環境省
Ministry of the Environment

Ministry of the Environment, Government of Japan

Low Carbon Technology Research, Development and Demonstration Program

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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 CO_2 emissions, and to contribute to stronger measures to address climate change.

Proclaiming a "decarbonized society" as the ultimate goal and aiming to accomplish it ambitiously as early as possible in the second half of this century, while boldly taking measures towards the reduction of GHGs emissions by 80% by 2050, it is necessary to foster innovation to enable greater CO_2 emission reductions in every sector and to mainstream them quickly in society. It is important to strengthen future climate change measures by addressing technical challenges such as how to boost efficiency and cut the cost of CO_2 emission reduction technologies, thereby creating new and better ones, and disseminating them in the real world.
Meanwhile, there is no assurance that sufficient progress will be made 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, uncertain profitability, and small incentives for industries to voluntarily bolster their own climate actions. Therefore, the national government must lead the way to promote the RD&D of the technologies required to make the large reductions in CO_2 emissions that are needed to meet national policies.
In that context, this Program aims to strongly promote the RD&D of technologies that can be most effective in reducing CO_2 emissions and lead to stronger future actions to address climate change and achieve significant reductions in CO_2 emissions, and as a result to create the "Circulating and Ecological Economy" described in Japan's Fifth Basic Environment Plan and contribute to the early realization of a decarbonized society, as articulated in Japan's Long-term Strategy Under the Paris Agreement as Growth Strategy.

Program Funded by the Special Account for Energy Policy
This Program is funded by the Sub Accounts for Supply and Demand of Energy, under the national Special Account for Energy Policy.
Legislation governing the Special Account 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, the utilization of otherwise unused 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 capture and storage of CO_2 emissions. Similarly, RD&D conducted outside of Japan is ineligible.

It is expected that after completion of this Program, the funded technologies will quickly be used in practical applications, developed into products, and commercialized.
Technologies eligible for the Program are expected to be at a level of maturity whereby after RD&D they have prospects to be utilized quickly through practical applications, development into products, and commercialization. In principle, technologies will not be considered eligible for this Program if they are still at the basic research stage or if they will require further RD&D for scaling up after the completion of the project.

Budgets and Implementation Timeframe

【Budgets】
For the "Open Innovation Priority Themes", the annual budget is approximately 200 million to 700 million yen per project per year For the "Bottom-Up Area-Specific RD&D", the annual budget is approximately 30 million to 500 million yen per project per year. The subsidy will cover up to one-half of project costs on a cost basis.
In principle, the cost of equipment is not covered for commissioned projects. Where equipment is required and will continue being used after a project ends, please apply for the subsidy program.

【Project Timeframe】
In principle, projects must be completed with three years. If the mid-termreview results in a very positive evaluation and the project implementer wishes to address more advanced challenges, a project can in some cases be extended to a maximum total of five years.

Eligible Technology Areas

This Program has a top-down approach to solve local community "needs," in parallel with a bottom-up approach based on technology "seeds," to realize a decarbonized society by strategically mainstreaming and promoting the spread of leading-edge technologies in society, in recognition of national policies.

(1) Open Innovation Priority Themes ("Climate Change and Disaster Prevention")

The aim of this category is to achieve a smooth path to commercialization by starting as a commissioned project in the first year, having companies collaborate in parallel in different areas through open innovation to develop multiple component technologies and create ways to integrate them as systems, and in subsequent fiscal years transition into the subsidy program.

(2) Bottom-Up Area-Specific RD&D

This category is for RD&D to move toward creating a circulating and ecological economy and realizing a decarbonized society, by connecting 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 private sector voluntary initiatives.

(a) Social transformation areas 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 in not just cars and individual buildings but also social infrastructure and societal systems, such as transportation, energy, and building structures.

- 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.
- 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.
- 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.

Note that in terms of social transformation, proponents can also submit proposals that span two or more of these areas, or proposals in other sectors.

(b) Local resource use and circular economy areas 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 ecological economy that also leads to regional revitalization, by having each region make the best use of its unique assets and form autonomous 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.

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

Selection Process

Proposals 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 sub-groups in each specialty. For multi-year proposals, annual performance targets will be established and a progress review conducted at the end of each fiscal 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).

