



August 26, 2021

Four Demonstration Projects toward the Development of a CO₂-free Hydrogen Supply Chain selected as NEDO's Green Innovation Fund Project

ENEOS Corporation (President: Ota Katsuyuki; "ENEOS") announces that its four demonstration projects related to the development of a CO₂-free hydrogen supply chain were selected by the National Research and Development Agency, New Energy and Industrial Technology Development Organization (NEDO) as their "Green Innovation Fund^{*1}/Large-scale Hydrogen Supply Chain Construction Project."

The selected projects were the "Large-scale demonstration of an MCH (methylcyclohexane) ^{*2} supply chain," "Direct MCH electrosynthesis^{*3} (Direct MCH^{®*4}) technology development," "Hydrogen single fueled power generation equipment demonstration," and "Demonstration project for the commercialization of liquefied hydrogen supply chain." The demonstration period is planned to extend to the end of fiscal 2030 for the first three of the above projects, and the end of fiscal 2029 for the last one. Below are overviews of each project.

(1) Large-scale demonstration of an MCH supply chain

Collaborating with our partners for study of the development of an MCH supply chain including local companies in Australia, Malaysia and other locations^{*5}, ENEOS will verify technologies used in CO₂-free hydrogen and MCH production plant construction and operation overseas, maritime transportation of MCH, and receiving, storage MCH and de-hydrogenation with maximum utilization of existing equipment at several ENEOS refineries on a commercial scale of tens of thousands of tons of MCH per year. In addition to using CO₂-free hydrogen produced from MCH in production processes for petroleum products such as desulfurization in refineries, supply to users near the refineries such as power plants will also be considered.

(2) Direct MCH electrosynthesis (Direct MCH[®]) technology development

ENEOS will further develop technology to increase the scale of MCH production equipment (electrolyser), aiming for commercializing Direct MCH[®] technology which has been developed and researched by the company. Direct MCH[®] technology will enable us to reduce the production costs of MCH derived from renewable energy compared to the existing production process. In Australia, we will make further efforts to develop large, 5 MW (hydrogen production capacity: equivalent to 1,000 Nm³/h) commercial-scale plant technology, and to verify its operation.

(3) Hydrogen single fueled power generation equipment demonstration

After confirming the applicability of large-scale hydrogen single fueled power generation technology, ENEOS will demonstrate the technology using its gas turbines. This will be the first verification with actual equipment in Japan. Due to its high combustion temperature, thermal NO_x will largely increase in exhaust gas. Moreover, because it combusts rapidly, it will cause

backfire and combustion oscillation. Then we will collaborate with a power generator manufacturer to verify hydrogen single fueled combustion equipment that addresses these issues. In addition, this project will investigate the feasibility of achieving power with zero emissions for ENEOS by supplying CO₂-free hydrogen in the “MCH supply chain large-scale demonstration.”

(4) Demonstration project for the commercialization of liquefied hydrogen supply chain

We will demonstrate a series of international liquefied hydrogen supply chains from manufacturing to transportation/storage of CO₂-free hydrogen on a scale of tens of thousands of tons per year, in collaboration with Japan Suiso Energy, Ltd (wholly-owned company of Kawasaki Heavy Industries, Ltd.) and Iwatani Corporation*7. We aim to establish supply infrastructure for neighboring power plants by installing import terminals at locations with high potential for hydrogen supply via pipeline, such as industrial complexes.

This initiative is consistent with United Nations Sustainable Development Goals (SDGs) 7. Affordable and clean energy, 9. Industry, innovation and infrastructure, and 13. Climate action. ENEOS is contributing to the stable and efficient supply of decarbonized energy through development of CO₂-free hydrogen supply chains.

*1 Japanese government project offering support for 10 years in areas from research and development/demonstration to social implementation for companies addressing business challenges to achieve Japan’s goal of “Carbon Neutrality by 2050.” It targets 14 fields including energy-related industries (including hydrogen/fuel ammonia industries), transportation/production-related industries and household/office-related industries.

• NEDO press release related to its Green Innovation Fund Project (Japanese only)

<https://www.nedo.go.jp/news/press/AA5_101471.html>

*2 Normal temperature, normal pressure liquid with a volume of 1/500 of hydrogen gas. It is characterized by ease of handling including storage and transport.

*3 Method of directly producing MCH using water and toluene with electricity derived from renewable energy and other sources.

• ENEOS press release related to Direct MCH®

<[Succeeded in the world's first technical verification to produce "CO₂-free hydrogen" at low cost \(March 15, 2019\)](#)>

*4 Direct MCH® is a registered trademark of ENEOS Corporation.

