環境省
Ministry of the Environment

Ministry of the Environment, Government of Japan

Low Carbon Technology Research, Development and Demonstration Program

Low Carbon Technology Research, Development and Demonstration Program

Purpose and Features

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

For Japan to realize a 26% reduction in GHG emissions by FY2030, further progress in CO_2 emission reduction measures is still needed in every sector. Technological breakthroughs are needed to boost efficiency, reduce the costs of CO_2 emission reduction technologies, and consequently establish new and better low-carbon technologies. It is also crucial for them to be widely deployed in society in order to enhance countermeasures in the future.
Meanwhile, there is no assurance that adequate progress will be made in research and development of the technologies needed to reduce CO_2 emissions if this relies solely on the private sector, due to risks associated with R&D, uncertain profitability, and the lack of incentives for industries to voluntarily bolster their own climate change countermeasures. Therefore, it is essential that the national government provide leadership and encouragement for the research, development, and demonstration (RD&D) of technologies needed to make large reductions in CO_2 emissions in the medium and long term.

In that context, this Program aims to promote the RD&D of technologies that can be highly effective in reducing CO_2 emissions and lead to stronger future measures (including regulation) to address climate change and to achieve significant emission reductions.

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 Japanese government's Special Account for Energy Policy. Legislation governing the special account limits the use of these funds to the R&D of technologies such as renewable energy, the utilization of otherwise unused energy, and energy conservation that can contribute to reductions in energy-related CO_2 emissions in Japan.

After completion of this Program, the funded technologies are expected to be utilized quickly through applications, commercialization, and mainstreaming.

Technologies eligible for the Program are still at the development or demonstration stage, but eligibility is limited to technologies that have a prospect of being commercialized quickly after completion of this Program. The technologies which require future development or demonstration afterward are basically not eligible for the Program.

Eligible Technology Areas

Funding is available for the RD&D of technologies that can lead to stronger future measures against climate change, in areas where CO_2 emission reductions could be relatively large, but where only limited progress could be expected by private sector initiatives alone.

1 Low Carbon Transportation

Development and demonstration of technologies to decarbonize the transportation sector. Examples include technologies to promote and improve the performance of electric vehicles (EV), hybrid vehicles (HV) and fuel-cell vehicles (FCV), which are expected to become more widely used in the future; and to improve energy efficiency in the transportation sector (including rail, etc., but excluding the automotive sector).

2 Low Carbon Buildings

Development and demonstration of technologies to decarbonize the household and commercial sectors, etc. Examples include technologies to improve energy efficiency in housing and offices and make progress toward zero emissions by improving energy conservation and introducing renewable energy for equipment and facilities in buildings.

3 Low Carbon Renewable Energy

Development and demonstration of technologies to promote the introduction of renewable energy, including photovoltaic, wind, micro-hydro, and geothermal energy, etc. Examples include improving photoelectric conversion efficiency for photovoltaic power generation and improving the performance of fuel cells that generate electricity from hydrogen generated by renewable energy.

4 Low Carbon Biomass and Recyclable Resources

Development and demonstration of technologies to promote the utilization of biomass-from-waste technologies and decarbonization through resource recycling. Examples include technologies to decarbonize and reduce costs of total systems that utilize biomass from waste (including biomass collection methods and manufacturing methods). (The Program is limited to technologies with an expected GHG emission reduction of at least 50% compared to baseline scenarios, considering the entire life cycle from raw material extraction and production to transportation, use and waste.)

5 Innovations for Decarbonization of Social Infrastructure

Development and demonstration of innovative technologies for decarbonization of social infrastructure. Examples include efforts to achieve significant decarbonization of social infrastructure that is a source of CO_2, including energy infrastructure, information infrastructure, and logistics/distribution, by using storage technologies for hydrogen, electricity, and thermal energy, as well as IoT, AI and big data analysis technologies.