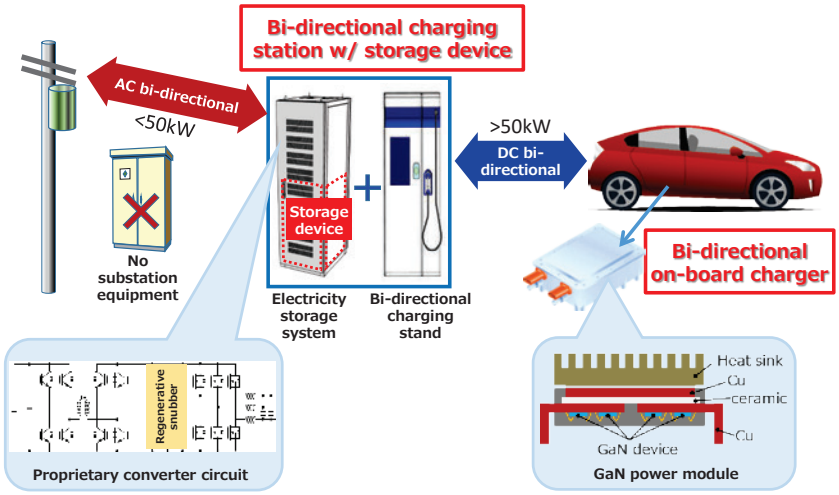
Energy storage technologies that use hydrogen, batteries, capacitors, and/or thermal storage, etc.; system innovation technologies for decarbonization by making societal systems such as energy infrastructure and information infrastructure autonomous and decentralized, highly efficient, and/or resource 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.

Bi-directional EV charging system technology for autonomous distributed energy systems

Contractor：Panasonic Corporation
Duration：FY2019 - FY2021

Project Overview

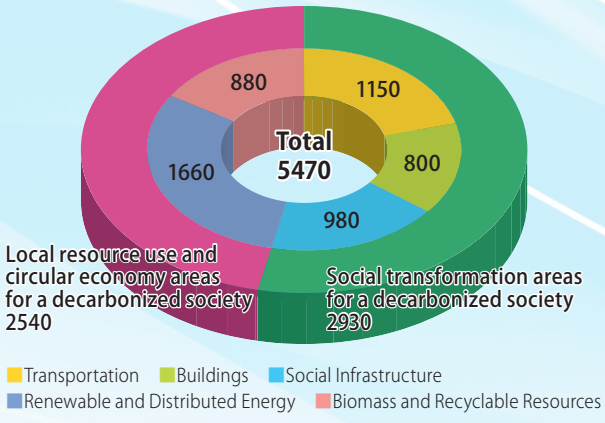
Autonomous distributed energy systems are a key part of the concept of the "Regional Circulation and Ecological Sphere" being promoted by Japan's Ministry of the Environment. All of this will require the effective use of the batteries in electric vehicles (EVs), systems to ensure supply/demand balance in the power grid in the context of a rapidly growing supply of renewable energy, and systems to avoid any adverse impacts from EV quick chargers on the power grid.



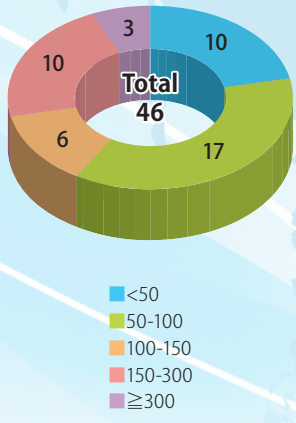
To address these challenges, this project will develop a bi-directional charging system that will significantly reduce grid loads and installation costs. (Bi-directional means the grid can supply electricity to the EV battery, and the EV battery can also supply the grid.) Specifically, the project will develop and demonstrate a compact, high-efficiency bi-directional quick-charging station with a storage device, based on a proprietary converter circuit (GAP-D3). It will also develop and demonstrate a bi-directional on-board charger for EVs with high frequency switching and power module technologies that use GaN devices. The ultimate aim is to promote the spread of autonomous distributed energy systems and contribute to the realization of a low-carbon society.

