Ministry of the Environment
Government of Japan

March 6, 2017

COOL CHOICE

Programs for low carbon technologies

Daiki NOSE, MME, MSc

Researcher

Climate Change Projects Office, Climate Change Policy Division,
Global Environment Bureau,
Ministry of the Environment, Government of Japan

1. Programs for low carbon technologies in Climate Change Projects Office

2. Key projects to introduce less-CO2 energy
   i. Microgrids
   ii. Renewables
   iii. Low-carbon hydrogen

Programs for low carbon technologies in Climate Change Projects Office

Overview of CCPO programs

1. **Hydrogen**
2. **Renewables (floating offshore wind, tidal power, geothermal etc)**
3. **Micro grid**
4. Cellulose Nanofiber
5. Carbon Capture and Storage
6. Low carbon technology research, development & demonstration
7. Nudge

Etc.

4. Cellulose Nano Fiber (CNF)

- One fifth as light as and five times as strong as steel
- The body of an automobile can be lighter by 10%
- Project to promote the next-generation materials such as cellulose Nano fiber (3.9 billion yen in 2017)

(Figure: Nano Cellulose Forum)

Positioning of Cellulose Nano-fiber in Environmental Policies

➢ Decrease of vehicle CO2 emissions.

Automobile plastic parts are reinforced with CNFs, and better fuel efficiency from lighter weight and significant contribution to global warming prevention are expected.

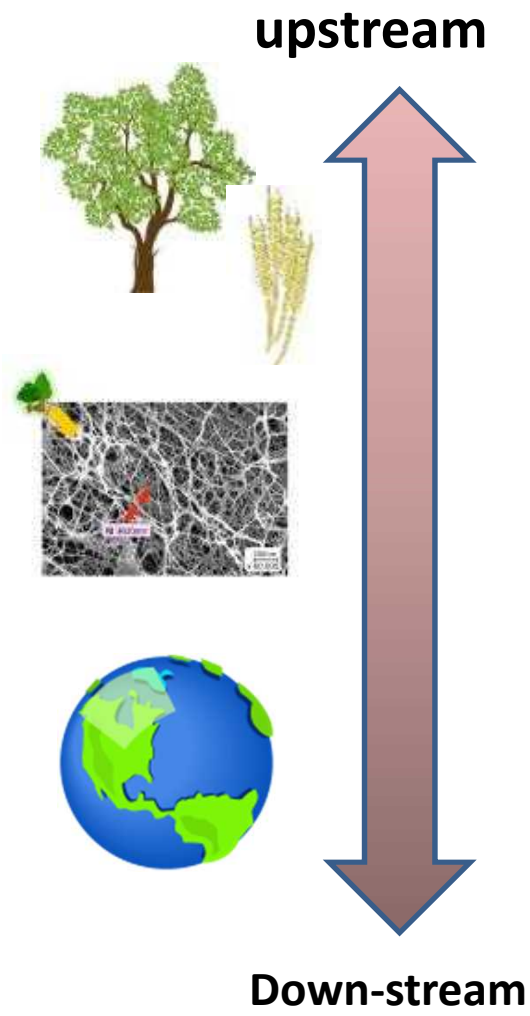
➢ Provision of method for waste CNF products

Consideration of technical issues in recycling (car, HE etc.) .

➢ Realization of recycling-oriented society

It will also lead to an efficient use of rich domestic forest resources, expecting to build a low-carbon, material circulation recycling-oriented society.

Corporation of relevant ministries and the policy collaboration



Ministry	Main role in charge
MAFF	Provision of raw materials for nano-cellulose
MEXT	Basic research on CNF
METI	Manufacturing of CNF (Technology development etc.)
MOE	Expansion into promising fields for global warming prevention

5. Carbon Capture and Storage

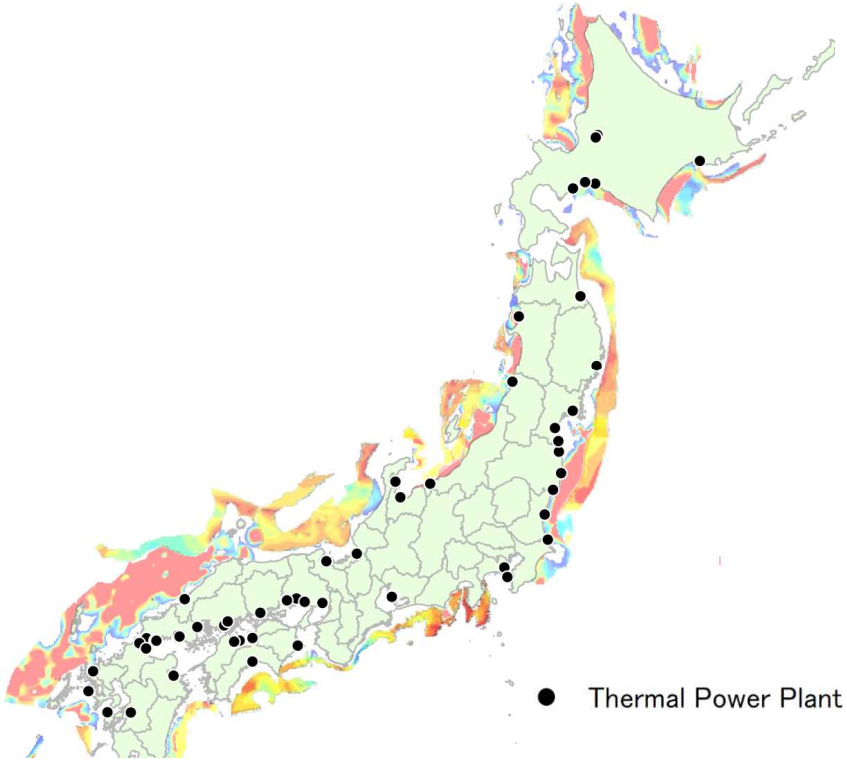
- **The establishment of carbon market** is necessary for the self-motivated introduction of CCS in business.
- **The Japanese government is responsible for research, development and implementation of CCS**, making the commitment to the long-term GHG reduction target.
- **MOEJ makes an appropriate contribution** to the promotion of CCS toward the long-term GHG reduction immediately.
- The appropriate contribution includes not only financial supports for research, development and implementation of CCS but also **preparations for the necessary domestic legislation**.

1. **Investigation of Potential CO2 Storage Sites**
   (FY2014-FY2021, *Joint project with Ministry of Economy, Trade and Industry*)
2. **Sustainable CCS project**
   (FY2014-FY2020)

Investigation of Potential CO2 Storage Sites

Identify potential CO2 storage sites
in waters surrounding Japan until 2021.

In FY2014-FY2017, Japan CCS Co., Ltd. was commissioned to conduct the project and is currently conducting the surveys and analyses of seismic data.



Note) Mizuho Information & Research Institute creates these figures by using data of RITE "Nationwide storage potential quantity survey", and NEDO/AIST (2012) "Evaluation of integrated system covering from power generation to carbon dioxide storage" etc.

seismic survey

Sustainable CCS Project

- CCS (Carbon dioxide Capture and Storage) is a critical technology for achieving our 80% GHGs (greenhouse gases) emissions reduction target in 2050.
- TOSHIBA ENERGY SYSTEMS & SOLUTIONS CORPORATION, the representative of this project, demonstrates the technology of capturing CO_2, and the participating parties (Mizuho Information & Research Institute and 11 other organizations) addresses issues on the introduction of CCS in Japan.
- This 5-year project (FY2016-2020) is funded by the Japanese government, Ministry of the Environment (MOE).

Demonstration of CO_2 capture technology integrated with coal-fired power plant

- The facility that captures CO_2 from emissions of the coal-fired power plant (Mikawa Power Plant, 50MW) using amine-based solvents is constructed and demonstrated while assessing environmental impacts.

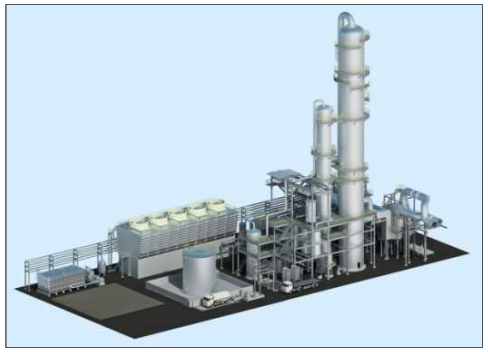
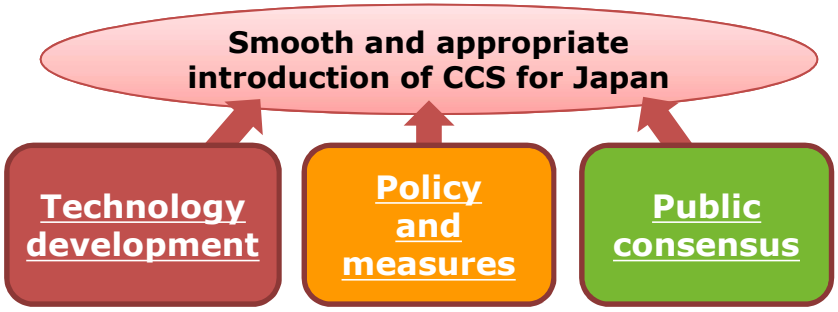


Fig. CO_2 capture demonstration plant (image)
(Source: http://www.toshiba.co.jp/about/press/2016_07/pr_j2602.htm)

Investigation of strategies to introduce CCS in Japan

- The strategies for enabling CCS in Japan are developed by investigation the following:
  - Methods for mitigation of CO_2 leakage and remediation on offshore storage
  - Regulations and measures
  - communication strategy and knowledge sharing platform



6. Research, Development & Demonstration

Purpose

To Promote reductions in CO2 emissions and contribute to stronger future measures against climate change.

Field

- Low carbon transportation.
  ex. EV/HV/FCV component technologies, energy efficiency.
- Low carbon buildings
  ex. energy efficiency/renewable energy in household/office toward zero emission.
- Low carbon renewable and distributed energy
  ex. PV/wind/micro-hydro/geothermal, energy efficiency, decentralized energy system.
- Low carbon biomass and recyclable resources
  ex. Biomass from waste

http://www.env.go.jp/earth/ondanka/cpttv_funds/pamphlet_e.html

6. Research, Development & Demonstration

Example of Low carbon transportation

Fuel cell forklift truck and optimum hydrogen fuel gas supply system

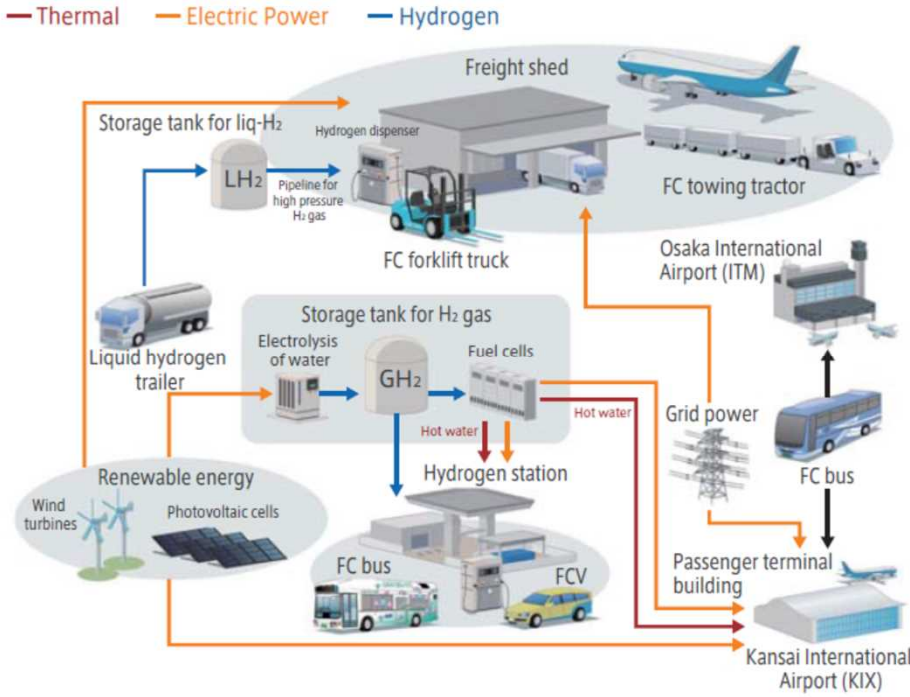
Contractor: Toyota Industries Corporation **Duration:** FY2014–2016 (planned)

Fuel cell forklift truck

Project Outline

A practical model of a fuel cell forklift truck that achieves excellent environmental and economic performance is being developed for trial operation in the international cargo area of Kansai International Airport (KIX). This project is installing and testing Japan's first system to supply hydrogen fuel gas from a large storage tank to multiple dispensers via long high-pressure pipes. The company is working to establish a model to promote both the use of fuel cell forklift trucks and the matching hydrogen supply system, with an eye on international markets, while helping to raising Japan's potential as a hydrogen-based society in the future.