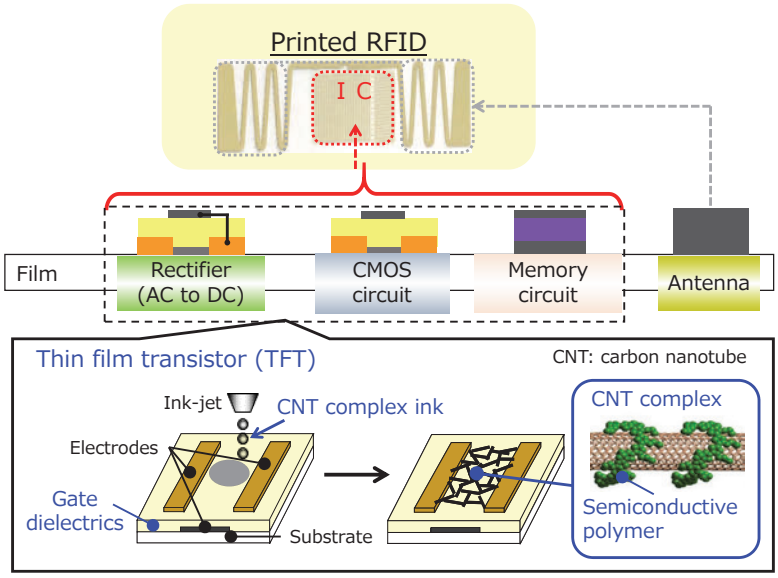
RD&D for Social Infrastructure Innovation

Innovative low cost printed RFID technology

Contractor：Toray Industries, Inc.
Duration：FY2017 - FY2019 (planned)

Project Overview

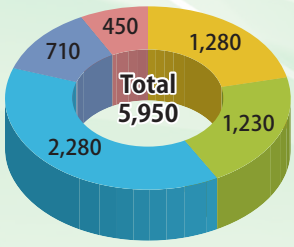
Radio frequency identification (RFID) is an automatic recognition technology that uses radio waves to identify tags attached to objects. RFID can scan at a distance and read many items at once, giving it significant potential applications in retail self-checkout systems and distribution efficiency. On the environmental front, RFID can promote energy saving and reduce transportation volume by improving efficiency in retail and logistics. RFID can also help address current concerns about overwork and labor shortages. Today's silicon-based RFID tags are relatively expensive, ranging from 10 to 20 yen apiece, so applications have been limited. This project will develop and demonstrate low-cost printed UHF-band RFID using semiconductive carbon nanotubes, having potential performance comparable to today's silicon-based semiconductors, with the aim of boosting efficiency and reducing CO_2 emissions in the entire supply chain.



Film formation: Technology for forming a thin film on a substrate.
This project will fabricate integrated circuits by forming TFTs using ink-jet printing with CNT complex ink.

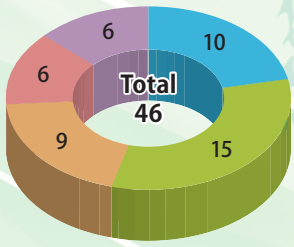
Statistics on Ongoing Projects in FY2018

Budget allocation for each field (million yen)



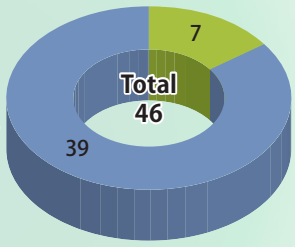
- Transportation
- Buildings
- Renewable and Distributed Energy
- Biomass and Recyclable Resources
- Social Infrastructure

Number of projects by budget size (million yen)



- <50
- 50-100
- 100-150
- 150-300
- ≧300

Number of projects by type of representative organization



- University
- Private Company

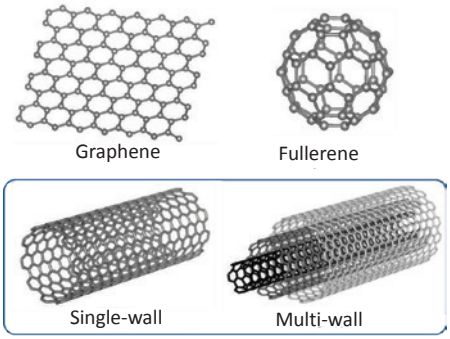
RD&D for Transportation

CNT electrical wire for ultra-high performance motors to reduce CO_2 emissions from transportation

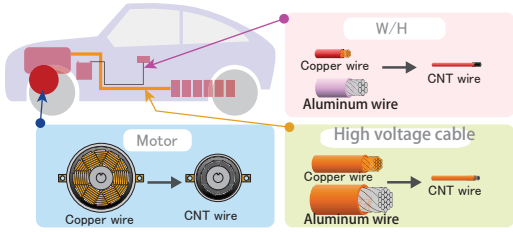
Contractor：Furukawa Electric Co., Ltd.
Duration：FY2017 - FY2019 (planned)

Project Overview

In the automotive field, weight reduction leads directly to energy savings. Many efforts are under way using materials and design to make vehicles lighter. Copper has always been the main conductor used in electrical wires, but in recent years it is being replaced in wire harnesses (W/H) with aluminum, which is lighter. This project aims to demonstrate reduced CO_2 emissions with an innovative, light, compact, high-performance electric motor using a prototype of ultra-light electrical wire made of carbon nanotubes (CNT) in the motor windings.
CNT wire has half the weight of aluminum, one-fifth of the weight of copper, 20 times the strength of steel, and excellent metallic conductivity. Applying CNT wires in the automotive field will contribute to the realization of a low-carbon society.