Statistics on Ongoing Projects in FY2019

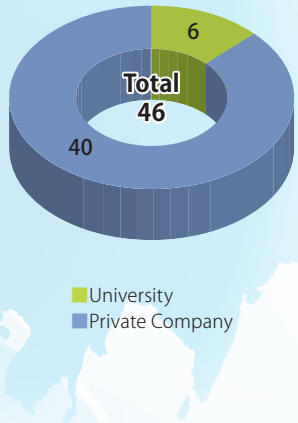
Budget allocation for each field (million yen)



Number of projects by budget size (million yen)



Number of projects by type of representative organization



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.

Electric vehicle system with high energy-density for large vehicles, and EV bus demonstration trials in metropolitan areas

Contractor：Kumamoto University
Duration：FY2018 - FY2019

Project Overview

Aiming to promote the rapid adoption of electric vehicle (EV) buses in public bus services, this project innovated high-performance EV systems for mass-production large vehicles including buses and trucks. Technologies include high-energy lithium-ion batteries, large-capacity reduction gears, and compatibility with 100 kW quick chargers, etc. Demonstration trials of these electric buses will be conducted along bus routes in Yokohama City, which presents diverse and challenging conditions for EV bus operation, including high passenger volumes, steep slopes, and heavy traffic conditions.
Besides testing bus performance and evaluating the new technologies, the project will also gather valuable data on electricity consumption and charging by operating along different bus routes, to help develop a model for the future large-scale introduction of EV buses.

EV system development for large vehicles with high energy density technologies

System specifications	
Battery	160 kWh
Motor	200 kW
Transmission	Large capacity reduction gear (transmission removed)
Quick charge	100 kW

High energy battery system (40 kWh x 4)

100 kW quick charger

Large capacity reduction gear

EV bus demonstration trials on Yokohama City bus routes

Demonstration trial route (example)

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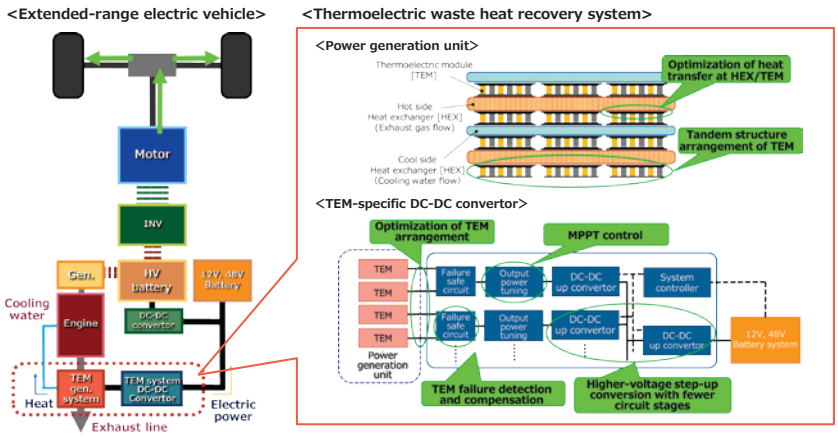
Thermoelectric waste heat recovery system on hybrid and extended-range electric vehicles to reduce CO_2 emissions

Contractor：SANGO Co., Ltd.
Duration：FY2018 - FY2020

Project Overview

To reduce CO_2 emissions, automakers have been working to electrify vehicles, as in the example of hybrid vehicles, but progress has been slow in terms of exhaust-heat recovery. Thermoelectric (TE) energy conversion is a power generation technology that uses the Seebeck effect for thermal-to-electric conversion. The difference in temperature between the engine exhaust gas and cooling-water can be used to improve fuel efficiency by generating several hundred watts of electricity or supplying heat that can be used for engine warm-up or vehicle interior heating, resulting in a significant reduction in CO_2 emissions. However, the development of automotive TE modules and DC-DC converters has been slow, so stable and highly efficient TE generators have not yet been built. This project aims to develop a high-efficiency heat-exchanger to recovers exhaust gas heat, an optimized TE generator module, and a high-efficiency DC-DC converter that minimizes power-generation loss due to disconnection and temperature variations, aiming to reduce CO_2 emissions.



Thermoelectric waste heat recovery system for a hybrid or extended-range electric vehicle powertrain.

