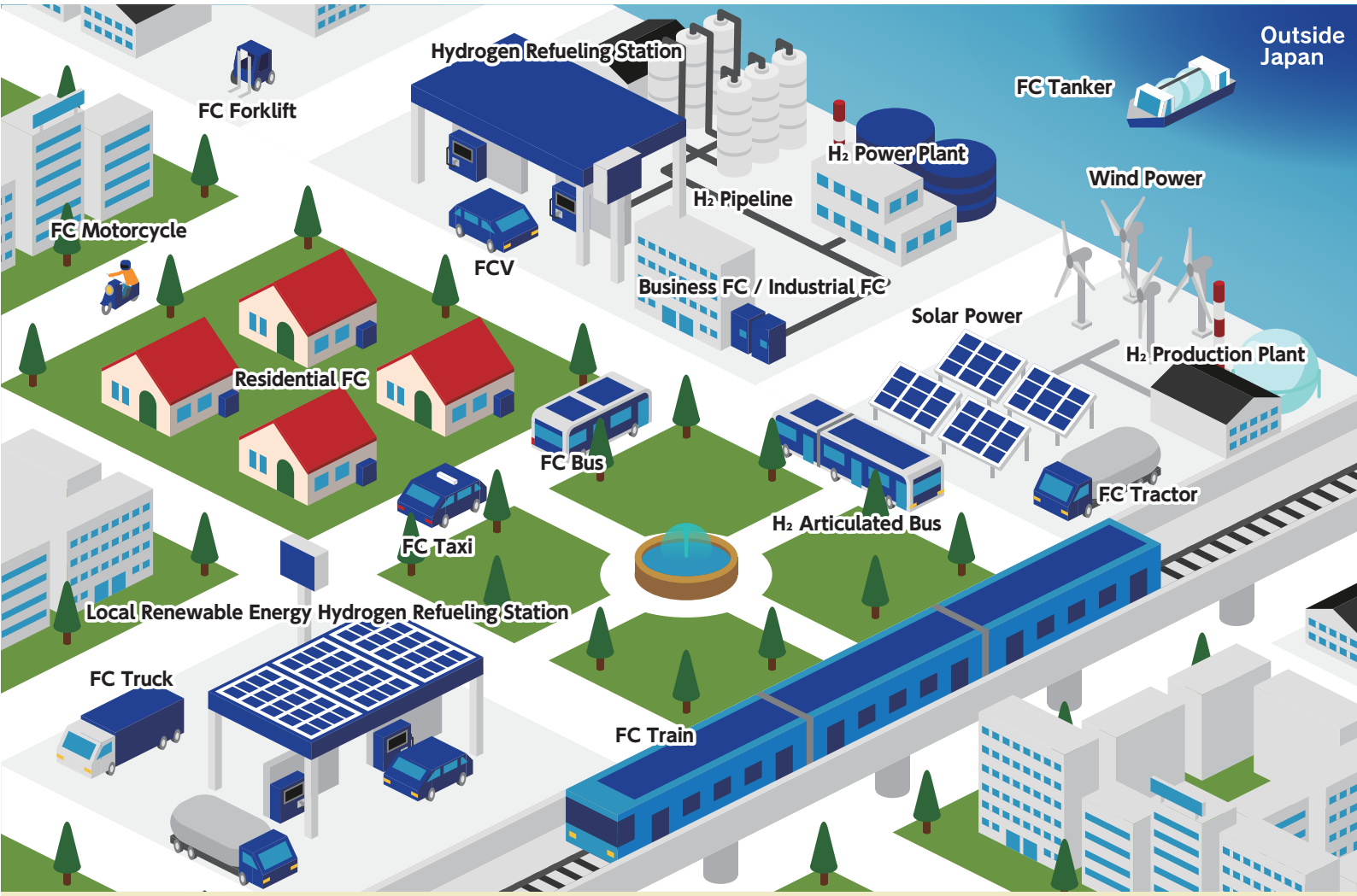
環境省
Ministry of the Environment

PROJECTS FOR THE CREATION OF A HYDROGEN SOCIETY

When used, hydrogen fuel does not generate any CO_2, and fuel cells can provide sufficient electrical power and heat. In addition, we expect that using renewable energies to produce hydrogen fuel will lead to total decarbonization from the production through use stages. Hydrogen will play an important role in the creation of a decarbonized "hydrogen society," a society that uses hydrogen as a common energy source. As we believe hydrogen will play a large role in our society, we are currently undertaking various hydrogen utilization projects.



WHAT IS HYDROGEN?

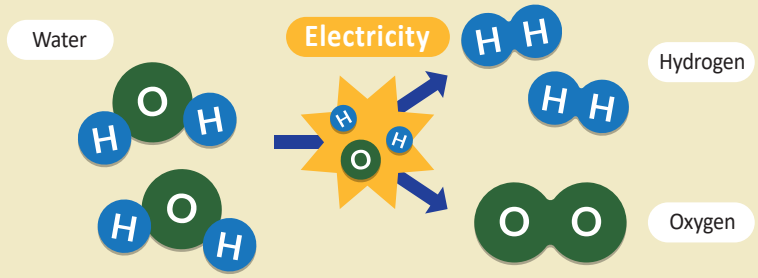
Hydrogen is the lightest gas on Earth and is made up of two hydrogen (H) atoms, expressed with the molecular formula H_2. Hydrogen atoms form bonds with various elements and are found in a variety of chemical compounds, such as water and fossil fuels. This characteristic makes it possible to produce H_2 from various resources. For example, hydrogen can be produced by methods such as water electrolysis (H_2O) to generate hydrogen (H_2) and oxygen (O_2) gas.