Carbon nanotube
Structure of a carbon nanotube



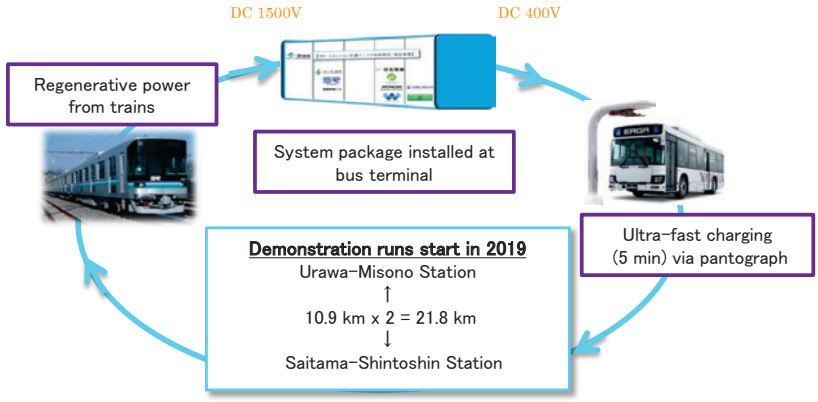
Applications for CNT wire

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

Contractor：Sumitomo Corporation
Duration：FY2017 - FY2019 (planned)

Project Overview

Electric railway networks in Japan already recover some regenerative power from train braking and use it for other trains and auxiliary equipment. However, it is difficult to recover and use all of it, so the excess energy is released from the catenary as heat into the air.
The aim of this demonstration trial is to develop an ultra-fast charging system to harness this excess regenerative power and use it for both train's operation and charging electric buses within five minutes. e-Buses are still not widespread in Japan due to long charging times and cost of rapid charging with high-voltage electricity. The project will also test whether e-Buses can match the performance of diesel buses, with the added benefits of reducing CO_2 emissions in the public transportation sector.



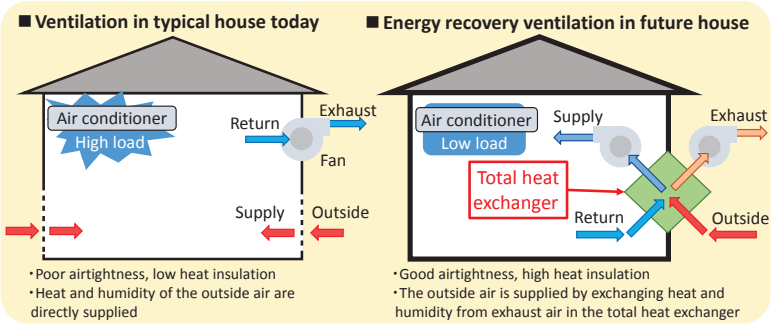
RD&D for Buildings

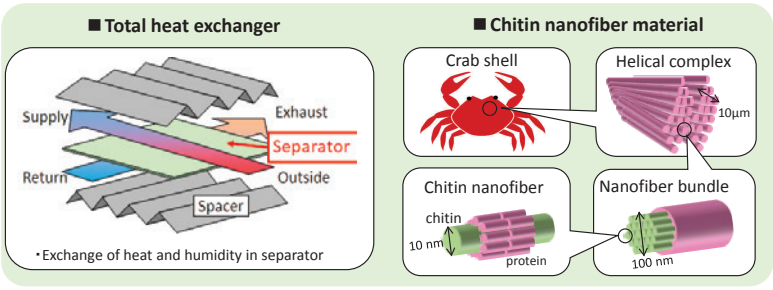
Energy-saving in ventilation to reduce electricity consumption by air conditioning equipment

Contractor: Mitsubishi Electric Corporation
Duration: FY2017 - FY2019 (planned)

Project Overview

Buildings and houses of the future will be more air-tight and better insulated. This will give ventilation systems an even greater role in maintaining indoor comfort but increase energy consumption for air conditioning. An energy recovery ventilator equipped with a total heat exchanger to recover heat and humidity from supply and exhaust airflows could help maintain indoor comfort and simultaneously reduce an air conditioner's energy consumption.
This project aims to improve the humidity recovery function in energy recovery ventilators by developing a separator that uses a new material (chitin nanofiber), test the separator in a total heat exchanger, and verify the energy saving effects.
This development could help realize a low carbon society by reducing the air conditioning load in ventilation.





