sewage. Thermal energy storage systems that use the aquifer are attracting attention in coastal urban areas where groundwater flow velocity is slow, with advantages of direct access from the ground surface and the potential to store energy storage from season to season. This project has successfully demonstrated high-capacity technology (100 m³/h pump volume, 700 kW heat source capacity, 100% re-injection) in central Osaka City, avoiding issues with land subsidence and thermal well clogging. However, in some urban areas the usable aquifer is only 10 meters thick and thermal interference of cold thermal storage mass on small sites is a problem. This project is developing technology to independently utilize the groundwater of multiple aquifer layers, by installing a new thermal well and heat source system at Amity Maishima, a sports center for persons with disabilities in the coastal area of Osaka City. The project is proceeding with impact assessments on land subsidence and carbon emission reductions.



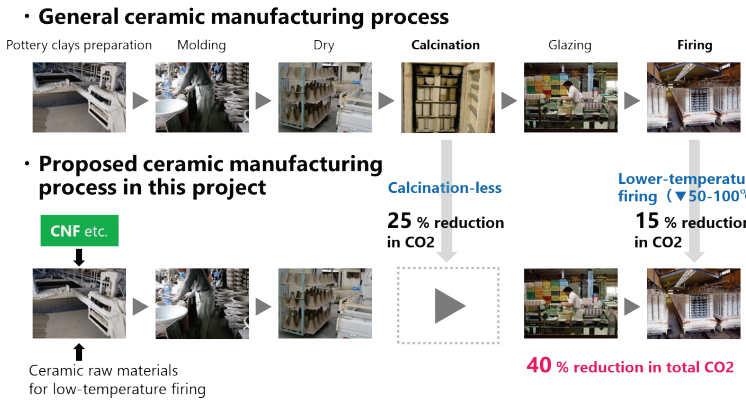
Technologies to reduce overall system costs, from the collection to the utilization of waste-derived biomass.

Development and demonstration of CO_2 low emission ceramics manufacturing technology by energy saving in the manufacturing process

Contractor: Ceramic Science Branch, Mie Prefecture Industrial Research Institute (with project partners Mie University, Asaoka Kiln Industry Raw Materials Co., Ltd, Taisegama Inc.)
Duration: FY2018 - FY2020

Project Overview

Manufacturing processes for ceramics products require a large amount of energy for drying and multiple firing processes, resulting in significant CO_2 emissions. This project focuses on the ceramics manufacturing industry collaborating with a prefectural research institute and university to develop and demonstrate energy-saving technologies for the manufacturing processes. Specifically, in order to simplify the calcination (bisque-firing) process, the green body of ceramics will be strengthened by combining ceramic materials and biomass-derived materials such as cellulose nanofiber and cellulose derivative. The project will also develop various types of ceramic materials that can be fired at lower temperatures, to reduce CO_2 emissions in firing processes by 40%.



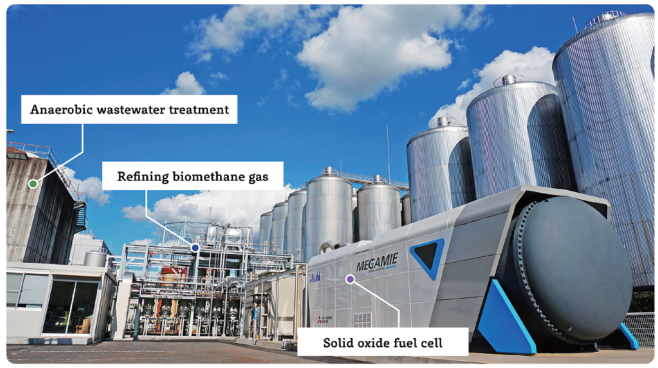
This project will contribute to the realization of a low carbon society via the creation of a low CO_2 emission ceramic production area, with Yokkaichi Banko ware in Mie Prefecture as a model.

Fuel cell power generation system using high-purity bio methane from breweries wastewater treatment.

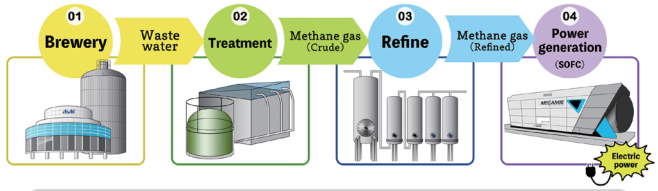
Contractor: Sumitomo Mitsui Finance and Leasing Co. (with project partner Asahi Quality & Innovations)
Duration: FY2019 - 2021

Project Overview

Bio-methane ("biogas") from anaerobic treatment of the wastewater discharge from food and beverage processing plants is seen as a promising biofuel. Biogas is expected to help reduce CO_2 emissions, especially in combination with fuel cells, but deterioration in fuel cell output over time is a challenge for stable long-term power generation. This project aims to use the biogas byproduct from brewery wastewater treatment for power generation with solid oxide fuel cells (SOFC). Biogas from wastewater contains hydrogen sulfide and other impurities that impede power generation, but a new process that refines biogas to a high level of purity, proven in preliminary tests, is expected to limit SOFC degradation and achieve 10,000 hours of continuous power generation. The project also aims to spread the technology by sharing technical information and providing financing.