Conceptual diagram of the hydrogen grid in Kansai International Airport (KIX)



http://www.env.go.jp/earth/ondanka/cpttv_funds/pamphlet_e.html

6. Research, Development & Demonstration

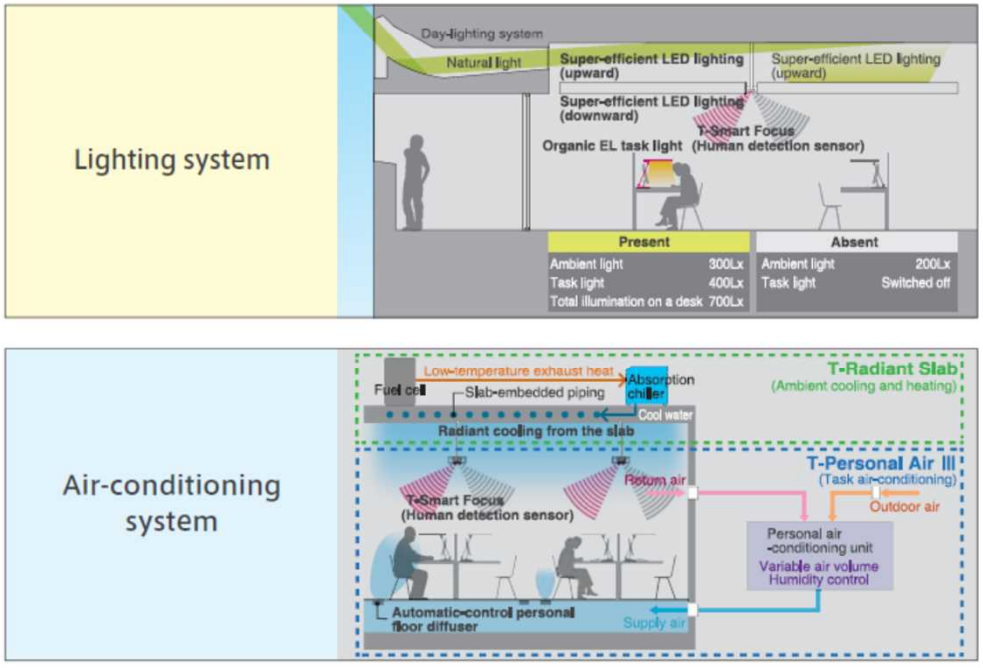
Example of Low carbon buildings

Net Zero Energy Building (ZEB) technologies in small/medium-sized buildings in urban areas

Contractor: Taisei Corporation **Duration:** FY2013–2015 (planned)

Project Outline

This project is testing various energy-saving technologies in a demonstration building for the purpose of creating a Zero Energy Building (ZEB) design for urban areas. The target is a 75% reduction in energy consumption compared to conventional buildings, in order to achieve a net-zero energy (annual) budget for the building. For lighting systems, the project evaluates the light environment and energy saving using natural light collection equipment. For air-conditioning systems, the project evaluates the thermal environment and energy saving using a radiant cooling/heating slab and "personal" air-conditioning systems. With these technologies, the project aims to demonstrate and promote ZEB technologies in urban areas.



http://www.env.go.jp/earth/ondanka/cpttv_funds/pamphlet_e.html

6. Research, Development & Demonstration

Example of Low carbon renewable and distributed energy

Compact, efficient wave-power plant

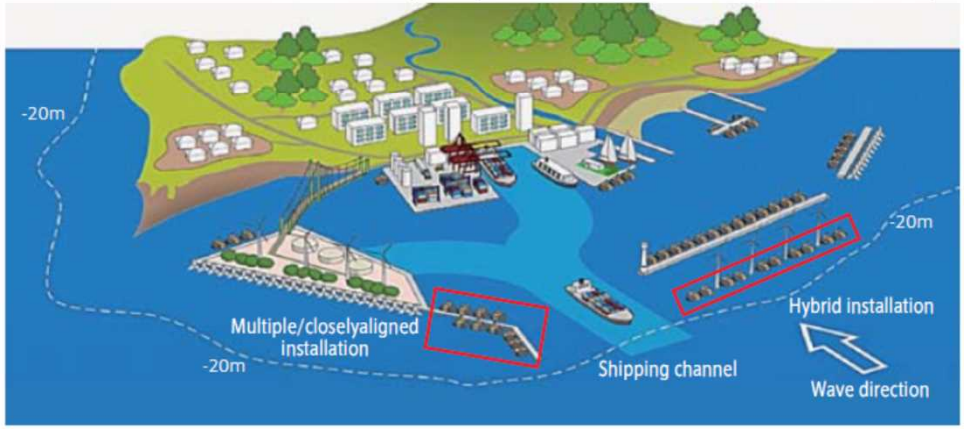
Contractor: Mitsui Engineering & Shipbuilding Co., Ltd. **Duration:** FY2013 - FY2015

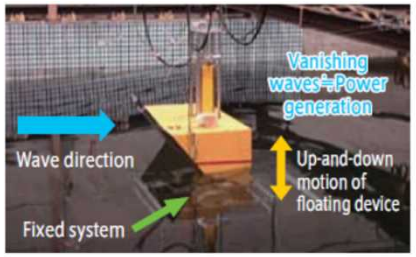
Project Outline

This firm is developing technology for a compact, efficient and intelligent wave-power harvesting system. The system is designed for islands and ports that need extra electricity. It is designed to provide power efficiently to the port area and facilities using an intelligent control module. It is expected to work even where waves are relatively small. The design uses space efficiently, and has a high power gain (on average about 40 times that of photovoltaic systems). Other features include quick installation and flexibility in site selection. Many configurations are possible, including hybrid installation with offshore wind power plants, and multi-unit installations. The system will be tested at Oarai Port in Ibaraki Prefecture.

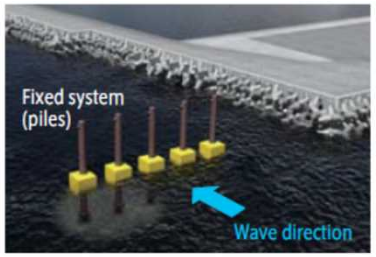
Suggested installation

- Space-efficient use of port area and around area.
- Hybrid installation with wind power plant.
- Lowering cost by commoditized power facilities.
- New business model by local production for local consumption around the port area.





Basis of power generation



Multiple installation at port area, ex.breakwater
(Single installation for this project.)

http://www.env.go.jp/earth/ondanka/cpttv_funds/pamphlet_e.html

6. Research, Development & Demonstration

Example of Low carbon biomass and recyclable resources

Co-firing system with high biomass ratio in an existing coal power plant

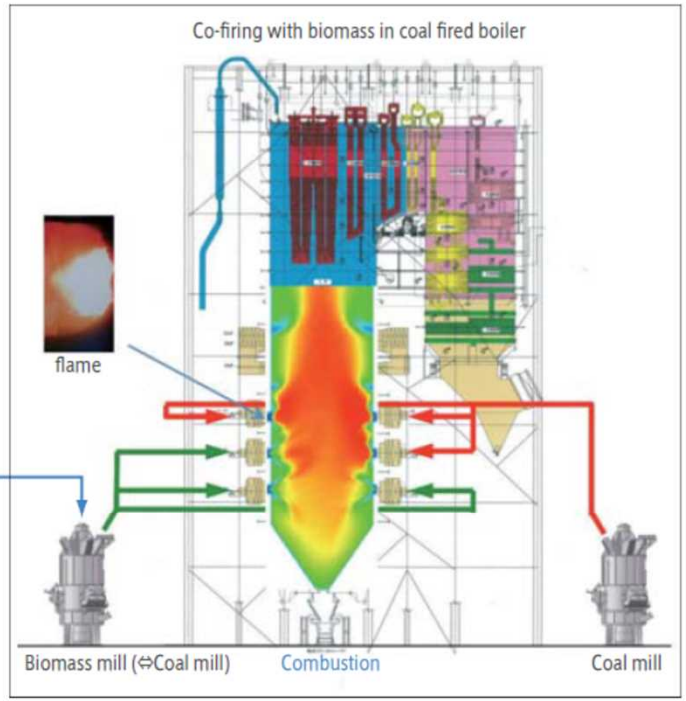
Contractor: IHI Corporation **Duration:** FY2013 - FY2015

Project Outline

Coal-fired power plants are an economical and stable source of electricity, but their CO_2 emissions per kilowatt-hour are higher compared to some other types of power plants. Co-firing using a high ratio of wood biomass to coal could be an effective way to reduce CO_2 emissions from a coal-fired plant.

Testing last year showed that co-firing with 50% of combustion energy provided by wood biomass was economically- and technically-feasible in a conventional coal-fired plant.

This year, the project will test improvements in some processes that bring wood biomass from the forest to power plants that are on the scale of hundreds of megawatts. Co-firing tests will be conducted with higher biomass ratios.



http://www.env.go.jp/earth/ondanka/cpttv_funds/pamphlet_e.html

7. Nudge

Behavioral change and lifestyle innovation

- Technology and devices with high performance are becoming widespread through the technology innovation including the improvement of efficiency and development of innovative technology.
- Usage of technology and devices largely depends on users' behavioral patterns. Users may not make the most of the performance by using them ineffectively or wastefully.

Running water

Light at night

- Low carbonization has been mainly focused on hard (i.e., technology and devices) measures. Soft (i.e., behavior) measures on lifestyle changes have been insufficient.

Lifestyle innovation that drastically changes behavioral patterns to low carbon ones is necessary

Ongoing projects (FY 2017-21)

Four ongoing projects

Representative	Collaborator	Target energy type (Target sector)	Energy utility	Length
Deloitte Tohmatsu Consulting	Central Research Institute of Electric Power Industry, TEPCO Energy Partner, Toppan Printing Company	**Electricity, Gas, Gasoline** (Residential, Transportation)	TEPCO Energy Partner	FY 2017 -2021 (planned)
Oracle Japan	Jyukankyo Research Institute	**Electricity, Gas** (Residential, School education, Commercial)	Hokkaido Gas Corporation, Tohoku Electric Power Company, Hokuriku Electric Power Company, Kansai Electric Power Company, Okinawa Electric Power Company, Tokyo Gas Company	FY 2017 -2021 (planned)
Miyama Smart Energy	Kyushu Smart Community, Team IBOD	**Electricity, Gas, Kerosene** (Residential, Transportation)	Local energy utilities, including Miyama Smart Energy Company (Fukuoka Prefecture)	FY 2017 -2021 (planned)
McCann Healthcare Worldwide Japan	University of Tokyo, National Institute for Environmental Studies	**Electricity** (Residential, Medicine & healthcare)	–	FY 2017 -2021 (planned)

Project overview (household) (FY 2017-21)

Budget: JPY 2 billion in FT 2017 (～USD 20 million)

① Home energy report is sent monthly to experimental group chosen by random sampling.
② Information is provided at various timings (monthly, quarterly, real time, etc.).
Channels of communication are mail, email, web, mobile app, and their combination.
③ Feedback and advice considering each case
are provided when actual status of energy use and answer to questionnaire are obtained from each subject.
④ Result is analyzed to see whether any obvious change can be seen b/w control and experimental groups.

