#### **CALCULATING GREENHOUSE GAS EMISSION REDUCTIONS**

#### LCA Guidelines

Confirming that hydrogen energy usage contributes to reducing greenhouse gas emissions throughout the entire 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.



#### Emission Reduction 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<sub>2</sub> reductions in hydrogen use. This tool automatically calculates hydrogen supply costs and CO<sub>2</sub> emission reductions at each stage of the hydrogen supply chain: production, transportation, supply, and use. The tool (an Excel file), its manual, and sample calculations are available in Japanese only on the MOE website.

> https://www.env.go.jp/seisaku/list/ondanka\_saisei/lowcarbon-h2-sc/support-tool/

#### **CO2 CAPTURE AND UTILIZATION WITH HYDROGEN**

By reacting it with CO<sub>2</sub> recovered from thermal power plants, hydrogen derived from renewable energy sources can be used to produce chemicals without the use of fossil fuels. Called carbon dioxide capture and utilization (CCU), this is attracting attention as an important tehcnology for creating a decarbonized society.



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# PROJECTS FOR THE CREATION OF A HYDROGEN SOCIETY

When used, hydrogen fuel does not generate any CO<sub>2</sub>, 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 gas is the lightest gas on Earth and is made up of two hydrogen (H) atoms, expressed with the molecular formula H<sub>2</sub>. 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<sub>2</sub> from various resources. For example, hydrogen can be produced by methods such as water electrolysis (H<sub>2</sub>O) to generate hydrogen (H<sub>2</sub>) and oxygen (O<sub>2</sub>) gas.







### THE BENEFITS OF HYDROGEN AS AN ENERGY SOURCE

Hydrogen is being used as an energy source to break free from today's carbon-based society, with initiatives underway both in Japan and other countries. Moreover, hydrogen fuel has the following advantages.

#### **Environmentally Friendly**

Since hydrogen fuel does not emit CO2 when used to generate electricity, it can reduce impact on the environment. We expect that hydrogen produced from renewable energy source will further reduce CO<sub>2</sub> emissions.



#### **Revitalization of Local Economies**

Hydrogen fuel produced from locally-generated energy sources and used within the same area will increase local business opportunities, leading to local revitalization.

#### **DECARBONIZING SUPPLY CHAIN**

In order to achieve decarbonization with hydrogen fuel, it will be necessary to implement consistent measures from production to storage and transportation to use.



#### **PROJECTS TO CREATE A HYDROGEN SOCIETY**

As part of our efforts to achieve decarbonization, Japan's Ministry of the Environment (MOE) is engaged in a variety of hydrogen utilization projects. These projects can also help revitalize local economies.

Promotion of hydrogen supply chain construction projects to achieve decarbonization

Creating a Hydrogen Society

Support of the development of hydrogen technologies to achieve decarbonization

Helpful in Emergencies

Stockpiling hydrogen fuel will allow fuel cells to supply energy in times of emergency such as natural disasters, when access to conventional power sources is severed.



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4

Hydrogen fuel cells generate not only electricity, but also heat, enabling the effective use of energy.

Support of the construction of

to create a hydrogen society

self-sustained & decentralized hydrogen

energy supply systems for greater flexibility

Support of the development of applications

## 1 HYDROGEN SUPPLY CHAIN PROJECTS

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

- low carbon hydrogen supply chain
- hydrogen models using existing facilities and infrastructures



\*These images are for illustration purposes only.







# 2 GREATER FLEXIBILITY WITH SELF-SUSTAINING AND DECENTRALIZED HYDROGEN ENERGY SUPPLY SYSTEMS

The MOE supports the construction of self-sustaining and decentralized hydrogen energy supply systems for greater flexibility. Such systems can supply electricity and heat in the event of a disaster.

#### Self-Sustaining & Decentralized Hydrogen Energy Supply Systems

The MOE supports implementing hydrogen energy supply systems that include storage batteries, water electrolysis devices and storage tanks that will enable regions to construct models of hydrogen-based renewable energy storage and usage in line with the characteristics of each region.



# **3** APPLICATIONS FOR CREATING A HYDROGEN SOCIETY

The MOE supports the development and implementation of applications in the transport and other sectors.

F	C Forklift	End User
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 just environmentally friendly, they also boast a convenient, quick refueling time of approx. three minutes.		
PI	hoto compliments of Toyota Indu	stries Corp.

#### Multipurpose FCV

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



Photo compliments of Toyota Motor Corp.