WATER ELECTROLYSIS

Electrolyzing water

▼

Producing hydrogen and oxygen

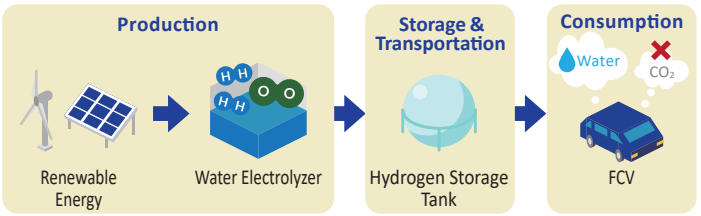


THE BENEFITS OF HYDROGEN AS AN ENERGY SOURCE

The use of hydrogen is being promoted both within Japan and overseas as part of efforts towards creating a decarbonized society. There are three compelling reasons for using hydrogen as an energy source.

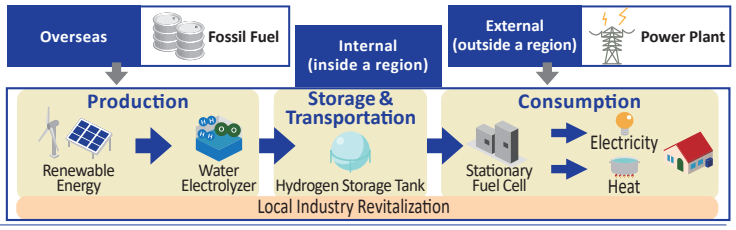
Leading to Decarbonization

Hydrogen does not emit CO_2 when used, making it an environmentally friendly energy source. Additionally, converting unused renewable energies into hydrogen allows for the storage of large amounts of energy over extended periods, thereby enhancing the efficiency of renewable energy utilization. Furthermore, by utilizing hydrogen in sectors* where decarbonization is challenging due to electrification difficulties and other factors, CO_2 emissions can be reduced. (*heavy industries, long-distance and large-scale overland transport, shipping, aviation, etc.)



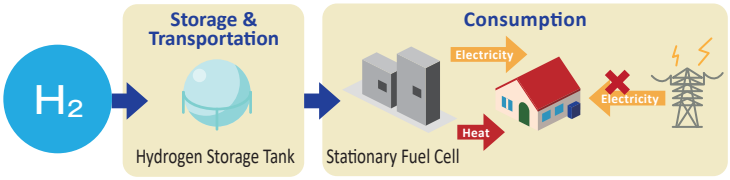
Leading to the Revitalization of Local Industries

Hydrogen can be produced from a variety of locally available resources. The use of local energy sources such as renewable energy and hydrogen in place of imported fossil fuels or electricity produced outside the region can create jobs and revitalize local industries.