Business entity

- plans program

Plan

optimization

Do

- implements program
- diversified communication patterns based on behavioral sciences and big data

Check

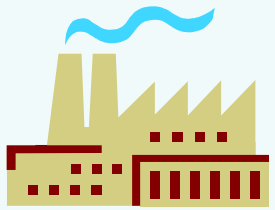
- analyses the result
- reports the result and progress on a regular basis
- specifies improvements and proposes improvement plans

Act

- reflects the improvement plans to the platform

- designs program
- constructs platform
- analyzes data

- offers experiment field
- shares data



Energy utility (electricity, gas, etc.)

dual service provider is preferred to demonstrate comprehensively

Customer retention and branding by service differentiation in the era of energy liberalization

Various areas in Japan

chosen by locality, climate, culture, etc. (eg., Urban vs Rural, Cold vs Warm)

Customer (individual/household)

more than a million will be involved

per one type of nudging,
2-30 + 2-30 thousand households
(control + experimental)

Control

- **data** (monthly/ smart meter)
- **questionnaire**

- **w/o nudge**

Experimental

- **w/ nudge** (home energy report/ billing alert/gamification/ target marketing)
- **questionnaire** (mail/email/web/phone/visit)

each subject can obtain personalized feedback and advice after answering questionnaire

- ◆ Japanese model of behavioral change that contributes to CO2 emission reduction
- ◆ Brand-new policy approach that is highly cost-effective and preserves freedom of choice of targets
- ◆ Novel business model in collaboration with municipalities and industries

Behavioral Sciences Team (BEST, Japan's Nudge Unit)

--- Established on April 14, 2017 on the initiative of the Ministry of the Environment

➢ Purpose

To induce people to action by guiding their own decision without stress in a way that considers each person's case and create an innovation in their lifestyles

To disseminate the nudge approach to behavioral change in both private and public sectors

To help people take better actions by guiding their own decision

➢ Goal

To make the nudge approach take root locally by creating a win-win situation for all stakeholders

Open space for open discussion
where everyone can join

➢ Who can join

Industry, academia, local & central governments, etc.

Every person and entity that is ambitious to make Japan and the world a better place

Central gov'ts joined so far: Ministry of the Environment; Cabinet Secretariat; Cabinet Office; Consumer Affairs Agency; Ministry of Health Labour and Welfare; Ministry of Economy, Trade and Industry; Agency for Natural Resources and Energy; Ministry of Land, Infrastructure, Transport and Tourism

➢ Field

Not only energy & environment but health care, education, etc.

➢ Global cooperation

Info sharing, policy dialogue, collaborative study, international conference, etc. with overseas governments, businesses, and experts.

1. Measures for low carbon technologies in Climate Change Projects Office

2. Key projects to introduce less-CO2 energy

i. Microgrids
ii. Renewables
iii. Low-carbon hydrogen

MOE's Policy for Renewable Energy

For the maximal introduction, measures are taken in all phases of RDD&D.

Concept

- Realization of a low-carbon society with "autonomous & distributed energy system," while also achieving high resistance to disaster and regional revitalization and development. → **Accelerated introduction of renewable energy** is essential.

Projects to accelerate the introduction of renewables – by energy sources

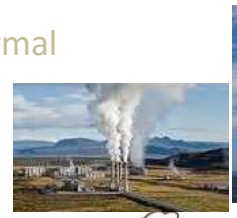
Wind
- Demonstration of floating offshore wind power generation

Geothermal
- Gathering info of environment impact assessment regarding wind and geothermal
- Promotion of low-carbon emission society utilizing geothermal power

Biomass
- Promotion of local communities utilizing wood-based biomass power and heat
- Building a regional-recycling biogas system
- Promotion of low emission waste -to-energy system

Hydropower
- Promotion of hydropower generation utilizing in waterworks

Ocean
- Demonstration of tidal power generation




Maximum usage of regional-based renewable energy resources

Utilization of renewables with hydrogen and battery

- Utilize residual renewable energy to produce and utilize low-carbon hydrogen for fuel cell and FCVs.
- Utilize batteries to normalize fluctuations of solar and wind power generation.

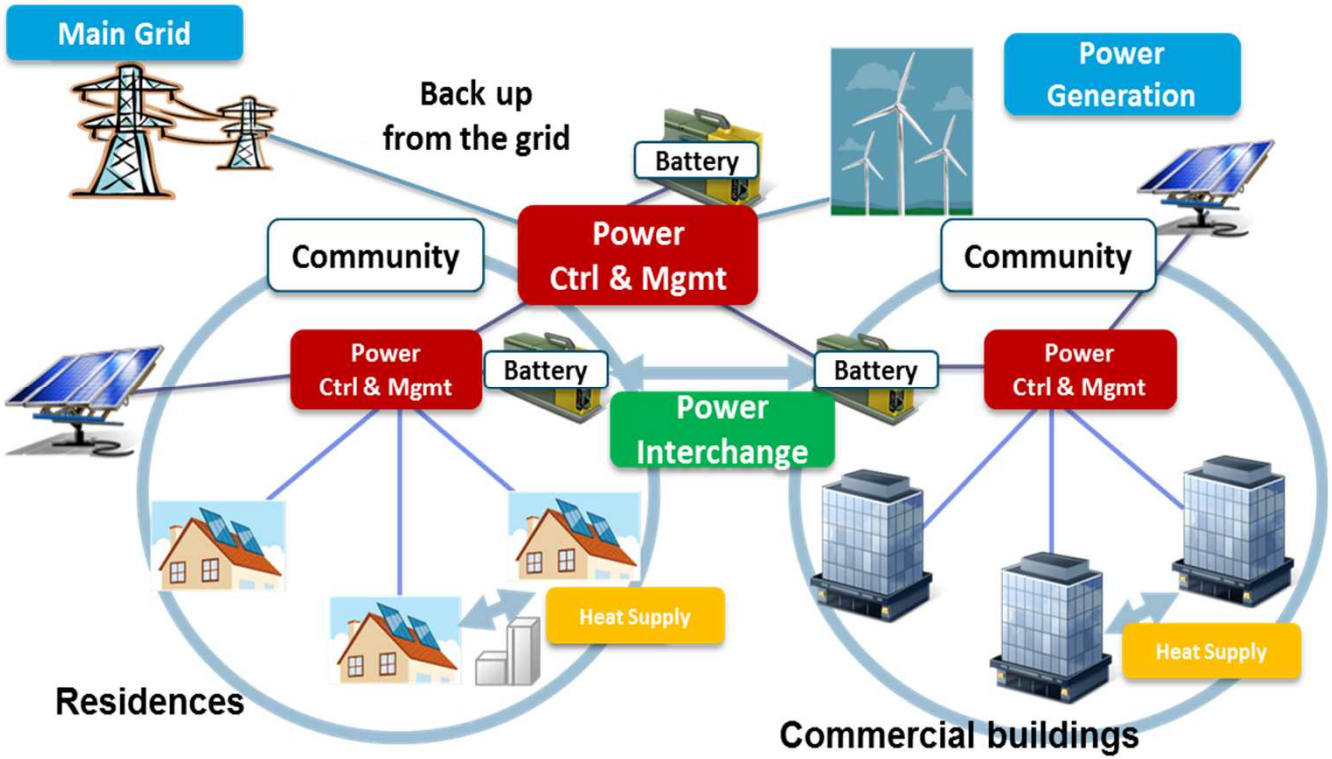

Financial support for local municipalities

- 'Green New Deal' fund; Create leading low-carbon and renewable-oriented communities in harmony with nature.

Project on building an autonomous and distributed low-carbon society

- Launched a project of full-scale demonstration of renewable power generation, storage, and interchange in areas with microgrids.
- Aims to build disaster-resistant communities that can self-supply power during disasters by utilizing renewables, and to lower carbon emissions through maximum renewable energy deployment and improvement of energy efficiency.

Realize an autonomous and distributed low-carbon energy system



Scheme

MOE

↓

Nonprofit Organization

↓

Grant rate: Up to 75%

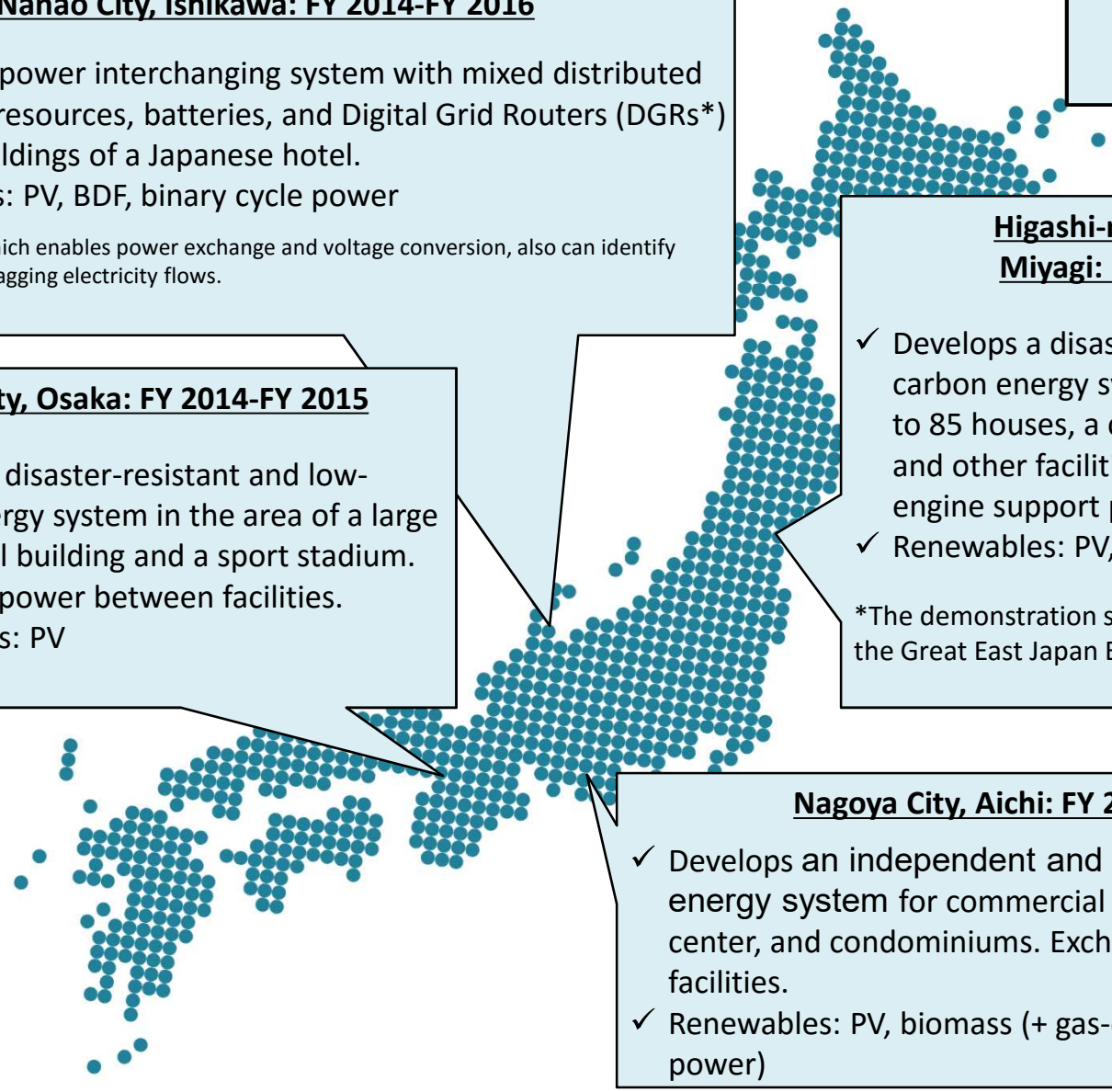
Municipalities/ Private firms

【Period】
Up to three years

Ongoing Projects – Four Demo Sites

Demonstration site: Period

Project Overview



Nanao City, Ishikawa: FY 2014-FY 2016

- ✓ Develops a power interchanging system with mixed distributed renewable resources, batteries, and Digital Grid Routers (DGRs*) at three buildings of a Japanese hotel.
- ✓ Renewables: PV, BDF, binary cycle power

* DGR is a router which enables power exchange and voltage conversion, also can identify electricity through tagging electricity flows.