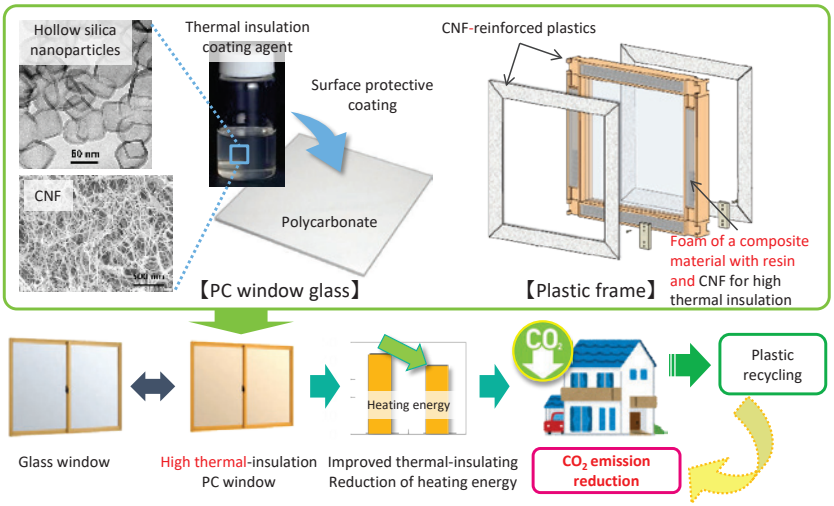
Technologies to achieve zero emissions and improve energy efficiency of homes and offices by introducing energy saving and renewable energy for building equipment and facilities.

Improving thermal insulation using nanocellulose for windows in building openings

Contractor: RENIAS CO., LTD.
Duration: FY2017 - FY2019

Project Overview

The thermal insulation factor of windows greatly affects the heat transference performance of a house. Polycarbonate (PC) has a low thermal conductivity and is an alternative to glass. It improves the thermal insulation of windows, but requires a protective surface coating to increase scratch resistance and maintain high transparency. Surface coating agents can be prepared by blending hollow silica nanoparticles as a thermal insulating material with or without cellulose nanofiber (CNF) as a dispersion agent. This project aims to develop high performance PC window glass (high thermal insulation, high transparency, increased scratch resistance) by applying newly developed coating agents to PC. To increase thermal insulation and the area of PC window glass for good light transmission, an attempt was also made to reinforce resin window frames by adding CNF, which has a fine mesh structure and strengthening effect for resin, as an alternative to aluminum. The commercialization of PC windows with reinforced window frames will greatly contribute to the reduction of CO_2 emissions from houses and commercial buildings.

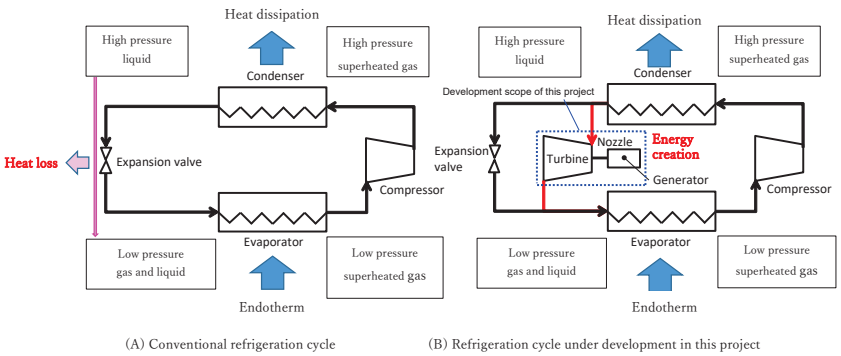


High-efficiency centrifugal chillers with electricity-generating functions

Contractor: Mitsubishi Heavy Industries Thermal Systems, Ltd.
Duration: FY2018 - FY2019

Project Overview

Air-conditioning equipment accounts for approximately 30 percent of the energy consumed in offices and buildings. Energy saving technologies have been developed to improve their efficiency, but more can be done. Centrifugal chillers are significant consumers of energy among heat source equipment. This project aimed to develop technologies to transform energy losses from heat expansion during the refrigeration cycle into electricity by recovering the energy through expansion turbines. Utilizing the electricity generated for chiller units and auxiliary equipment will help enhance system efficiency. To promote their future use, we are now developing centrifugal chillers that can operate with HFO refrigerants, which have global warming potential of less than 1 (GWP of CO_2 is 1) and do not damage the ozone layer. We are working to develop and demonstrate highly-efficient centrifugal chillers with energy-creating technologies to contribute to the reduction of CO_2 emissions.