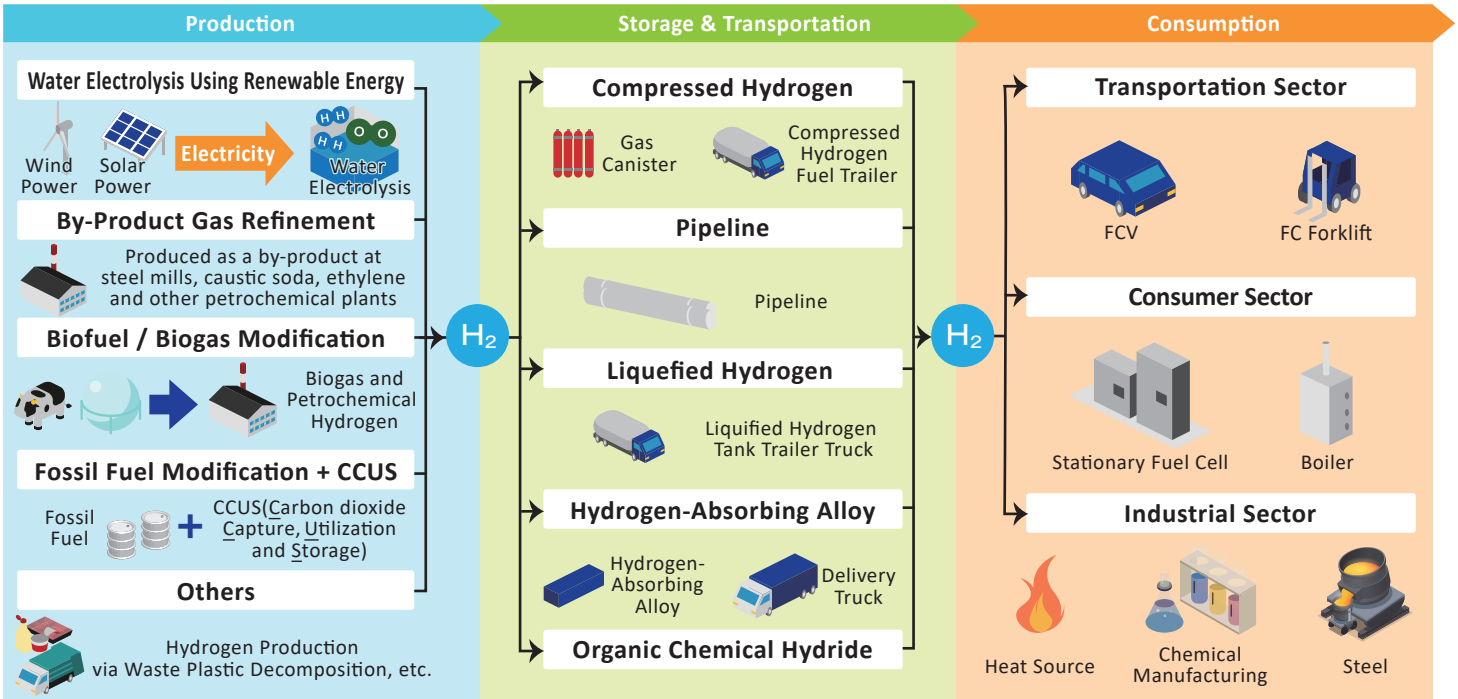
Available Even During Emergencies

Hydrogen can be stored and transported. Therefore, it can be used to generate electricity even if the power infrastructure is disrupted due to a natural disaster. Also, since hydrogen is transportable, it serves as a flexible form of energy.



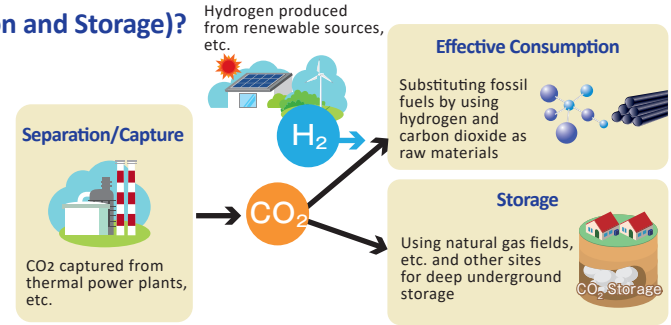
AN OVERVIEW OF HYDROGEN SUPPLY CHAIN AND ITS VARIOUS TECHNOLOGIES

The creation of a hydrogen supply chain comprised of production, storage & transportation and consumption stages is essential for utilizing hydrogen as an energy source. Each of these three stages is characterized by the use of various technologies.



COLUMN What is CCUS (Carbon dioxide Capture, Utilization and Storage)?

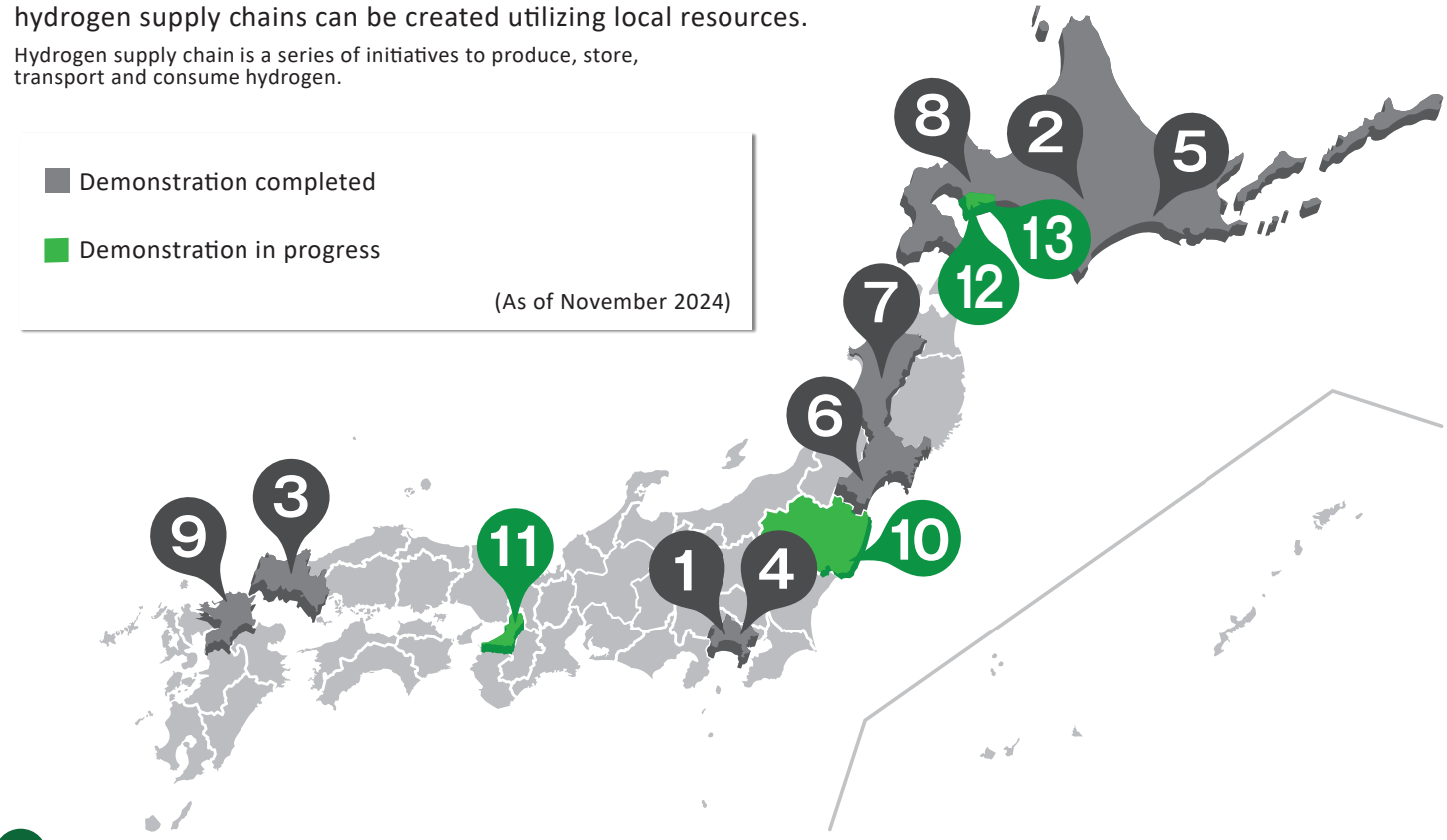
It is possible to manufacture chemicals that do not require fossil fuels by chemically reacting CO_2 captured from thermal power plants with renewable hydrogen. Moreover, the captured CO_2 can be stored underground, reducing the amount of CO_2 that would otherwise be released into the atmosphere. The technology, known as CCUS (Carbon dioxide Capture, Utilization and Storage), is gaining the significant attention as an important technology for achieving a decarbonized society.