Higashi-matsushima City, Miyagi: FY 2014-FY 2016

- ✓ Develops a disaster-resistant and low-carbon energy system that supplies power to 85 houses, a community hall, clinics, and other facilities. Batteries and biodiesel engine support power supply.
- ✓ Renewables: PV, BDF

*The demonstration site is a residential district for the Great East Japan Earthquake victims.

Suita City, Osaka: FY 2014-FY 2015

- ✓ Develops a disaster-resistant and low-carbon energy system in the area of a large commercial building and a sport stadium. Exchanges power between facilities.
- ✓ Renewables: PV

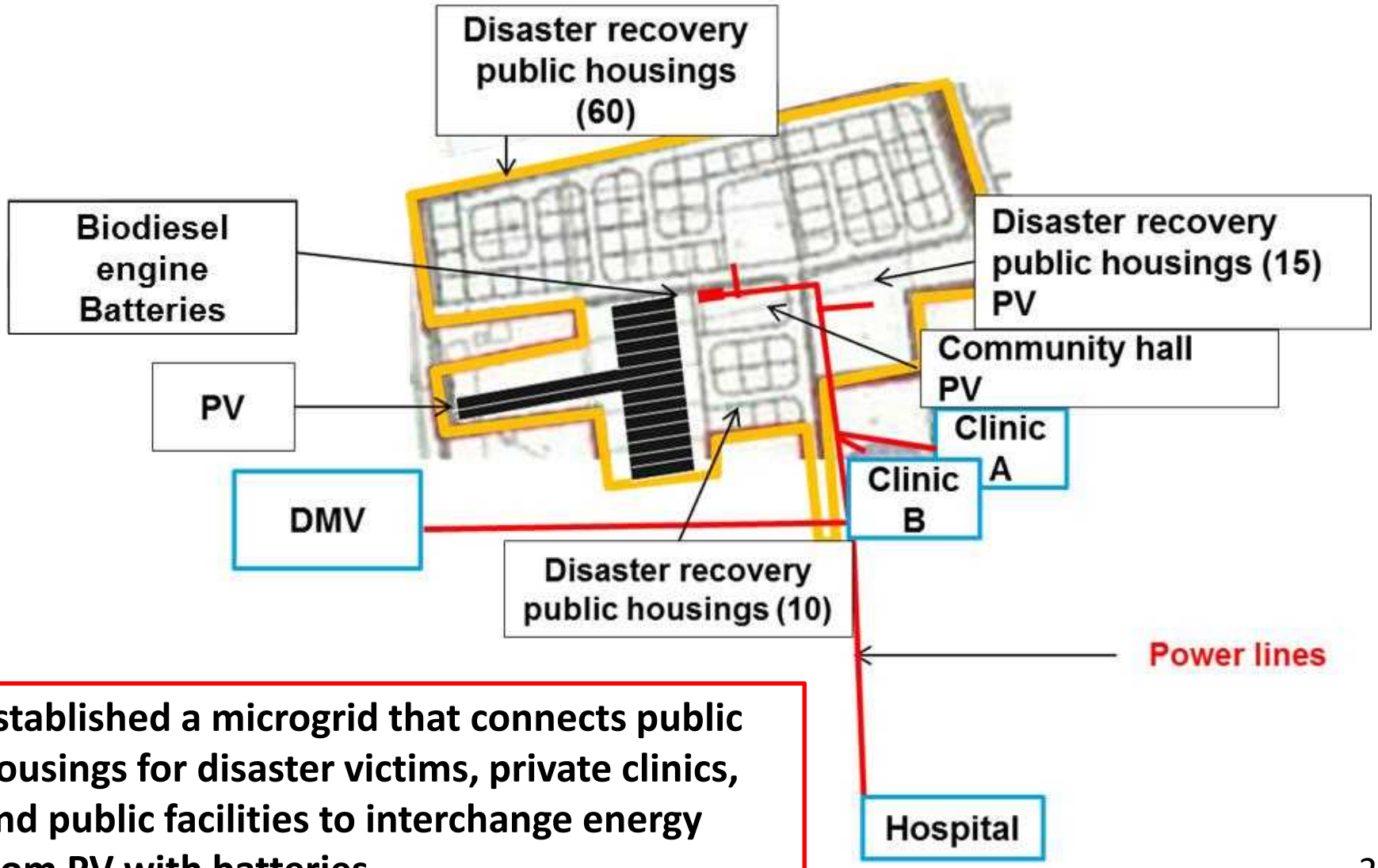
Nagoya City, Aichi: FY 2014-FY 2016

- ✓ Develops an independent and distributed low carbon energy system for commercial buildings, a sports center, and condominiums. Exchanges power between facilities.
- ✓ Renewables: PV, biomass (+ gas-combined heat and power)

PV, photovoltaic; BDF, bio diesel fuel

Higashi-matsushima City Project

Supply renewable power to mixed demand (consumers)

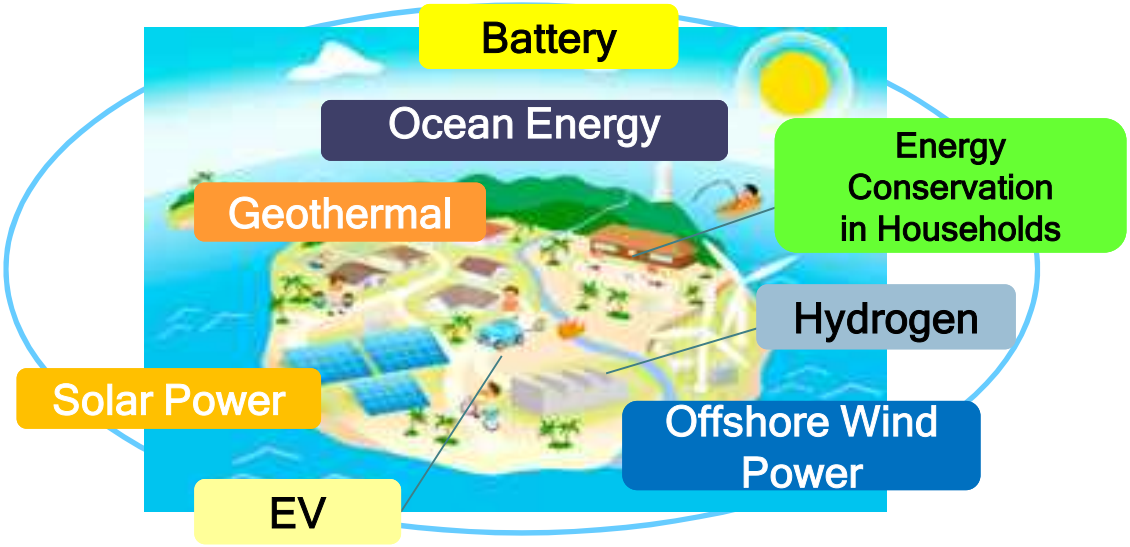


Established a microgrid that connects public housings for disaster victims, private clinics, and public facilities to interchange energy from PV with batteries.

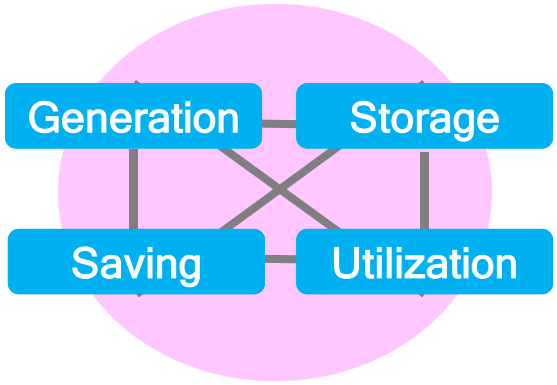
Project on energy autonomy for small islands

- Off-grid islands depend on diesel generators for their energy, which results in high expense and CO2 emissions.
- Important to introduce not only renewables and energy-saving facilities but batteries to control fluctuation of renewables like solar and wind.

Introduction of Renewables + Energy Conservation



Subsidy up to 67%



A Case - Hateruma Island, Okinawa Prefecture

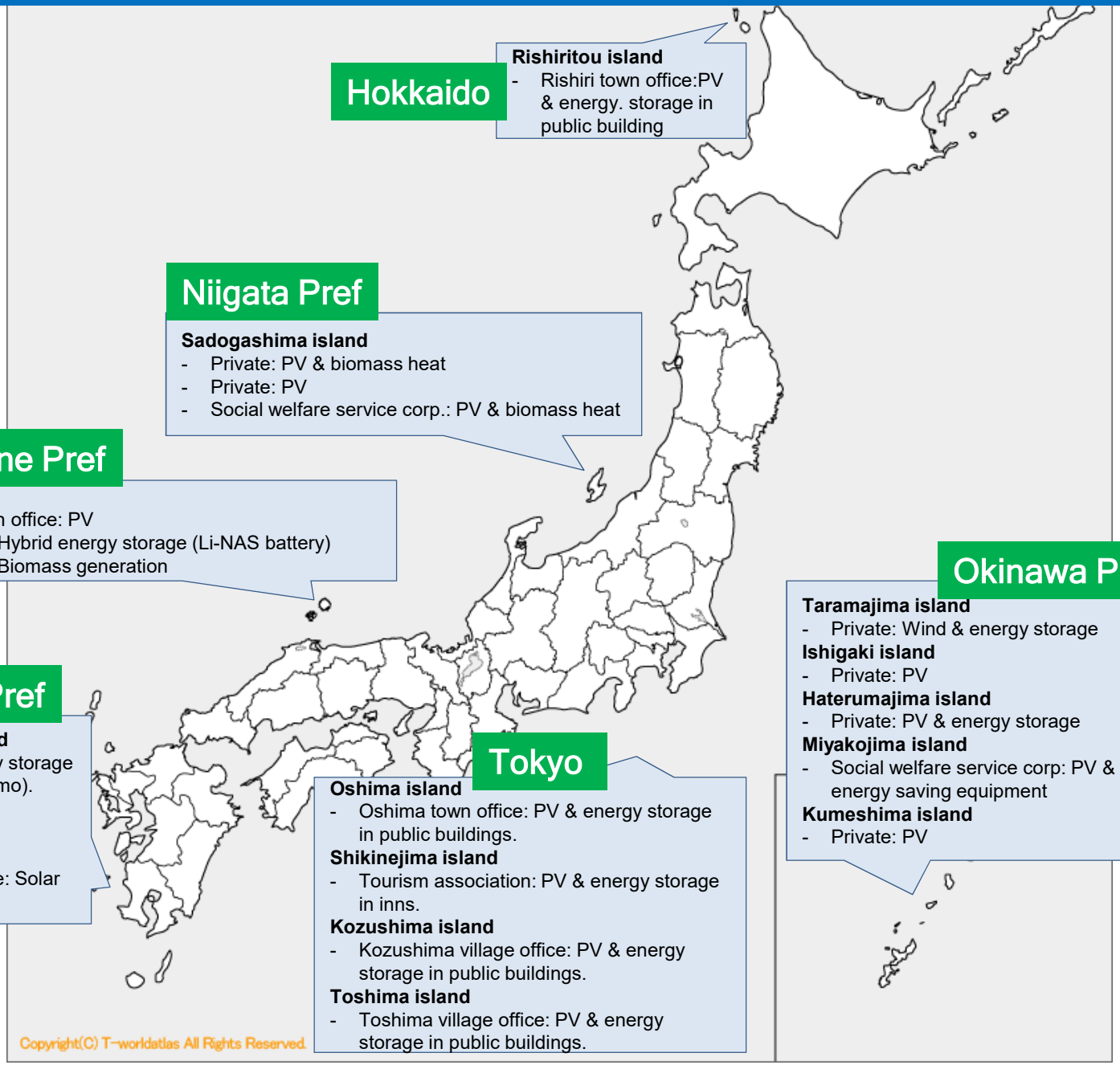
- Introduced PV (300kW) and battery (500kW) that works in cooperation with the existing wind turbine (490kW).
- Proportion of energy generation from renewables increased from 18% to more than 50%.