Demonstration plant at the Ibaraki Factory of Asahi Breweries, Ltd.



Power generation from fuel cells using biogas derived from brewery wastewater

Ongoing Projects in FY2020

Note: Open innovation type priority theme start recruiting from the 2020 fiscal year

Social transformation areas for a decarbonized society

Drastic energy saving technology of wide area distributed edge system with5G base station
NIPPON TELEGRAPH AND TELEPHONE WEST CORPORATION 2018-2020

Innovative low cost printed RFID technology
Toray Industries, Inc. 2017-2020

Dynamic carbon management to realize a circulating and ecological economy utilizing AI and IoT
DAIEI KANKYO CO., LTD. 2019-2021

Bi-directional EV charging system technology for autonomous distributed energy systems
Panasonic Corporation 2019-2021

Development of interconnection inverter control technology based on concept ofvirtual synchronous generators to utilize fluctuating renewable energy sources
PACIFIC POWER CO., LTD. 2019-2021

Demonstration of resilience method for local energy production and consumption based on regional cooperation and synergies
IHI Corporation 2020-2021

Demonstration of infrastructure for ultra-fast charging ofelectric transit buses with excess regenerative electricity from trains
Sumitomo Corporation 2017-2020

High energy density EV system for large vehicles and trial in metropolitan route buses
Kumamoto University 2018-2020

Thermoelectric waste heat recovery system on hybrid and extended-range electric vehicles for reducing CO_2 emissions
SANGO Co., Ltd. 2018-2020

Development of manufacturing methods for high-efficiency, low-cost neodymium -iron- boron laminated magnets for EV and FCV drive motors
NDFEB Corporation 2019-2021

Development and demonstration of high-efficiency power generation and storage control systems for series hybrid commercial vehicles
Sanics Co., Ltd. 2019-2021

Thermal storage radiation air conditioning system from the concrete slab with renewable energy and heat pump
Ritsumeikan University 2018-2020

Boosting air-conditioning efficiency using artificial intelligence with people- and air-flow sensors for spaces with exterior openings
Kobe University 2017-2020

High efficiency air conditioning and hot water systems using heating/cooling thermal energy generated by natural refrigerant heat pump
DENSO CORPORATION 2018-2020

Enhanced manufacturing techniques for low CO_2 emission concrete construction materials
Nakagawa Hume pipe Industry Co., Ltd. 2018-2020

Compact thermoelectric generation system with thermosiphon heat exchanger
Yanmar Co., Ltd. 2018-2020

High-efficiency and low-cost power generation system packaging utilizing gas differential pressure
TOHO GAS Co., Ltd. 2019-2021

Local resource use and circular economy areas for a decarbonized society

Low-cost pure hydrogen PEFC fuel cell power system for commercial and industrial use
Toshiba Energy Systems & SoLutions Corporation 2018-2020

Wave energy converter with vertical layout ofpiston-type hydraulic cylinders utilizing reflected wave energy (Hiratsuka wave power plant)
Institute of Industrial Science, The University of Tokyo 2018-2020

Innovative thermal well using dual aquifers for commercial building air conditioning in concentrated urban areas
Mitsubishi Heavy Industries Themal Systems 2018-2020

High-utilization photovoltaic power generation with Nano-hybrid Capacitors to assist distributed systems
IHI Inspection & Instrumentation Co., Ltd. 2018-2020

Fuel-cell portable generator and electric generator truck
Denyo Co., Ltd. 2019-2021

Metal hydride/air batery (HAB) and electricity storage systems to expand the use of renewable energy
FDK Corporation 2019-2021

Low-cost, low-carbon methods to decommission spar-typefloating offshore wind turbines
TODA CORPORATION 2019-2020

Zero-energy air-conditioning system to maximize renewable energy utilization in subways
YOKOHAMA MINATOMIRAI RAILWAY COMPANY 2019-2021

Compact system to generate electricity from unutilized energy in factories
Panasonic Corporation 2020-2022

Innovative sewage treatment system for energy saving and energy production
Mitsubishi Kakoki Kaisha, Ltd. 2017-2020

Recycling technologies for used disposable diapers
Unicharm Corporation 2018-2020

Biomass Steam Explosion System for Low Carbonization of Coal-Fired Power Generation
IHI Corporation 2018-2020

Energy-efficient technology for ceramics manufacturing processes with reduced CO_2 emissions
Mie Prefecture Industrial Research Institute Ceramic Science Branch 2018-2020

Fuel cell power generation system using high-purity bio methane from breweries wastewater treatment.
Sumitomo Mitsui Finance and Leasing Co., Ltd. 2019-2021

Next-generation waste treatment system for high-efficiency energy utilization
Hitachi Zosen Corporation 2020-2023

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