1 HYDROGEN SUPPLY CHAIN CONSTRUCTION PROJECTS FOR DECARBONIZATION

The MOE promotes decarbonization by engaging in projects that demonstrate hydrogen supply chains can be created utilizing local resources.

Hydrogen supply chain is a series of initiatives to produce, store, transport and consume hydrogen.



10 An Urban Hydrogen Supply Chain that Aims for Recovery and Decarbonization

*Project adopted in fiscal 2020

■Project Name: Project to Construct and Demonstrate a Low-Cost Renewable Hydrogen Supply Chain Using an Operation Optimization System
■Location: Namie Town, Fukushima Prefecture ■Primary Partner: OBAYASHI Corp. ■Governmental Partner: Namie Town

Production

Renewable hydrogen produced at the Fukushima Hydrogen Energy Research Field (FH2R) is used.

Storage & Transportation

Compressed hydrogen transported in canisters and by tank trailer trucks is delivered efficiently using a system that monitors the amount of hydrogen remaining at end users and the status of delivery vehicles.

Consumption

Used in stationary fuel cells installed at a lodging facility, etc.

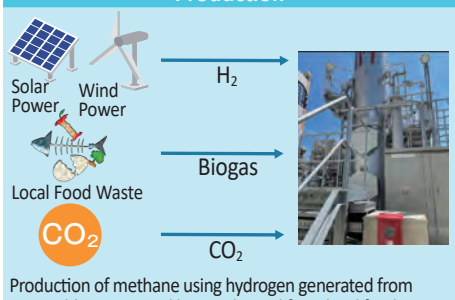
A compact refueling station that supply FCVs with hydrogen.

11 Using Renewable Energies and Food Waste to Produce and Utilize Carbon-Neutral Natural Gas

*Project adopted in fiscal 2022

■Project Name: Hydrogen Supply Chain Demonstration Project of Methanation Utilizing Renewable Hydrogen and Food Waste Biogas in Urban Areas
■Location: Osaka City, Osaka Prefecture ■Primary Partner: OSAKA GAS Co., Ltd. ■Governmental Partner: Osaka City

Production

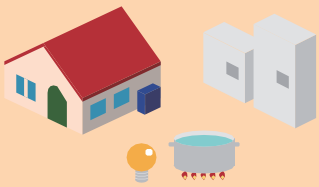


Production of methane using hydrogen generated from renewable energy and biogas derived from local food waste.

Storage & Transportation

Methane delivered through pipelines to end users while taking odorization and safety measures into account.

Consumption



Usable with conventional urban gas appliances (fuel cell, water heater, boiler, gas stove, cogeneration system, etc.).

*These images are for illustration purposes only.

Scan this QR code to watch a demonstration video.

12 Delivering Renewable Hydrogen via Existing Gas Distribution Networks and Diversifying Methods of Using Hydrogen

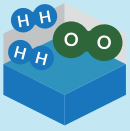
*Project adopted in fiscal 2022

■Project Name: Project to Demonstrate a Model That Delivers Hydrogen at Low Pressure in Cylindrical Tanks Containing a Hydrogen-Absorbing Alloy to Residences and Small Businesses Utilizing an Existing Gas Delivery Network ■Location: Muroran City, Hokkaido
■Primary Partner: Muroran gas Corp. ■Strategic Partners: Muroran City, Muroran Advancement Center of Industrial Technology and Management, MURORAN INSTITUTE OF TECHNOLOGY, Kyushu TLO Co., Ltd., TAISEI Corp., AIR WATER HOKKAIDO INDUSTRIAL GAS Inc., and KITA KOUDENSHA Corp.
■Governmental Partner: Muroran City

Production


Wind Power


Receiving Panel


Water Electrolyzer

Through controlling water electrolysis operations in accordance with the amount of electricity generated by wind power plants, the electrolyzer's operation rate improves.

Storage & Transportation


Consolidated LP Gas Delivery


Cylindrical Metal Hydride Tank

Reducing delivery costs by using tanks containing a hydrogen-absorbing alloy and delivering hydrogen using an existing LP gas distribution network.

Consumption


Stationary Fuel Cell


Boiler


Hydrogen Gas Steel Cutter

Enhanced hydrogen consumption through diversifying hydrogen operated machinery at end users.

13 Stable Supply of Renewable Hydrogen Combining Multiple Energy Sources

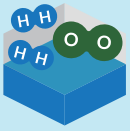
*Project adopted in fiscal 2023

■Project Name: Turning Hokkaido into a Hydrogen Island, a Large-Scale Renewable Hydrogen Supply Chain Demonstration Project That Does Not Depend on the Power System
■Location: Tomakomai City, Hokkaido ■Primary Partner: SPARX Green Energy & Technology Co., Ltd ■Governmental Partner: Tomakomai City

Production

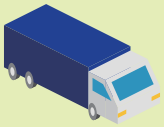

Waste-to-Energy


Solar Power


Water Electrolyzer

Stable hydrogen production by combining electricity from waste-to-energy and solar power plants.