Wind Turbine (490kW)

Battery (500kW)

PV (300kW)

Ongoing Projects



Hokkaido

Rishiritou island
- Rishiri town office:PV & energy. storage in public building

Niigata Pref

Sadogashima island
- Private: PV & biomass heat
- Private: PV
- Social welfare service corp.: PV & biomass heat

Shimane Pref

Oki islands
- Ami town office: PV
- Private: Hybrid energy storage (Li-NAS battery)
- Private: Biomass generation

Kagoshima Pref

Kamikoshikijima island
- Private: PV & energy storage (ancillary service demo).

Yakushima island
- Private: PV & HP

Tanegashima island
- Nakatane town office: Solar thermal

Tokyo

Oshima island
- Oshima town office: PV & energy storage in public buildings.

Shikinejima island
- Tourism association: PV & energy storage in inns.

Kozushima island
- Kozushima village office: PV & energy storage in public buildings.

Toshima island
- Toshima village office: PV & energy storage in public buildings.

Okinawa Pref

Taramajima island
- Private: Wind & energy storage

Ishigaki island
- Private: PV

Haterumajima island
- Private: PV & energy storage

Miyakojima island
- Social welfare service corp: PV & energy saving equipment

Kumeshima island
- Private: PV

1. Introduction - Paris Agreement and Japan's target for the introduction of renewables

2. Basic policy and financial scheme

3. Key projects to introduce less-CO2 energy
   i. Microgrids
   ii. Renewables
   iii. Low-carbon hydrogen

MOE's Policy for Renewable Energy

For the maximal introduction, measures are taken in all phases of RDD&D.

Concept

- Realization of a low-carbon society with "autonomous & distributed energy system," while also achieving high resistance to disaster and regional revitalization and development. → **Accelerated introduction of renewable energy** is essential.

Projects to accelerate the introduction of renewables – by energy sources

Wind
- Demonstration of floating offshore wind power generation

Geothermal
- Gathering info of environment impact assessment regarding wind and geothermal
- Promotion of low-carbon emission society utilizing geothermal power

Biomass
- Promotion of local communities utilizing wood-based biomass power and heat
- Building a regional-recycling biogas system
- Promotion of low emission waste -to-energy system

Hydropower
- Promotion of hydropower generation utilizing in waterworks

Ocean
- Demonstration of tidal power generation




Maximum usage of regional-based renewable energy resources

Utilization of renewables with hydrogen and battery

- Utilize residual renewable energy to produce and utilize low-carbon hydrogen for fuel cell and FCVs.
- Utilize batteries to normalize fluctuations of solar and wind power generation.


Financial support for local municipalities

- 'Green New Deal' fund; Create leading low-carbon and renewable-oriented communities in harmony with nature.

Floating Offshore Wind Turbine Demonstration Project

- ✓ Japan has the 6th largest exclusive economic zone in the world. **Offshore wind turbines have more introduction potential than that of onshore.**
- ✓ With higher wind speed, offshore wind power promises **stable and efficient power generation**.
- ✓ Having not much shallow sea areas, Japan **expects much from floating turbines** that can be introduced in deep sea areas (50 m or deeper)
- ✓ Demonstration project of floating wind turbines started in FY 2010. **The pilot scale** and **commercial scale models** were **installed in FY 2012 and FY 2013**, respectively**.** Associated technologies and systems were established by FY 2015 toward practical application.

Construction, installation, operation and evaluation of Japan's first commercial-scale floating offshore wind turbines

- Full-fledged demonstration off the coast of Kabashima, Goto City, Nagasaki Prefecture
- The world's first hybrid spar model

[Significant cost reduction taking advantage of Japanese technologies]

- ➢ Design and construction of a floating structure resistant to typhoons, etc.
- ➢ Coordination with the fishing industry/system in harmony with fisheries
- ➢ Environmental assessment method

In addition, demonstrate technologies and systems to produce hydrogen using surplus electricity in the process of power generation to supply energy for local production for local consumption

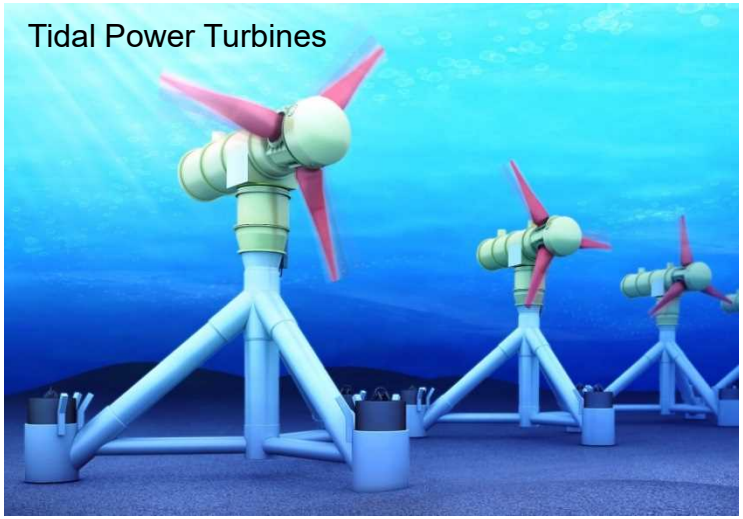
2MW demonstration model

In FY 2014, gather information concerning full-fledged operation and power generation using the 2000 kW commercial-scale equipment, its environmental impact, adaptation to weather conditions, safety, etc. to obtain knowledge toward practical application.

Tidal Power Generation System Demonstration Project

- ✓ **Predictable** because of a regular daily cycle.
- ✓ **Japan holds large potential** for tidal energy.
- ✓ However, **no demonstration of commercial-sized turbine (> 500kW) was conducted**.
- ✓ **Actions for early commercialization** through technology development and demonstration are necessary.

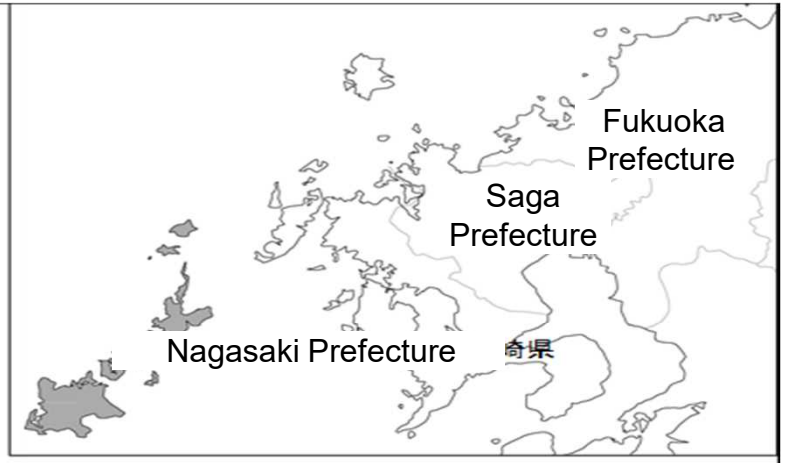
- Projects will be conducted for up to 5 years since 2014
- Overcome technical challenges for tidal power generation
- Establish evaluation methods for safety, reliability, economic aspect, and environmental assessment method



Outline

Project Name	2MW Tidal Wave Generation System Verification Project for the Commercialization of Marine Renewable Energy
Purpose	This verification project aims to conduct the first domestic, commercial-scale (2MW) tidal wave generation system to be implemented in Japanese waters with limited influence towards fishery and marine environment. This project aims to establish tidal energy technology and power generation systems for domestic implementation including ones with high difficulty in construction methods.
Project period	FY2016～FY2019（4 years）
Contractors	・Kyuden Mirai Energy Company ・Nippon Steel & Sumikin Engineering ・Nagasaki Marine Industry Cluster Promotion Association ・OpenHydro Technology Japan

○ The power generator will be located off the coast of Hisaka Islands in Goto City (Secretariat for the Headquarters for Ocean Policy, test site for marine renewable energy), and the verification will be conducted upon connection to a commercial power network.



Power Generation System

○ The power generator manufactured by Openhydro (HQ: UK), leading company in the field of tidal power generation, was selected for this verification project, which is Japan's first commercial-scale project and the world's largest (2MW) single-function apparatus project.

■ Generator

■ Basic Specifications

・Format: Open-Centre turbine
（Seabed installation）

・Output: 2MW

・Diameter: Approx.16m

・Height: Approx. 27m

・Weight: Approx.1,200t

・Rotation speed:
10～16 times per minute

Promotion of geothermal energy

- Japan has the third largest potential of geothermal resources and approx. 28000 hot springs.
- Development of geothermal energy requires consensus building of all the stakeholders and deliberate construction harmonized with nature.

- Geothermal development in national and quasi-national parks
  - Combined with deregulation
- Promotion of geothermal and hot spring power generation and thermal use
  - Financial support for feasibility study and introduction of facilities

1. Introduction - Paris Agreement and Japan's target for the introduction of renewables

2. Basic policy and financial scheme

3. Key projects to introduce less-CO2 energy
   i. Microgrids
   ii. Renewables
   iii. Low-carbon hydrogen

MOE's Policy for Renewable Energy

For the maximal introduction, measures are taken in all phases of RDD&D.

Concept

- Realization of a low-carbon society with "autonomous & distributed energy system," while also achieving high resistance to disaster and regional revitalization and development. → **Accelerated introduction of renewable energy** is essential.

Projects to accelerate the introduction of renewables – by energy sources

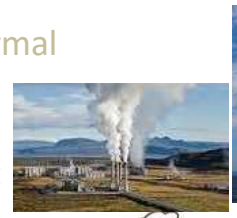
Wind
- Demonstration of floating offshore wind power generation

Geothermal
- Gathering info of environment impact assessment regarding wind and geothermal
- Promotion of low-carbon emission society utilizing geothermal power

Biomass
- Promotion of local communities utilizing wood-based biomass power and heat
- Building a regional-recycling biogas system
- Promotion of low emission waste -to-energy system

Hydropower
- Promotion of hydropower generation utilizing in waterworks

Ocean
- Demonstration of tidal power generation




Maximum usage of regional-based renewable energy resources

Utilization of renewables with hydrogen and battery

- Utilize residual renewable energy to produce and utilize low-carbon hydrogen for fuel cell and FCVs.
- Utilize batteries to normalize fluctuations of solar and wind power generation.


Financial support for local municipalities

- 'Green New Deal' fund; Create leading low-carbon and renewable-oriented communities in harmony with nature.

Hydrogen and Climate Change Policy

Why hydrogen matters in climate change policy ?