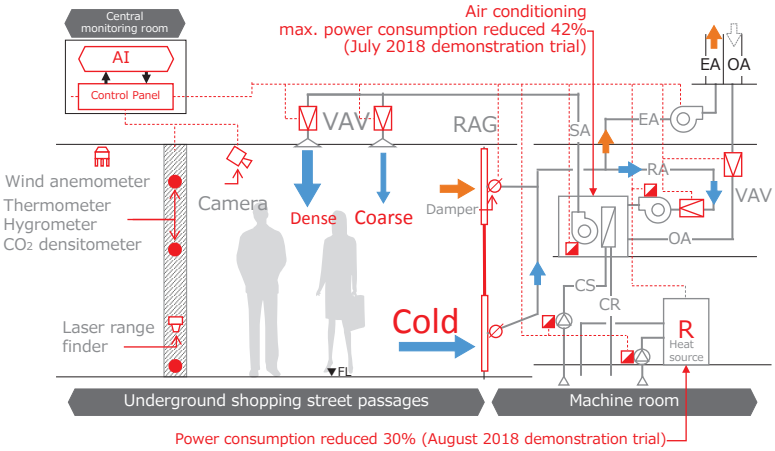
Boosting air-conditioning efficiency using artificial intelligence with people- and air-flow sensors for spaces with exterior openings

Contractor: Kobe University
Duration: FY2017 - FY2019 (planned)

Project Overview

The Santica underground shopping area in Sannomiya (Kobe city center) has many outdoor openings through which a daily average of 150,000 people enter and exit. Since it is not practical to close the doors, air coming in from outside has a significant impact on the air-conditioning load. This project is developing next-generation air-conditioning control technologies that use AI and sensing data to predict the flow of people (human distribution), monitor temperature and humidity, and control airflow (air flow, outside air volume, temperature, pressure, etc.) in block units, with the aim of reducing energy consumed for air-conditioning by 50% while still ensuring comfort.

Efficient air conditioning with artificial intelligence and sensors for spaces with exterior openings



Depending on the inflow of external air, the air volume in the vicinity of the doorway is controlled (using positive pressurization) to prevent air inflow. By adjusting the timing for the processing of the air-conditioning load, the heat source is constantly operated at high efficiency. By predicting, controlling, evaluating, and studying this series of controls using AI, we aim for a general-purpose system that can also be applied in other spaces with outdoor openings (underground shopping areas, railway stations, airports, large spaces, etc.).

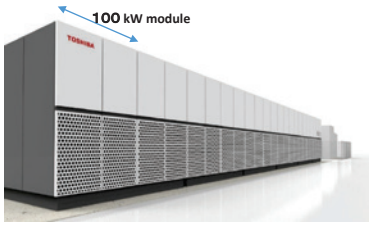
RD&D for Renewable and Distributed Energy

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

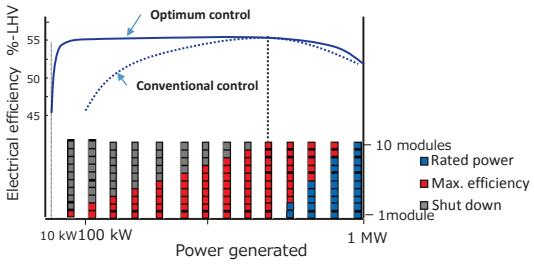
Contractor：Toshiba Fuel Cell Power Systems Corp.
Duration：FY2018 - FY2020 (planned)

Project Overview

Fuel cell systems are very efficient at generating electricity and hold much promise to help usher in a hydrogen-based society. This project will develop a polymer electrolyte fuel cell (PEFC) system for factories and large buildings, comprised of multiple 100 kW modules and capable of generating from 100 kW to several MW of electricity. Each module is controlled individually depending on electrical demand to realize high efficiency in a wide output range. Start up during a power outage can be supported by a small battery and modules can start sequentially.
The development of a fuel cell stack with high power density and durability will help reduce costs and space requirements and facilitate market entry. For higher temperature applications in factories, the project will also test cogeneration with heat pumps to utilize heat from PEFCs at around 60 degrees Celsius. Linking up with facilities that produce H2 as a by-product or with renewable energy will help reduce CO_2 emissions further.