Storage & Transportation


High-Pressure Tank Trailer Truck

Cost reduction through the use of high-pressure tank trailer trucks for storage and delivery to areas of demand.

Consumption


Boiler and Heater


Stationary Fuel Cell

Using hydrogen in stationary fuel cells, boilers and heaters installed in municipal facilities and nearby businesses reduce the consumption of kerosene, which is the most prevalent in cold regions.

1 Usage of Simply Fillable Hydrogen Vehicles to Transport Hydrogen and Hydrogen-Powered Forklifts

Project completed in fiscal 2020

■Project Name: Introduction of Fuel Cell Forklifts at Keihin Coast Area and Demonstration of Clean Hydrogen Utilization Model Construction
■Location: Keihin Coastal Area ■Primary Partner: TOYOTA MOTOR Corp.
■Governmental Partners: Kanagawa Prefecture, Yokohama City, and Kawasaki City

Production


Using electricity generated at wind power plants to produce hydrogen.


A hydrogen production stabilization system that enables power supply even during low wind or no wind conditions.

Storage & Transportation


Stored in tanks and then compressed, the hydrogen fuel is delivered by hydrogen delivery trucks to sites where it will be used.

Consumption


The hydrogen fuel is supplied to FC forklifts at produce markets, distribution centers and refrigerated warehouses.

Scan this QR code to watch a demonstration video.

2 Using Biogas Derived from Livestock Manure to Produce Hydrogen

*Project completed in fiscal 2021

■Project Name: Hydrogen Energy Supply Chain Demonstration Project from Livestock Manure ■Locations: Shikaoi Town and Obihiro City, Hokkaido ■Primary Partner: AIR WATER Inc. ■Strategic Partners: KAJIMA Corp., NIPPON STEEL Pipeline & Engineering Co., Ltd., and Air Products and Chemicals, Inc. ■Governmental Partners: Hokkaido, Shikaoi Town, and Obihiro City

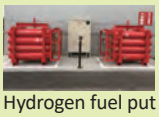
Production

Hydrogen is produced from biogas converted from livestock manure.

Storage & Transportation

Hydrogen fuel is compressed for delivery.

Hydrogen fuel loaded into delivery trucks.



Hydrogen fuel put into canisters for delivery.

Consumption

The hydrogen fuel is supplied to FCVs and FC forklifts from the hydrogen refueling station on the project operation site.

Used in stationary fuel cells installed at sturgeon breeding grounds and a zoological park.

3 Utilizing Unused By-Product Hydrogen In Local Facilities And FCVs

*Project completed in fiscal 2021

■Project Name: Project to Build a Model of Regional Cooperation and Local Energy Production / Consumption Using High Purity Waste Hydrogen from Caustic Soda Production ■Locations: Shunan City and Shimonoseki City, Yamaguchi Prefecture ■Primary Partner: Tokuyama Corp. ■Strategic Partners: TOSOH Corp., Yamaguchi Prefecture, Shunan City, and Shimonoseki City

Production

Unused by-product hydrogen generated at caustic soda plants plant is efficiently collected in tanks and with in-company hydrogen supply pipes and transported with four different supply chain methods.

Storage & Transportation

Hydrogen fuel is delivered via pipelines from caustic soda plants to a nearby swimming club.

Transported to roadside service areas in cylindrical tanks after compression.

The fuel is liquefied and transported by tanker trucks to a hydrogen station in Shunan and a refueling station in Shimonoseki.

©Iwatani Corp.

Consumption

Used in stationary fuel cells installed at a swimming club.

Used in stationary fuel cells installed at roadside service areas.

Supplied to FCVs and FC forklifts and used in stationary fuel cells and hydrogen boilers installed in wholesale markets and fishing ports.

4 Utilizing Hydrogen Produced from Waste Plastics at Lodging Facilities and in FCVs

*Project completed in fiscal 2021

■Project Name: Low-Carbon Hydrogen Demonstration Project of Waste Plastics Regional Circular Model
■Location: Kawasaki City, Kanagawa Prefecture ■Primary Partner: Showa Denko K.K. ■Governmental Partner: Kawasaki City

Production

Waste plastics

Reused Plastic Fuels (RPF)

Hydrogen produced from waste plastics.

Storage & Transportation

Hydrogen produced at the Showa Denko Kawasaki Plant is transported to sites where it will be delivered via pipeline or in a compresed hydrogen trailer trucks.

Consumption

Used in stationary fuel cells installed in lodging facilities, plant factories, etc.

Suppled to a hydrogen refuelling station for FCVs.

5 Boosting the Potential of Regional Renewable Resources: Hydrogen Production via Small-Hydro Power

*Project completed in fiscal 2020

■Project Name:Expanding the Use of Hydrogen Produced from a Small Hydropower Plant and Establishing a Hydrogen Utilization Model Suitable for the Local Characteristics of Hokkaido ■Locations: Kushiro City, and Shiranuka Town, Hokkaido
■Primary Partner: Toshiba Energy Systems & Solutions Corp. ■Strategic Partner: Iwatani Corp.
■Governmental Partners: Hokkaido, Kushiro City, and Shiranuka Town

Production

Hydrogen is produced via water electrolysis using a small-scale hydropower plant.