- Hydrogen is expected to contribute to the promotion of low-carbon economy and enhance energy security.
- However, hydrogen itself does not necessarily reduce CO_2 emissions because it needs energy inputs through production, storage, transportation, and utilization.
- From the perspective of the climate policy, therefore, it is important to develop low-carbon hydrogen supply chains and evaluation method of CO_2 reduction/emissions.
- MOE is launching a new hydrogen program to tackle these challenges while promoting RD&D projects including:
  - ✓ Solar Powered Hydrogen Station 2011 – 2014
  - ✓ Fuel Cell Bus 2013 – 2015
  - ✓ Fuel Cell Ship 2014 – 2015
  - ✓ Fuel Cell Forklift 2014 – 2016
  - ✓ Fuel Cell Garbage Wagon 2015 – 2017
  - ✓ Hydrogen supply chain with floating offshore wind power 2014 – 2015

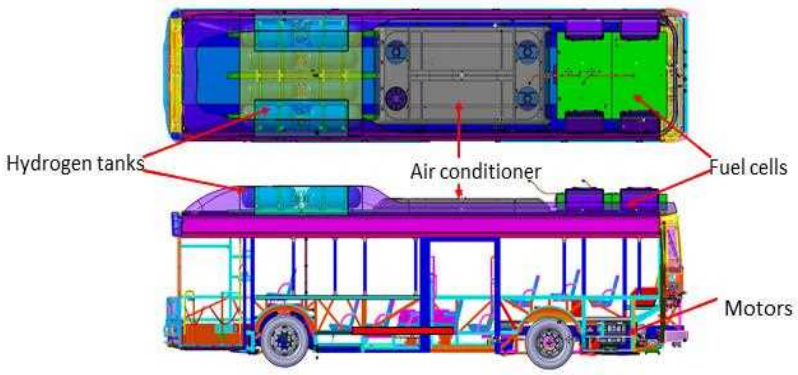
Hydrogen technology RD&D

Fuel cell bus project

- Develops a large route bus with fuel cells to further lower CO_2 emissions from public mass transportation.
- Improves mobility performance, durability, and reliability to commercialize in FY 2016.
- Makes prototype models and reviews basic performances, including power, stability, handling, etc.

Fuel cell forklift project

- Develops practical model of fuel cell forklifts that lower costs and enhance efficiency and durability to commercialize until the end of FY 2016.
- Establishes an efficient compressed-hydrogen gas pipeline system in warehouses to deliver hydrogen to forklifts.



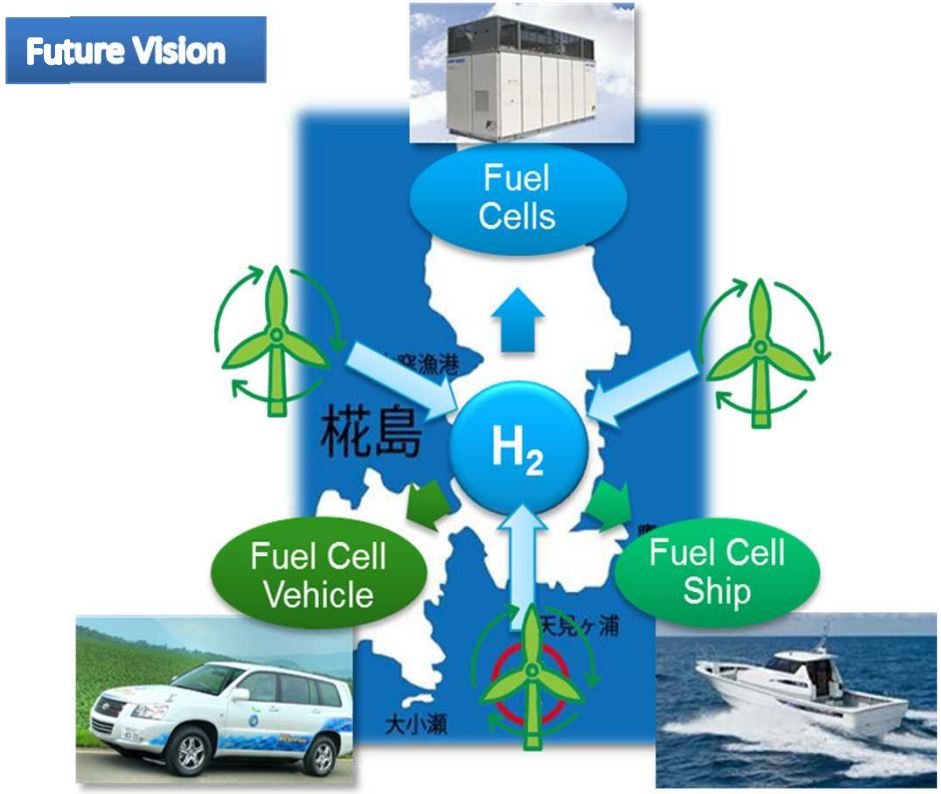
Fuel cell bus

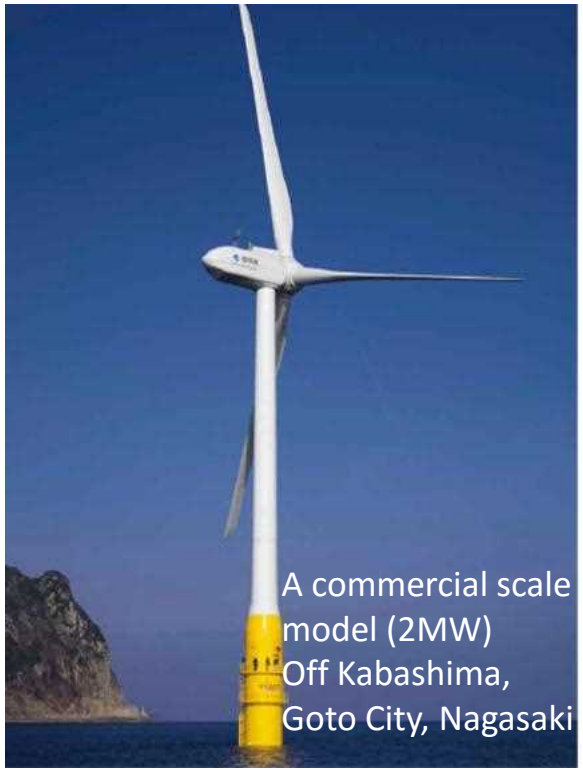

Fuel cell forklift

(source) Toyota Industries Corp., Toyota Motor Co. Ltd., and Hino Corp.

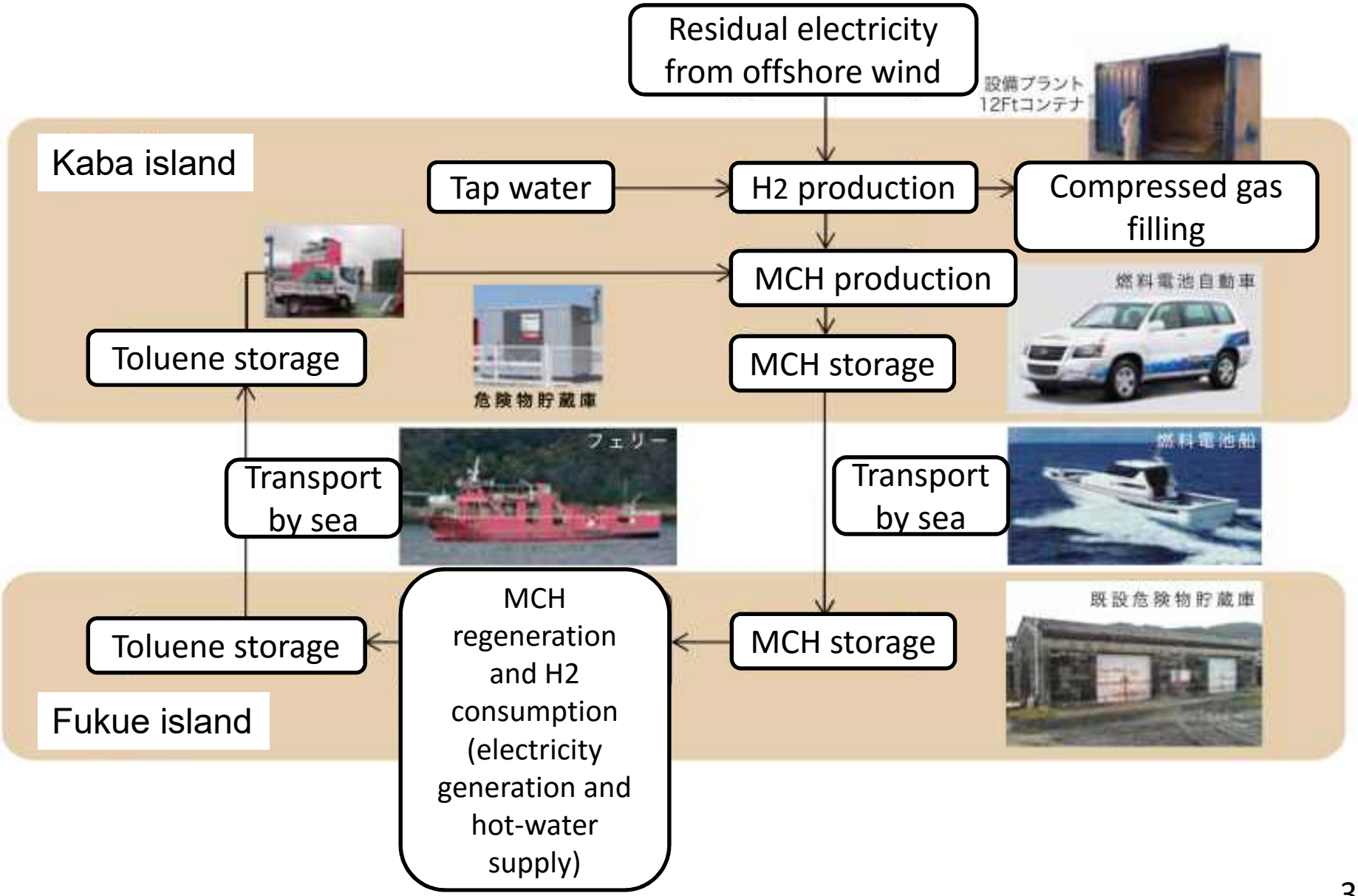
Project on hydrogen supply chain with floating offshore wind power

In addition to the first national demonstration of commercial-sized floating offshore wind turbine, MOE launched a demonstration system that locally produces, stores, transports, and utilizes hydrogen produced by residual energy from the floating offshore wind power. It enables to establish a low-carbon hydrogen supply chain with offshore wind.




A commercial scale model (2MW) Off Kabashima, Goto City, Nagasaki

Project on hydrogen supply chain with floating offshore wind power



Hydrogen demonstration and deployment project

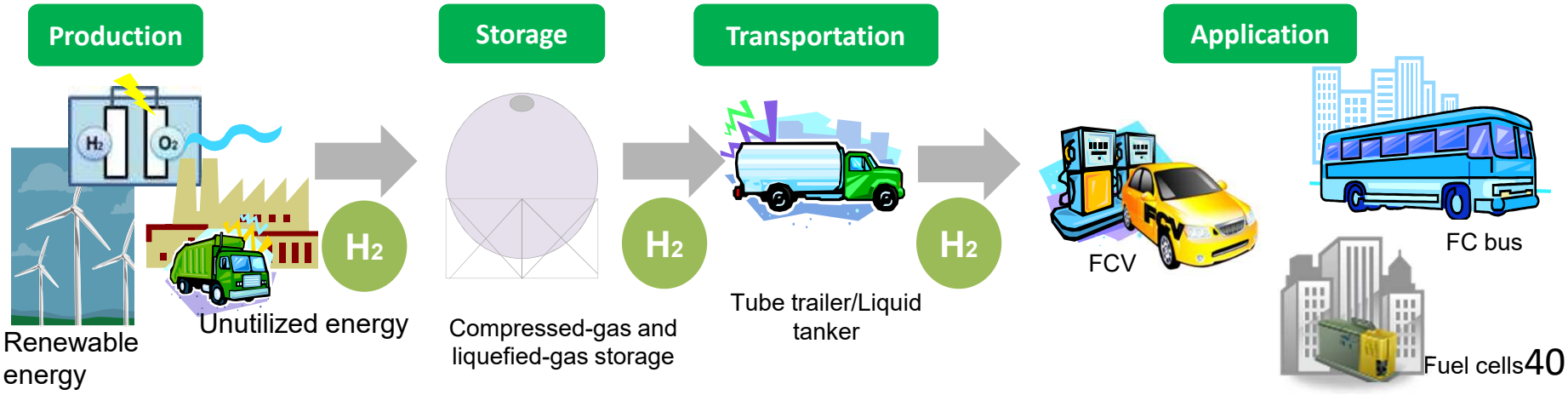
Project Overview

1. Establish a method for evaluating CO_2 emissions through the whole hydrogen supply chain.
2. Establish low carbon hydrogen supply chains with renewables and other low-carbon energy while collaborating with local governments and utilizing advanced low-carbon technology.
3. Subsidize hydrogen gas stations with hydrogen produced by renewable energy.