MW scale fuel cell power generating system



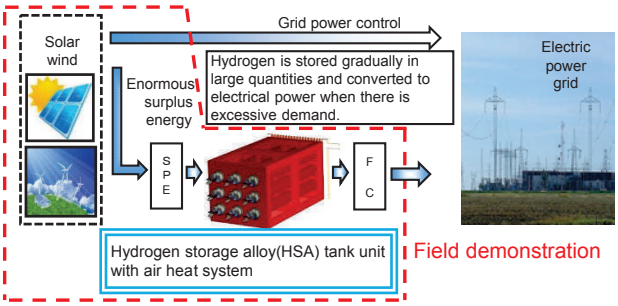
Optimum control of each module
(case of 1 MW with 10 modules)

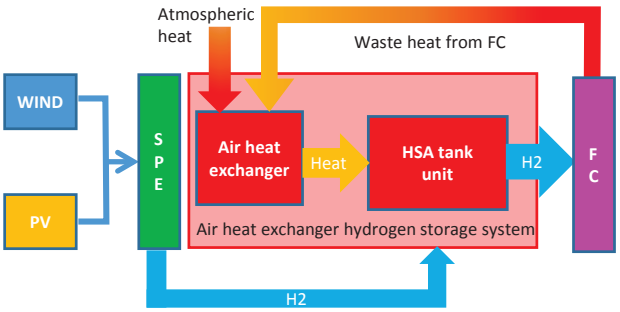
Reducing CO_2 emissions by storing renewable energy using hydrogen storage alloys

Contractor：NASU DENKI—TEKKO CO., LTD.
Duration：FY2017 - FY2019 (planned)

Project Overview

Mass storage of hydrogen is seen as a promising method for the effective utilization of enormous surpluses of energy that can be generated by renewable energy.
This project will develop and test a safe and compact system that uses hydrogen storage alloys (HSA).
Challenges include the cost of HSA and decreases in hydrogen absorption/desorption due to the build-up of heat from hydrogen reactions.
Using nano-structured iron-titanium alloys produced by the mechanical alloying method, the cost with HSA is expected to be significantly lower than with conventional rare-earth alloys. The project will also develop an "air heat exchanger hydrogen storage system" capable of smooth heat exchange between hydrogen reaction heat and atmospheric heat.
Field experiments to store hydrogen generated by solar and wind power will be conducted to determine the efficient operating conditions for this system.





RD&D for Biomass and Recyclable Resources

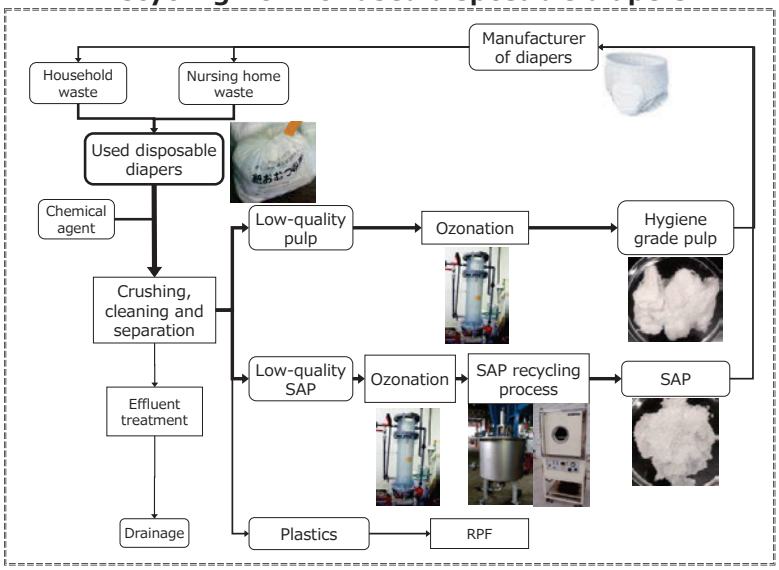
Recycling technologies for used disposable diapers

Contractor：Unicharm Corporation
Duration：FY2018 - FY2020 (planned)