Storage & Transportation

Stored in tanks and then compressed, the hydrogen fuel is delivered in high-pressure gas tanks to sites where it will be used.

Consumption

Used in stationary fuel cells installed in heated swimming pools and other facilities.

Scan this QR code to watch a demonstration video.

6 Cassette-type Hydrogen-Absorbing Alloy Storage for Safe and Simple Hydrogen Supply

*Project completed in fiscal 2021

■Project Name: Project to Demonstrate a Low-Carbon Hydrogen Supply Chain Using Fuel Cells and an Existing Logistics Network in Tomiya, Miyagi Prefecture ■Location: Tomiya City, Miyagi Prefecture ■Primary Partner: Hitachi, Ltd. ■Strategic Partners: Marubeni Corp., MIYAGI COOP., and Tomiya City

Production

Hydrogen is produced by solar power in Tomiya.

Storage & Transportation

The hydrogen fuel is stored in cassettes containing a hydrogen-absorbing alloy and transported to the sites using the existing logistics of Miyagi Coop.

Consumption

Used in stationary fuel cells installed in stores, etc.

Enabling hydrogen production even during power outages and other unstable conditions with a hydrogen combined generator that supplies power to auxiliary hydrogen production equipment.

7 Supplying Hydrogen by Mixing it with Natural Gas for Urban Areas and Utilizing an Existing Gas Distribution Network

*Project completed in fiscal 2021

■Project Name: Project to Demonstrate the Production of Hydrogen from Electrolysis Using Wind Power, as well as the Supply and Use of Hydrogen Mixed with Natural Gas ■Location: Noshiro City, Akita Prefecture ■Primary partner: NTT DATA INSTITUTE OF MANAGEMENT CONSULTING, Inc. ■Strategic Partner: DAINICHI Machine and Engineering Co.,Ltd. ■Governmental Partner: Noshiro City

Production

Hydrogen is produced using electricity generated at a wind power plant in Noshiro, Akita.

Storage & Transportation

Mixed with simulated natural gas for urban areas, hydrogen combined gas is stored in gas canisters and tanks and then transported through city gas pipelines.

Consumption

Used in kitchen stoves, water heaters, small boilers, micro-gas engines and other commercially available gas appliances installed in a model home.

Used in stationary fuel cells installed in municipally-owned facilities.

8 Hydrogen Production Using Unused and Waste Heat, and Transporting Hydrogen in Tanks Containing a Hydrogen-Absorbing Alloy

*Project completed in fiscal 2021

■Project Name: Project to Demonstrate a Low-Pressure Hydrogen Delivery System to Promote Hydrogen Use in Buildings and City Infastructure ■Location: Muroran City, Hokkaido ■Primary Partner: TAISEI Corp. ■Strategic Partners: Muroran City, Kyushu University, MURORAN INSTITUTE OF TECHNOLOGY., TOMOE SHOKAI Co., Ltd., and KITA KOUDENSHA Corp.

Production

©The Muroran Minpo Co., Ltd.

This project produces hydrogen via electricity generated by wind power facilities in Muroran, Hokkaido.

Storage & Transportation

Hydrogen is delivered in vehicle-mounted tanks containing a hydrogen absorbing alloy and stored in stationary tanks also containing a hydrogen-absorbing alloy.

Consumption

A hydrogen fuel cell installed at a hot spring facility generates electricity and heat. Excess heat is used to extract hydrogen from the fuel cell alloy.

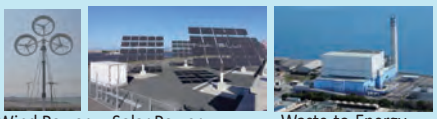
Used in fuel cells installed in hot springs and welfare facilities. Also, unused heat at the facilities and waste heat from stationary fuel cells are utilized to extract hydrogen from the storage alloy.

9 Efficient Hydrogen Production Using Waste-to-Energy and Local Renewable Energy Sources

*Project completed in fiscal 2022

■Project Name: Project to Demonstrate Green Hydrogen Production and Supply Using Local Renewable Energy in Kitakyushu City ■Locations: Kitakyushu City, Fukuoka City and Kurume City, Fukuoka Prefecture ■Primary Partner: Kitakyushu Power Co., Ltd. ■Strategic Partners: IHI Corp., FUKUOKA OXYGEN Co., Ltd., and ENEOS Corp. ■Governmental Partners: Fukuoka Prefecture and Kitakyushu City

Production



Wind Power Solar Power Waste-to-Energy

EMS (Energy Management System) electricity Water Electrolysis

An Energy Management System (EMS) efficiently adjusts surplus power from various renewable energy sources and produces hydrogen at a low cost.

Storage & Transportation

The compressed hydrogen fuel is transported in gas canisters.

The hydrogen fuel is delivered via pipelines.

Consumption

The hydrogen fuel is supplied to FCVs from a hydrogen refueling station and to FCFLs with a portable hydrogen re-fueler.

Used in stationary fuel cells installed in hydrogen-use demonstration houses and museums.

Scan this QR code to watch a demonstration video.

2 SUBSIDIZED PROJECT (SUBSIDIZING THE ESTABLISHMENT OF INDEPENDENT AND DECENTRALIZED SYSTEMS THAT CONTRIBUTE TO ENHANCED RESILIENCE)

The MOE supports businesses in introducing various hydrogen-related equipment for producing, storing, transporting and consuming hydrogen.