Objectives

- Reduce CO_2 emissions by promoting low-carbon hydrogen usages.
- Develop low-carbon supply chains and evaluate CO_2 emissions reduction through the entire process.
- Increase the number of hydrogen stations to enhance dissemination of fuel cell vehicles.

Low-Carbon Hydrogen Supply Chain Image



MOE[*1] is carrying out a "Project on Promoting a Low Carbon Society Utilizing Hydrogen Produced from Renewable Energy etc."

- **Outline of a "Project on Promoting a Low Carbon Society Utilizing Hydrogen Produced from Renewable Energy etc."**

Project vision

- Establishment of a low-carbon hydrogen supply chain (SC[*2]) model by FY2020
- Expansion of SC model after 2020 to contribute to commercial development

Working Name	Working Purpose	Working Outline 2015	2016	2017	2018	2019	2020～
Evaluation and validation of reduction effect on GHG[*3] using hydrogen SC	• Development of evaluation method of CO2 reduction • Considering actions to promote the low-carbon hydrogen SC • Supporting demonstration of low-carbon Hydrogen SC	• Development of evaluation method		• Operating evaluation method • Review of evaluation method			Target
		• Clarifying the problems		• Considering actions to promote low-carbon hydrogen SC		• Carrying out the actions	
		• Support demonstration project					
Demonstration of Low-Carbon Hydrogen SC	• Conducting demonstrations to build a hydrogen SC using local resources in order to commercialize	• Planning, Designing • Construction, Deployment		• Operation, Verification of CO2 reduction effect			Expanding and Commercialization
		• Considering cost reduction method and business strategy					
Supporting Installation of hydrogen station	• Supporting the installation of the hydrogen ST[*4] using renewable energy.	• 5 STs	• 14 STs	• Expanding installation of hydrogen STs			
Promoting fuel cell industrial vehicles development	• Promoting introduction of fuel cell industry vehicles		• 20 vehicles	• Expanding introduction of fuel cell industry vehicles			

*1 MOE = **M**inistry **o**f the **E**nvironment Government of Japan, *2 SC = **S**upply **C**hain, *3 GHG = **G**reen**h**ouse **G**ases, *4 ST = **S**tat**i**on

We formulate guidelines to evaluate the CO2 reduction effect of the hydrogen supply chain and consider measures to promote low-carbon hydrogen utilization

- **Overview and results in 2016**

	Outline in 2016	Main output
Development of evaluation method of CO2 reduction	Implementation of maintaining tools and formulating guidelines based on literature survey, interview survey, and expert opinion ■ Considering evaluation method of CO2 reduction effect of hydrogen supply chain, issues of guidelines based on LCA calculation results of regional demonstration ■ Formulating guidelines for evaluating CO2 reduction effect of hydrogen supply chain ■ Maintenance tools and manuals that support calculation etc	LCA Guidelines of Greenhouse Gas Reduction Effects by Hydrogen Supply Chain Calculation tool of Greenhouse gas reduction effect by hydrogen supply chain
Support demonstration project	Considering measures to promote low-carbon hydrogen utilization based on literature survey, interview survey and expert opinions. Implementing commercialization support tools ■ Extraction and organization of issues for demonstration and commercialization of hydrogen supply chain ■ Considering measures to promote low-carbon hydrogen utilization ■ Support considering CO2 reduction effect and hydrogen supply price for each regional demonstration	Organization of issues for constructing hydrogen supply chain

Low-Carbon Hydrogen Supply Chain Demonstration Project, sponsored by MOE*, Japan

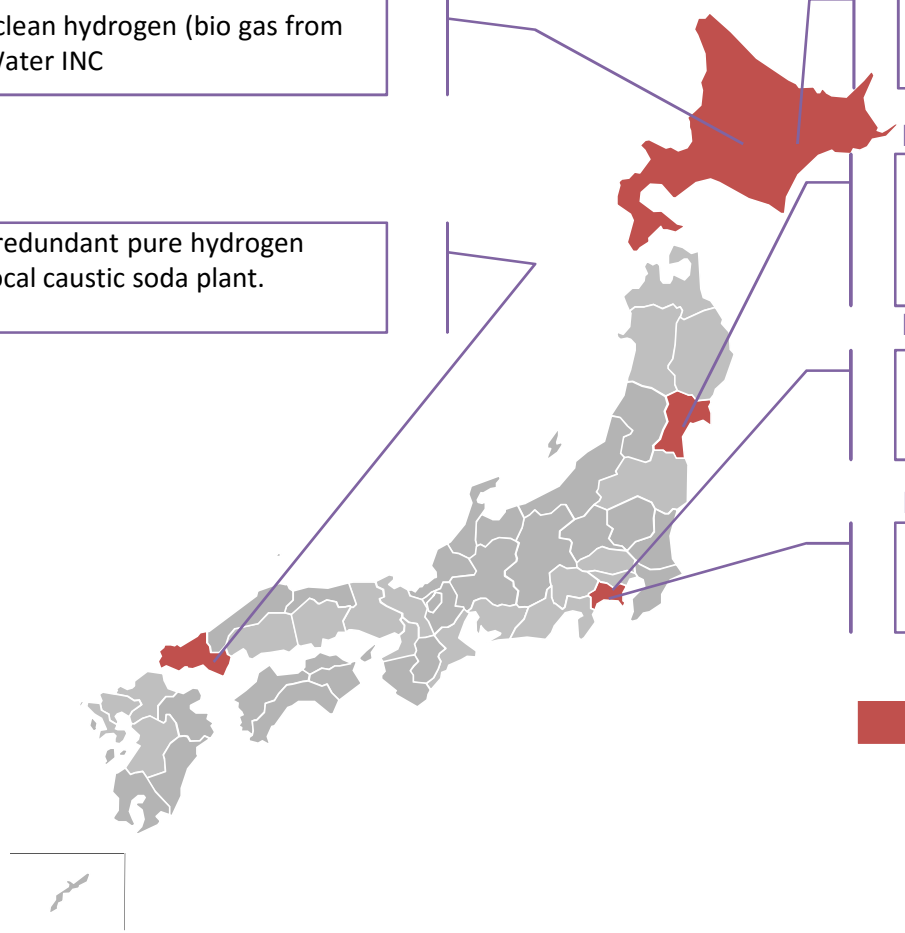
- **Low-Carbon Hydrogen Supply Chain Demonstration Project**

In Hokkaido (Shikaoi Town)

Demonstration using the clean hydrogen (bio gas from livestock excreta) By Air Water INC

In Yamaguchi Pref.

Demonstration using the redundant pure hydrogen supplied by Tokuyama's local caustic soda plant.
By Tokuyama Corporation



In Hokkaido (Shiranuka Town)

Demonstration using the clean hydrogen (small hydraulic power)
By Toshiba Corporation

In Miyagi (Tomiya City)

Demonstration of low carbon supply chain utilizing existing distribution network and pure hydrogen fuel cell (Hitachi Ltd.)

In Kanagawa Pref.

Demonstration using the hydrogen from used plastic
By Showa Denko K.K

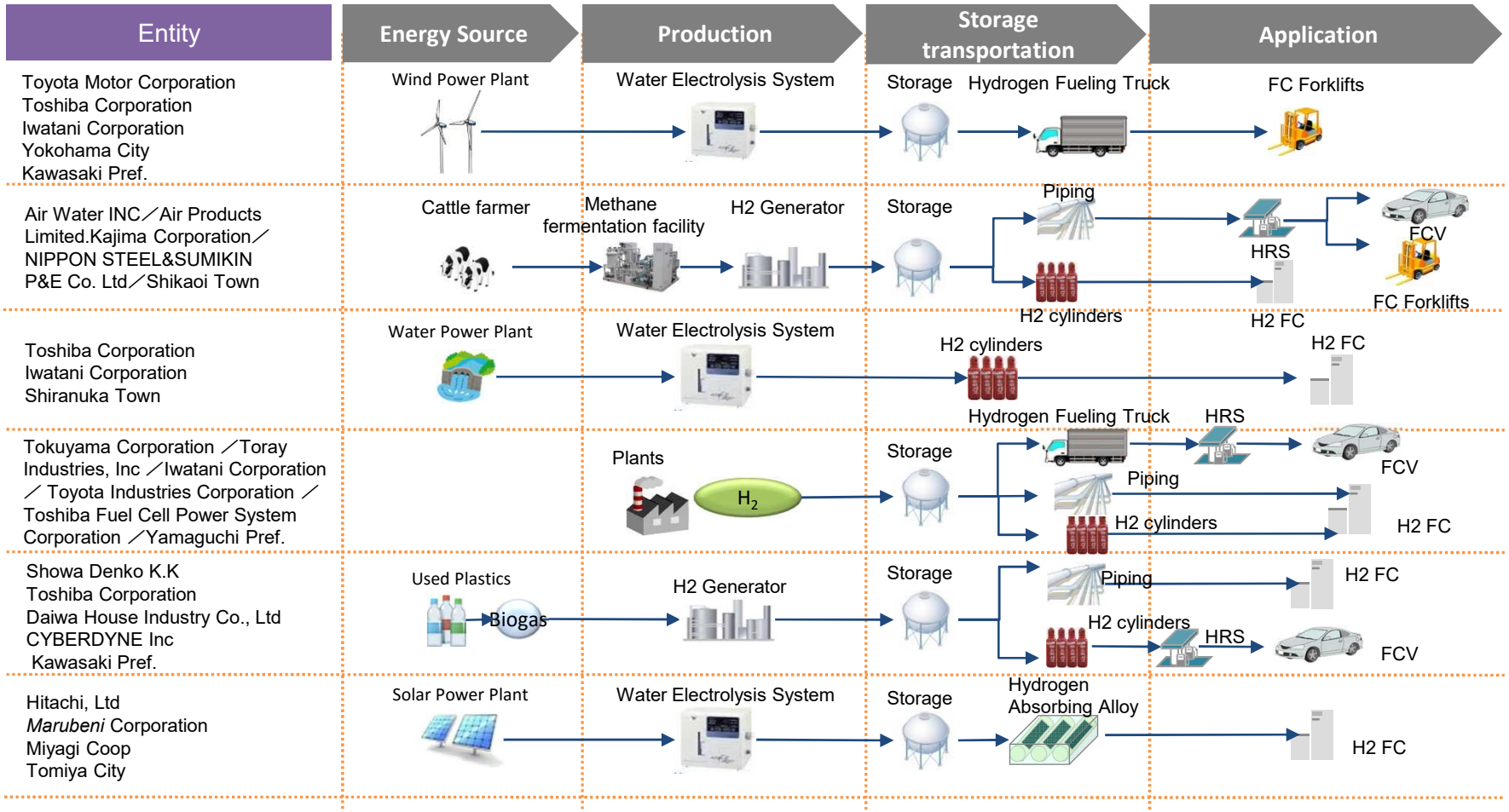
In Kanagawa Pref.