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.

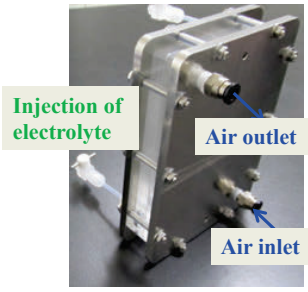
Metal hydride/air battery (HAB) and electricity storage systems to expand the use of renewable energy

Contractor: FDK Corporation
Duration: FY2019 - FY2021

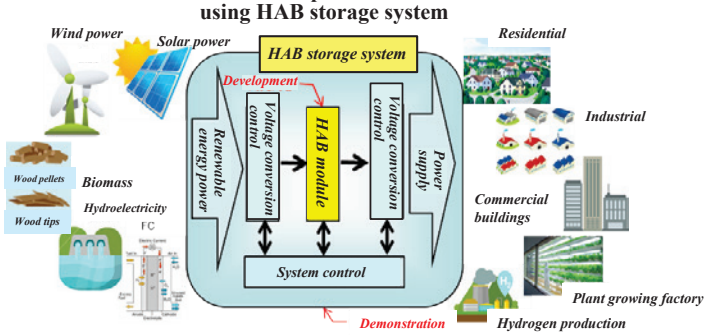
Project Overview

Renewable energy offers much promise to diversify electricity sources and reduce emissions of CO_2, a greenhouse gas. However, solar and wind power fluctuate, so storage batteries are required when connecting these sources to the power grid. Storage batteries currently used have strengths but also some weaknesses, such as low energy density and safety, so new storage battery designs are needed.
This project aims to develop a metal hydride/air battery (HAB) to store electricity generated by renewable energy and then supply electricity as required by various levels of power demand, and conduct demonstration experiments.
The HAB is a water-based air battery that has a high safety level and higher energy density per unit of volume than other secondary batteries. Stable charging/discharging performance is achieved by using an air electrode with a BRO catalyst and a hydrogen absorbing alloy for the negative electrode.
The project is expected to result in development of storage batteries and electricity storage systems that can be installed in spaces that until now have been difficult for other batteries.

10Ah MH-air battery(HAB)



Low-carbon power network using HAB storage system

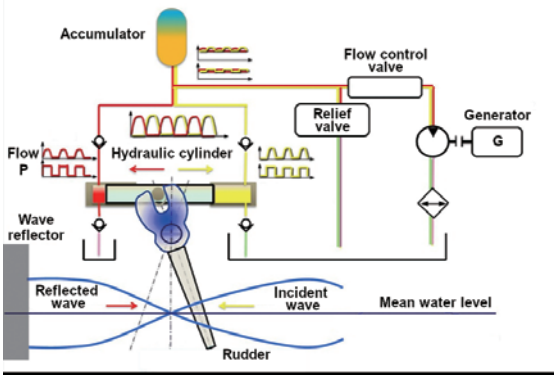


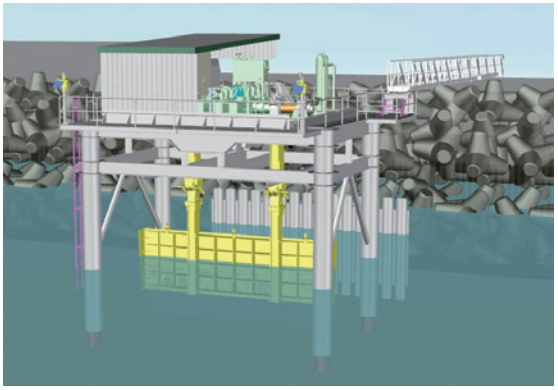
Wave energy converter with vertical layout ram-type hydraulic cylinders utilizing reflected wave energy (Hiratsuka Wave Power Plant)

Contractor: Institute of Industrial Science, The University of Tokyo
Duration: FY2018 - FY2020

Project Overview

The Hiratsuka Wave Energy Converter (WEC) receives wave energy from a pendulum rudder and converts it into hydraulic energy for a hydraulic motor that generates electricity. To reduce costs and ensure durability even in high waves from typhoons and storms, a commercially-available marine hydraulic steering system for ships is used. Electricity is produced by a generator and equipment designed for medium to small scale hydroelectric generation.
Vertical hydraulic cylinders are used to reduce the reactive force of waves. The rudder is made of aluminum and rubber to reduce weight. A reflector made of steel pipe sheet piles is installed between the shore-side breakwater and the rudder to generate electricity effectively from reflected waves. The objectives for the one-year demonstration test are to achieve the rated output of 45 kW with wave heights greater than 1.5 m, conversion efficiency of 50%, and a capacity factor greater than 35%.
After the demonstration trials, a world-leading commercial-use wave energy converter will be developed that can be installed in harbors and fishing ports around the world to help reduce CO_2 emissions.