Brother Industries, Ltd. — Water Electrolyzer, Hydrogen-Absorbing Alloy Fuel Case — Subsidy

We subsidize Brother Industries in the installation of equipment to generate hydrogen from solar power at their own factory, store it in hydrogen-absorbing alloy fuel cases and transport it. Anyone can transport hydrogen safely without leakage once it is absorbed into a storage alloy.

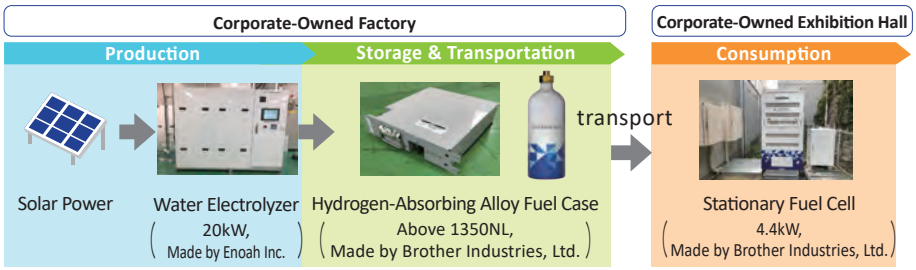


Image provided by Brother Industries, Ltd.

Meiji Electric Industry Co., Ltd. — Equipment for Hydrogen Derived from Renewable Energy Sources — Subsidy

We subsidize Meiji Electric Industry in the installation of a series of machinery to produce hydrogen with on-premise solar power generation equipment, and then store and use it. Hydrogen produced using surplus solar power is safely stored on-site in tanks with a hydrogen-absorbing alloy and then used as electricity and heat.

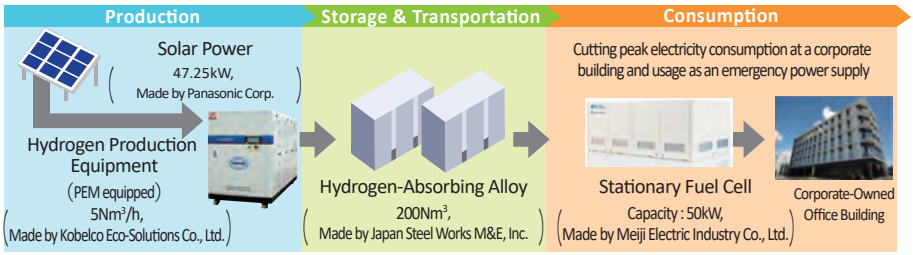


Image provided by Meiji Electric Industry Co., Ltd.

3 SUBSIDIZING THE DEVELOPMENT OF APPLICATIONS TO REALIZE A HYDROGEN SOCIETY

The MOE is subsidizing businesses to develop and incorporate applications, particularly in the transportation sector.

FC Forklift — Subsidy

R&D support for a FC forklift and the potential of reduced costs and improvement of energy efficiency and durability, leading to commercialization in 2016. These forklifts are not only environmentally friendly, but also boasts a convenient, quick refuelling time of approx. three minutes.

Photo compliments of TOYOTA INDUSTRIES Corp.

Multipurpose FCV — Subsidy

In 2021, Kumamoto Red Cross Hospital and Toyota began the world's first demonstration of the use of FC medical vehicles.

Photo compliments of TOYOTA MOTOR Corp.

FC Bus — Subsidy

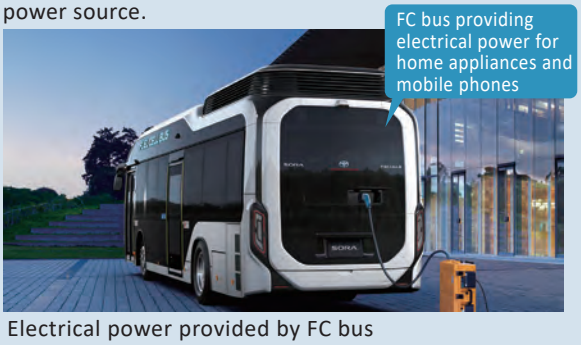
R&D support for FC buses to improve power performance, reliability and durability leading to commercialization in 2017.
It supports the implementation of FC buses, which boast both environmental friendliness and comfort.

Photo compliments of TOYOTA MOTOR Corp.

COLUMN

Example of FC Bus Utilization

When a typhoon struck Chiba Prefecture west of Tokyo in 2019, FC buses provided electricity as an emergency power source.