Demonstration using the clean hydrogen (wind power)
By Toyota Motor Corporation

: Prefecture where demonstration is being conducted
（As of September 2017）

Low-Carbon Hydrogen Supply Chain Demonstration Project, sponsored by MOE, Japan

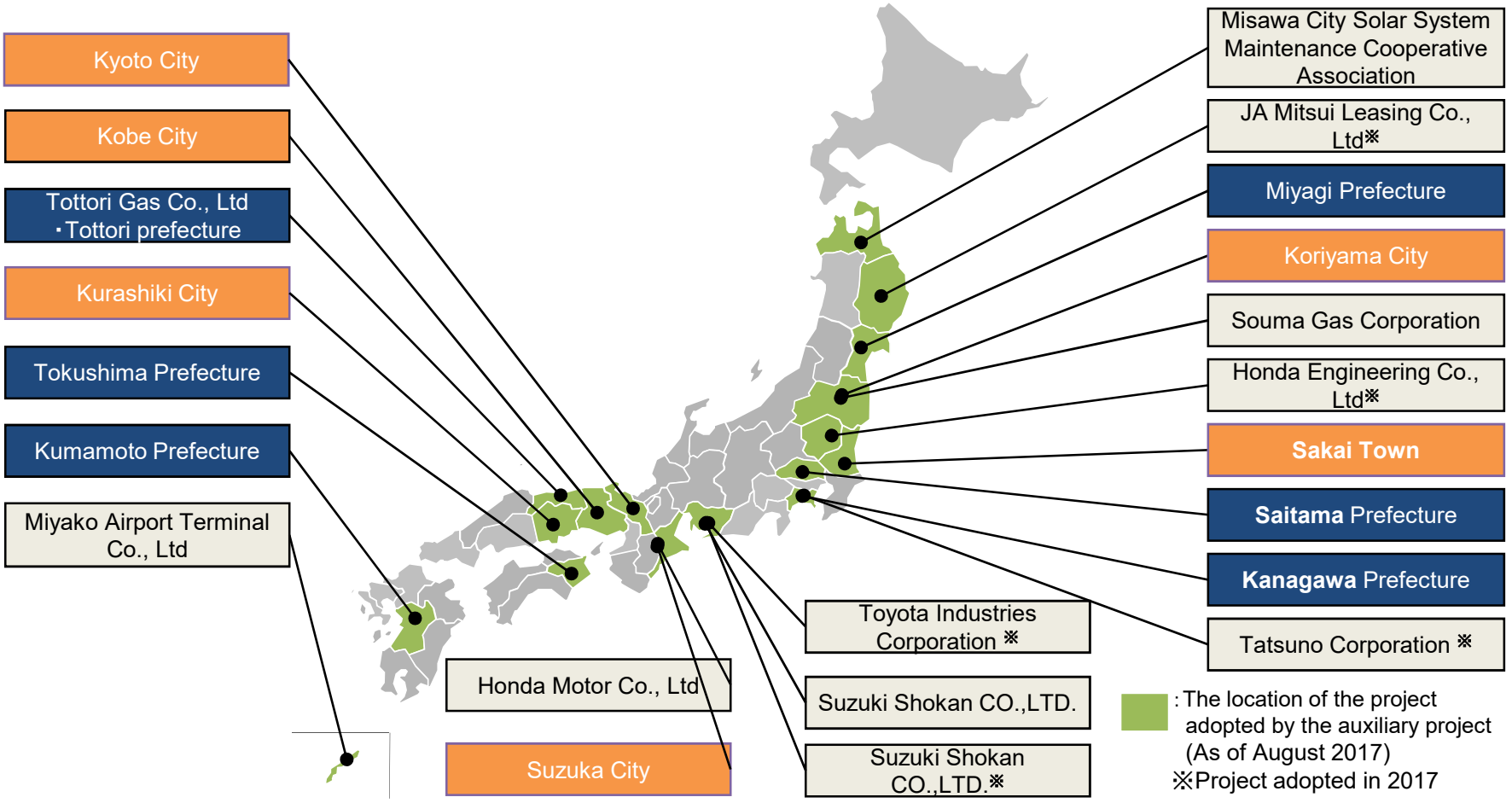
- **Supply Chain Lineup**



HRS*：Hydrogen Refueling Stations、FC**：Fuel Cell

There are 22 projects which introduce stations supplying hydrogen produced from renewable energy etc.

- **Projects which introduce stations supplying hydrogen produced from renewable energy etc,**



*: ST = Station

MOE subsidizes fuel cell industrial vehicles

- **Projects which promote the developing of fuel cell industrial vehicles**

(Reference) Feature of FC Forklift

- Manufacturer
  - Toyota Industries Corporation
- Characteristic
  - High environmental performance : zero CO2 emissions during operation
  - Improvement of work efficiency : 3 minutes filling hydrogen enable to operate continuously
  - External power supply function : AC 100 V outlet is installed and it can be used as an emergency power supply
- Hydrogen Specification
  - Filling pressure : 35 MPa
  - Mounting amount : 1.2 kg
  - Filling time: 3 minutes
- Other specifications
  - Working time : 8 hours
  - Power supply function : 1 kW × 15 hours

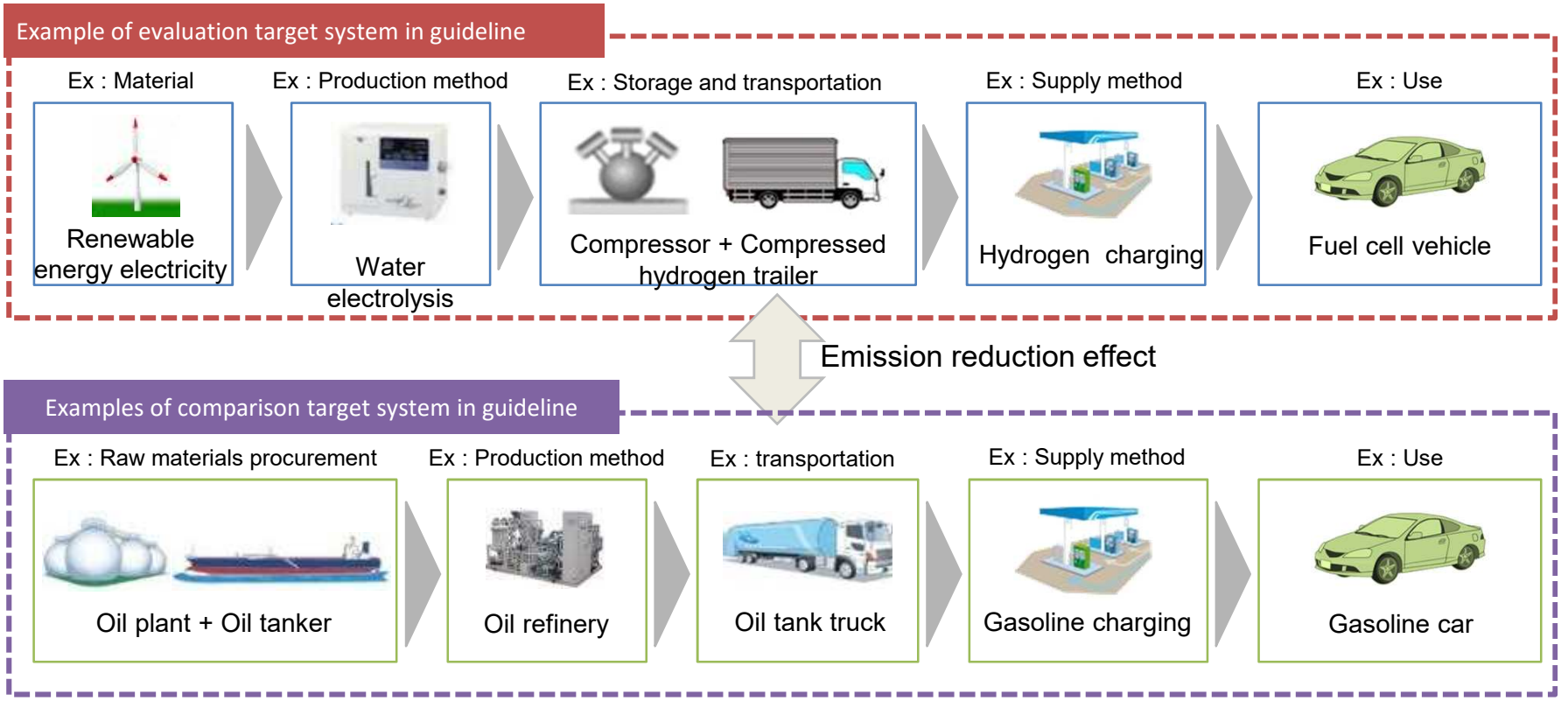
2.5 ton product fuel cell forklift

*the number of he project adopted by the auxiliary project

The purpose of formulating LCA guidelines is evaluating greenhouse gas emission reduction through hydrogen supply chain

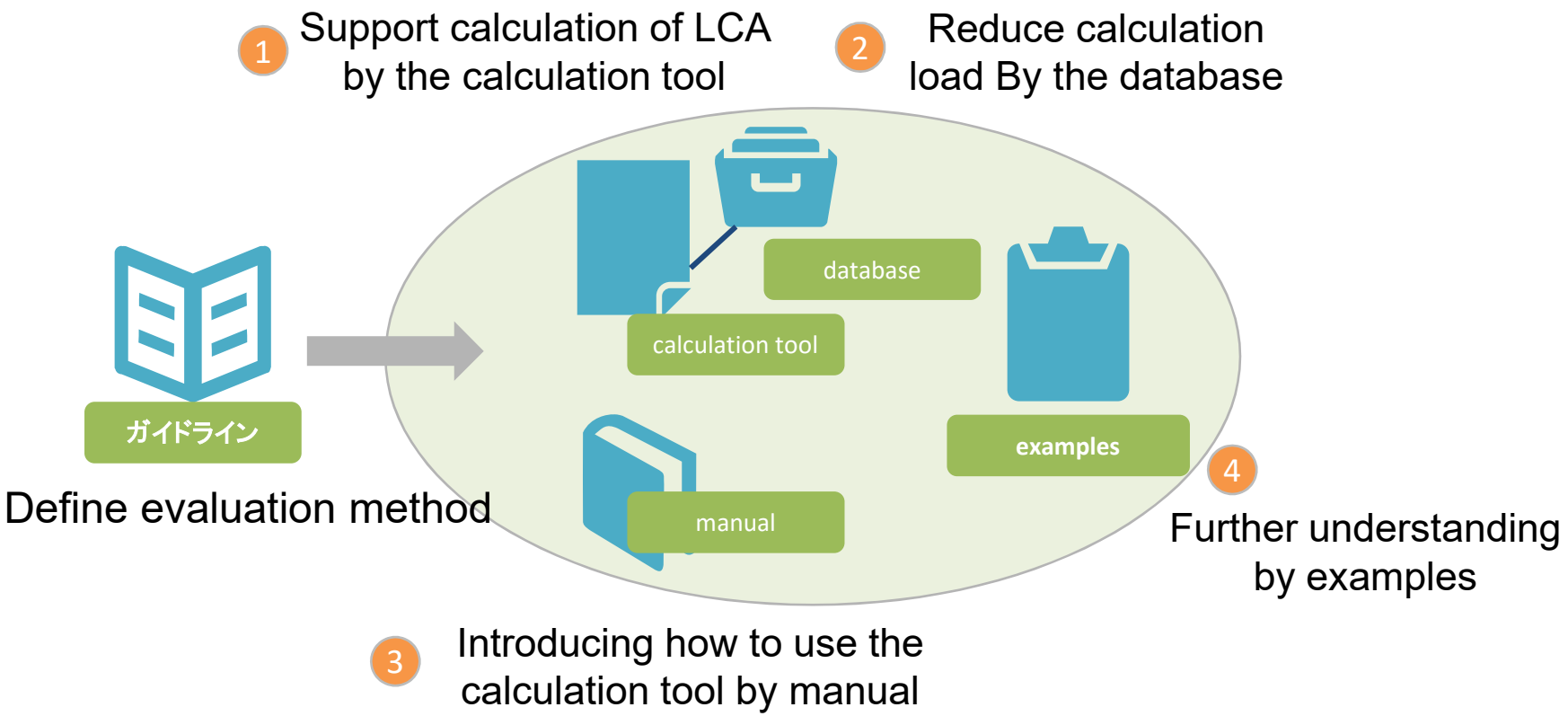
- **Evaluation object in LCA guideline**

The scope of the evaluation covers raw material procurement, manufacturing, storage and transportation, supply and use of the hydrogen supply chain. The emission reduction effect is calculated by comparing with the existing system (example : gasoline automobile etc.).



Calculation tools, databases, manuals, and examples were prepared respectively as a toolkit for LCA calculation

- **Toolkit for LCA calculation**



Merci Beaucoup!

Daiki NOSE
Daiki_Nose@env.go.jp