Project Overview

The use of disposable diapers is expected to rise in Japan with the aging of society. Used diapers are currently disposed as waste and mainly incinerated, creating a source of CO_2 emissions. This project will develop and test technologies for collecting and processing used disposable diapers to recycle them into pulp and superabsorbent polymer (SAP). It will look at the cost-effectiveness of recycling "from diapers to diapers" and the reduction of energy-related CO_2 emissions. The project will establish ozonation recycling technology to efficiently sterilize, bleach and deodorize used pulp and SAP, and a drying technique that rebuilds the absorption capacity of SAP and prevents a decline in absorption performance. Aiming at the practical application of these technologies, we will also establish methods in Shibushi City, Kagoshima, for efficiently collecting and separating used disposable diapers and mechanisms for using the recycled products as raw materials for disposable diapers.

Recycling flow for used disposable diapers



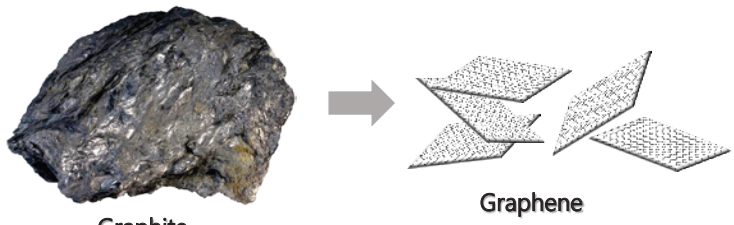
Graphene synthesis technologies and applications for energy devices to reduce CO_2 emissions

Contractor：Okayama University
Duration：FY2017 - FY2019 (planned)

Project Overview

Graphene is a next-generation material with superior properties compared to conventional carbon materials, including electrical conductivity, thermal conductivity, strength, and lubricity. This project aims to reduce CO_2 emissions by using graphene in lithium ion batteries and lubricant additives. A process of preparing graphene from natural graphite potentially emits no CO_2, so graphene is promising as an alternative to conventional carbon materials (e.g. carbon black) produced from fossil fuels. The high cost of producing graphene has limited its use, so we have been developing a simple process to produce graphene, reducing the costs and leading to the potential mass production of graphene. We aim to reduce CO_2 emissions by replacing carbon black used for tires with graphene and applying graphene to lithium ion batteries and lubricant additives for use in electric vehicles.

Production of graphene



Applications

Ongoing Projects in FY2018

Note: Fiscal year (FY) starts on April 1

RD&D for Transportation

EV system for large vehicles to promote early EV adoption in bus/truck category
IZUMI Motor car CO., LTD 2016-2018

Light-duty truck powered by fuel cell
Tokyo R&D Co., Ltd. 2016-2018

LNG-fueled marine hybrid system with gas engine, fuel cell, battery and gas heat pump
Yanmar Co., Ltd. 2016-2018

Heavy-duty LNG truck and optimal design for refuelling infrastructure
Isuzu Motors Limited 2016-2018

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

RD&D for Buildings

Data center hybrid cooling system with 1.0 power usage effectiveness
NIPPON TELEGRAPH AND TELEPHONE EAST CORPORATION 2016-2018

A zero-fuel, low-temperature snow-melting system that utilizes summertime solar heat and household water heat
TRUSTPLAN Inc. 2016-2018

High-efficiency air conditioning system with liquid desiccant and water-refrigerant heat pump technologies
Waseda University 2016-2018

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

RD&D for Renewable and Distributed Energy

Thermal well and heat pump system for aquifer thermal energy storage systems
Kansai Electric Power Co, Inc (KEPCO) 2015-2018

Micro hydro generation systems to optimize unutilized energy in existing water pipelines
Daikin Industries, Ltd. 2016-2018

Next-generation coastal wave power generation systems
Mitsui E&S Steel Structures Engineering Co., Ltd. 2016-2018

Power recovery unit to increase supply from solar panels and power conditioning systems
JGC Corporation 2016-2018

Offshore wind measurement and verification with buoy-mounted LiDAR
Japan Weather Association 2016-2018

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

New geothermal power generation method using hydrothermal circulation system
Obayashi Corporation 2017-2018

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 Fuel Cell Power Systems 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

RD&D for Biomass and Recyclable Resources

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

RD&D for Social Infrastructure Innovation

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

Drastic energy saving technology of wide area distributed edge system with 5G base station
NIPPON TELEGRAPH AND TELEPHONE WEST CORPORATION 2018-2020

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