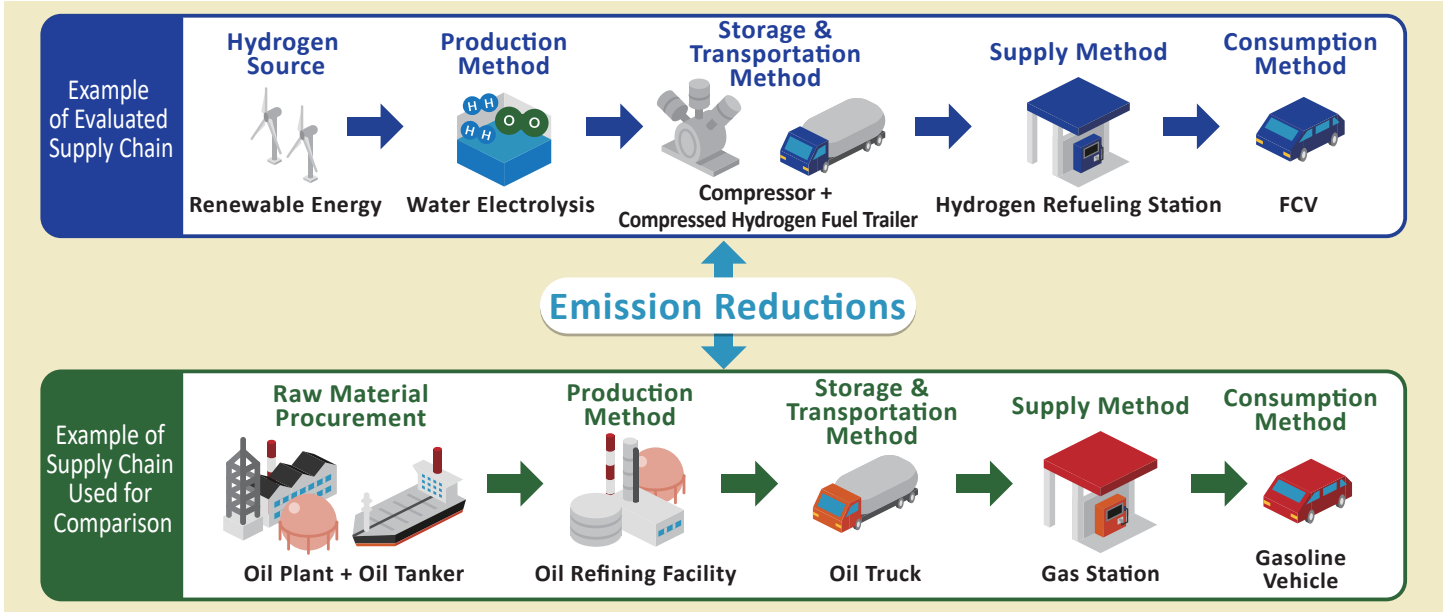
Electrical power provided by FC bus

Photo compliments of TOYOTA MOTOR Corp.

CALCULATING GREENHOUSE GAS EMISSION REDUCTIONS

Ⅰ LCA Guidelines

Confirming that hydrogen energy consumption method contributes to reducing greenhouse gas emissions throughout the supply chain, not only when hydrogen is used as fuel, is crucial. LCA Guidelines help to calculate greenhouse gas reductions in the supply chain. These reductions are calculated by subtracting the greenhouse gases emitted by a conventional energy supply chain from those emitted by a hydrogen-based supply chain.



Method of Calculating Greenhouse Gas Emissions

Volume of Activity × **Emission Factor** = **GHG Emission**

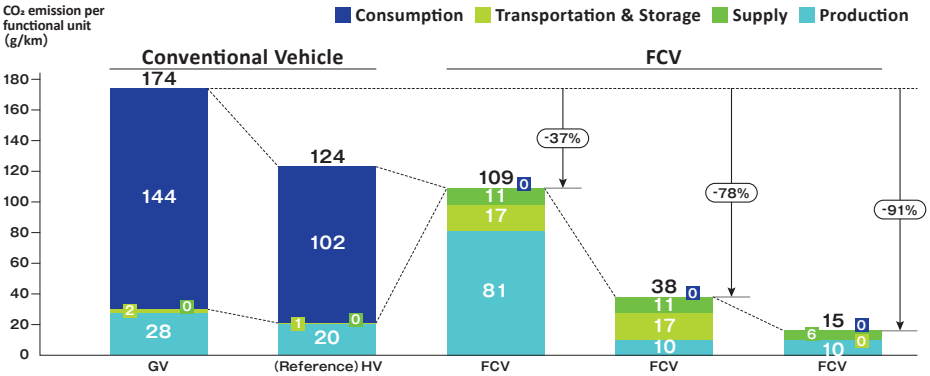
■Volume relates to the scale of business
➤ Each business entity in the supply chain calculates its activity volumes from invoices, design values, and other sources.
<Example values>
-Electrical consumption -Fuel consumption for transportation
-Amount of waste product

■Greenhouse gas emissions per unit of activity
➤ Use values in publicly available information
<Example values>
-Greenhouse gas emissions per 1kWh of electricity
-Greenhouse gas emissions per 1ℓ of fuel
-Greenhouse gas emissions per 1t of garbage burned

Ⅱ Emission Reductions Calculating Tool

In order to support the guidelines above, MOE created a tool for calculating greenhouse gas emission reductions in hydrogen supply chains as a part of the Ministry's 2016 project to evaluate and validate CO_2 reductions in hydrogen use. This tool automatically calculates hydrogen supply costs and CO_2 emission reductions at each stage of the hydrogen supply chain: production, transportation, supply, and consumption. The tool (Excel file), its manual and sample calculations are available in Japanese only on the MOE website. The complete set and consumption examples can be downloaded using the QR code at the bottom of this page.

(Example of calculation results) CO_2 emissions at each stage of the supply chain



Type	Gasoline vehicle	Hybrid vehicle	FCV (1)	FCV (2)	FCV (3)
Mileage Standard	16.5km/ℓ	23.2km/ℓ	152.4km/kg-H_2	152.4km/kg-H_2	152.4km/kg-H_2
Energy Source	Gasoline	Gasoline	Natural gas	Wind power	Wind power
Hydrogen Transport Method	—	—	Compressed hydrogen fuel trailer	Compressed hydrogen fuel Trailer	On-site supply (Hydrogen produced and supplied at hydrogen refueling station)

Contact Info: Climate Change Projects Office, Climate Change Policy Division,
Global Environment Bureau, Ministry of the Environment
TEL +81-570-028-341 Email:chikyu-jigyo@env.go.jp
MOE Hydrogen Supply Chain Platform

Ver.2024.11.22