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

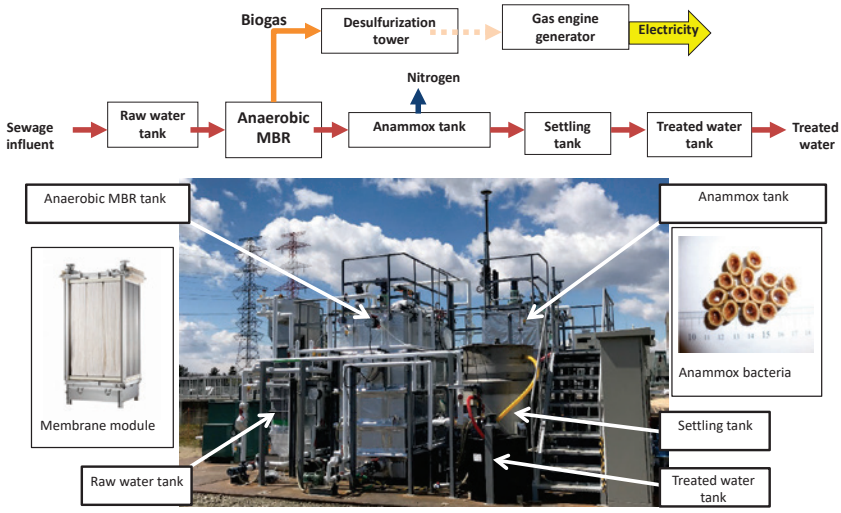
Development of Innovative Energy Saving/Energy Creating Domestic Wastewater Treatment System

Contractor：Mitsubishi Kakoki Kaisha, Ltd.
Duration：FY2017 - FY2019

Project Overview

Domestic wastewater such as sewage is purified generally by the activated sludge process. This technology was introduced from Europe with a history of about 100 years. This process uses aerobic microorganisms, consumes a large amount of energy for oxygen supply, and generates a large amount of sewage sludge.

We are promoting the practical application of an energy saving, energy creating, and low sludge generation wastewater treatment technology using anaerobic microorganisms, where the contaminants in domestic wastewater are converted to methane gas by an anaerobic membrane bioreactor (anaerobic MBR), and ammonia nitrogen, a cause of eutrophication, is converted to nitrogen gas by anammox bacteria.



The effects obtained with artificial sewage were confirmed with actual sewage, and a demonstration experiment is currently being conducted at a sewage treatment site. The treatment performance, CO_2 reduction effect, and reduction of waste amount of the new process will be evaluated, and an energy creating system including use of the formed biogas will be established, expanding application from domestic wastewater to the wider field of water treatment.

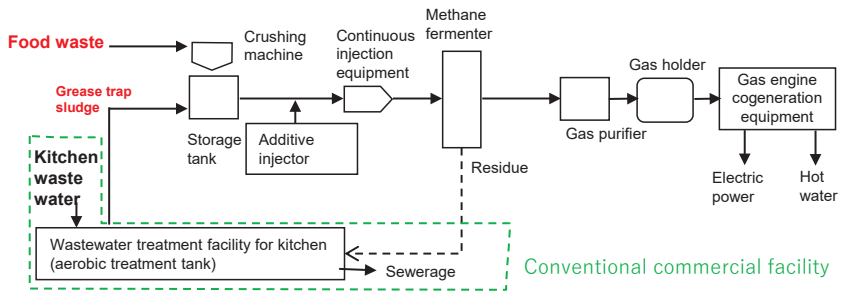
Biogas recovery technology for buildings that generate organic waste high in oil and fat content

Contractor：Takenaka Corporation
Duration：FY2018 - FY2019

Project Overview

Methane fermentation technology is already well-established to recover energy from food waste and kitchen wastewater from food retailers and the food services industry. The oil and fat in these wastes can produce a large quantity of biogas. However, some oil and fat is typically removed before processing, because a high ratio of oil and fat content can hinder the fermentation process. Past studies have suggested that injecting additives to supplement the volatile solids enables processing without the need to remove oil and fat.

The current project will develop a processing system by identifying an effective additive, determining an optimum oil and fat ratio for the methane fermentation process, and determining the amount of additive to inject into the process. The system's CO_2 emission reductions and economic efficiency will be evaluated. The project's aim is to demonstrate the practicality of this technology using additives for methane fermentation of grease trap sludge and food waste that contains a significant ratio of oil and fat content.



System under development

Demonstration facility

Ongoing Projects in FY2019

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 with 5G base station
NIPPON TELEGRAPH AND TELEPHONE WEST CORPORATION 2018-2020

Innovative low cost printed RFID technology
Toray Industries, Inc. 2017-2019

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 of virtual synchronous generators to utilize fluctuating renewable energy sources
PACIFIC POWER CO., LTD. 2019-2021

Light-duty truck powered by fuel cell
Tokyo R&D Co., Ltd. 2016-2019

High-density and high-output fuel cell units for industrial vehicles
Toyota Industries Corporation 2017-2019

CNT electrical wire for ultra-high performance motors to reduce CO_2 emissions from transportation
Furukawa Electric Co., Ltd. 2017-2019

Energy-saving automotive air conditioners to reduce CO_2 emissions
DENSO CORPORATION 2017-2019

Demonstration of infrastructure for ultra-fast charging of electric transit buses with excess regenerative electricity from trains
Sumitomo Corporation 2017-2019

High energy density EV system for large vehicles and trial in metropolitan route buses
Kumamoto University 2018-2019

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

Central air conditioning chillers using natural refrigerants
Panasonic Corporation 2017-2019

Boosting air-conditioning efficiency using artificial intelligence with people- and air-flow sensors for spaces with exterior openings
Kobe University 2017-2019

Energy-saving in ventilation to reduce electricity consumption by air conditioning equipment
Mitsubishi Electric Corporation 2017-2019

Insulated window by nanocellulose
RENIAS CO., LTD. 2017-2019

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

High efficiency centrifugal chiller with electricity generation function
Mitsubishi Heavy Industries Thermal Systems 2018-2019

High power and space-saving thermoelectric generation system with thermo-syphon heat exchanger
Yanmar Co., Ltd. 2018-2020

Thermal storage radiation air conditioning system from the concrete slab with renewable energy and heat pump
Ritsumeikan University 2018-2019

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

Offshore wind measurement and verification with buoy-mounted LiDAR
Japan Weather Association 2016-2019

Digital grid router (DGR) and power interchange settlement system to accelerate the introduction of renewable energy
DIGITAL GRID Corporation 2017-2019

Reducing CO_2 emissions by storing renewable energy using hydrogen storage alloys
NASU DENKI—TEKKO CO., LTD. 2017-2019

Removable tapered pile foundations and construction methods for promotion of marine renewable energy
Rinkai Nissan Construction Co., Ltd. 2017-2019

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 of piston-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 battery (HAB) and electricity storage systems to expand the use of renewable energy
FDK Corporation 2019-2021

Low-cost, low-carbon methods to decommission spar-type floating 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

Long term technical demonstration of CO_2 emission reduction using bio-coke from mixed feedstock in general incineration facilities and cast iron manufacturing
Japan Coal Energy Center 2015-2019

Graphene synthesis technologies and applications for energy devices to reduce CO_2 emissions
Okayama University 2017-2019

Innovative sewage treatment system for energy saving and energy production
Mitsubishi Kakoki Kaisha, Ltd. 2017-2019

Low carbon technologies based on collaboration between efficient productions of algae biomass and their conversions to high performance plastics
University of Tsukuba 2017-2019

Production technology for gas barrier bottles and packagings made from 100% bio-based polyethylene furanoate (PEF)
Toyobo Co., Ltd. 2017-2019

Recycling technologies for used disposable diapers
Unicharm Corporation 2018-2020

Biogas recovery technology for high oil and fat organic waste produced in building
Takenaka Corporation 2018-2019

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

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