*5 ENEOS press releases regarding collaboration study for the development of an MCH supply chain

<[Signing of Memorandum of Understanding with SEDC Energy Sdn Bhd and Sumitomo Corporation to Consider Collaboration on Hydrogen Project \(October 23, 2020\)](#)>

<[ENEOS signs MoU with Aramco for blue hydrogen and blue ammonia collaboration \(March 25, 2021\)](#)>

<[ENEOS Begins Joint Study with Neoen for Development of a Japan-Australia CO₂-free Hydrogen Supply Chain in South Australia \(August 2, 2021\)](#)>

<[ENEOS Begins Joint Study with Origin for Development of a Japan-Australia CO₂-free Hydrogen Supply Chain in Queensland \(August 23, 2021\)](#)>

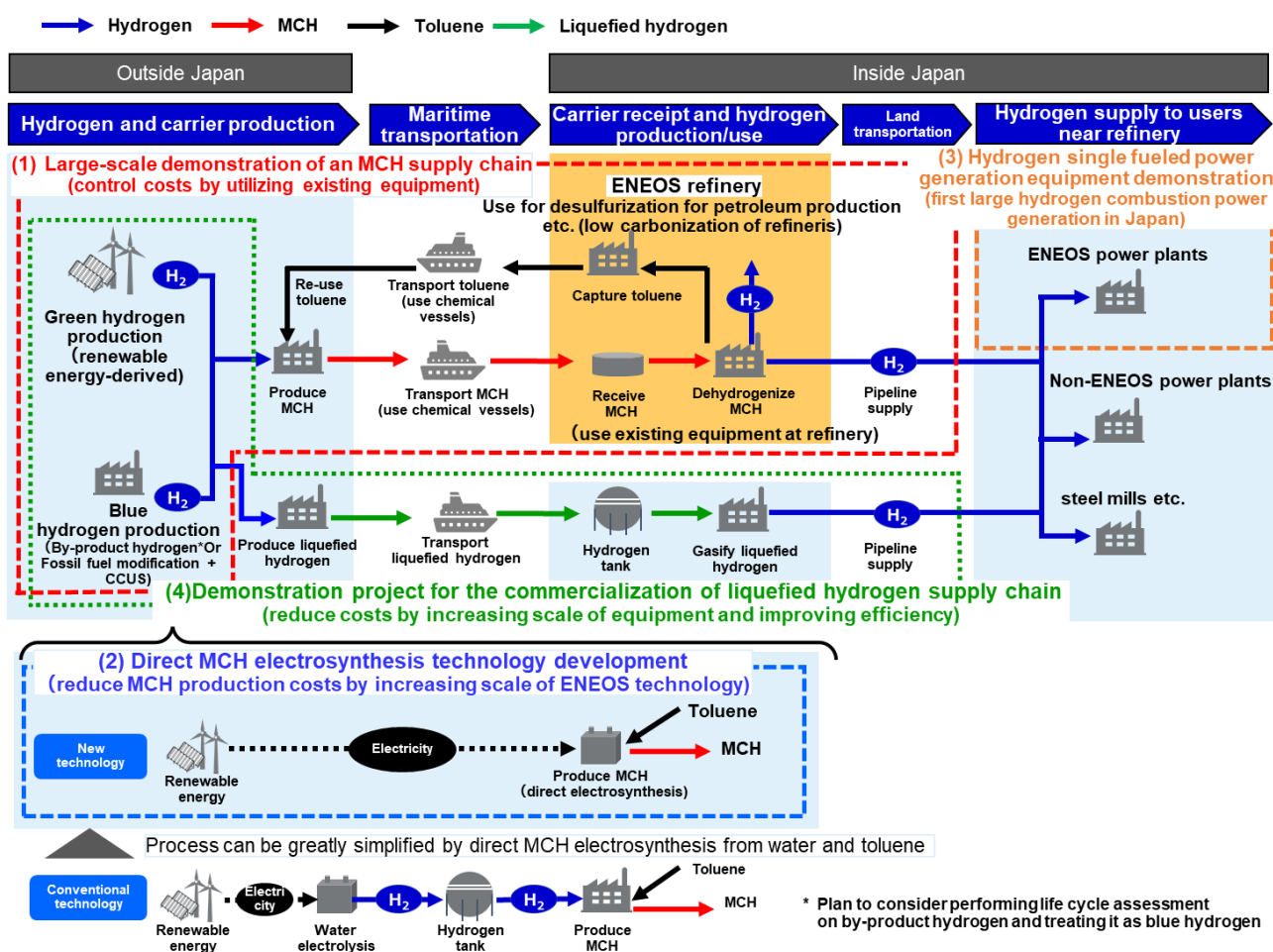
*6 ENEOS press release related to MCH demonstration at ENOS refineries

<[Commencement of Demonstration for Extraction of Hydrogen from Organic Hydride \(MCH\) at ENEOS Refineries \(August 10, 2021\)](#)>

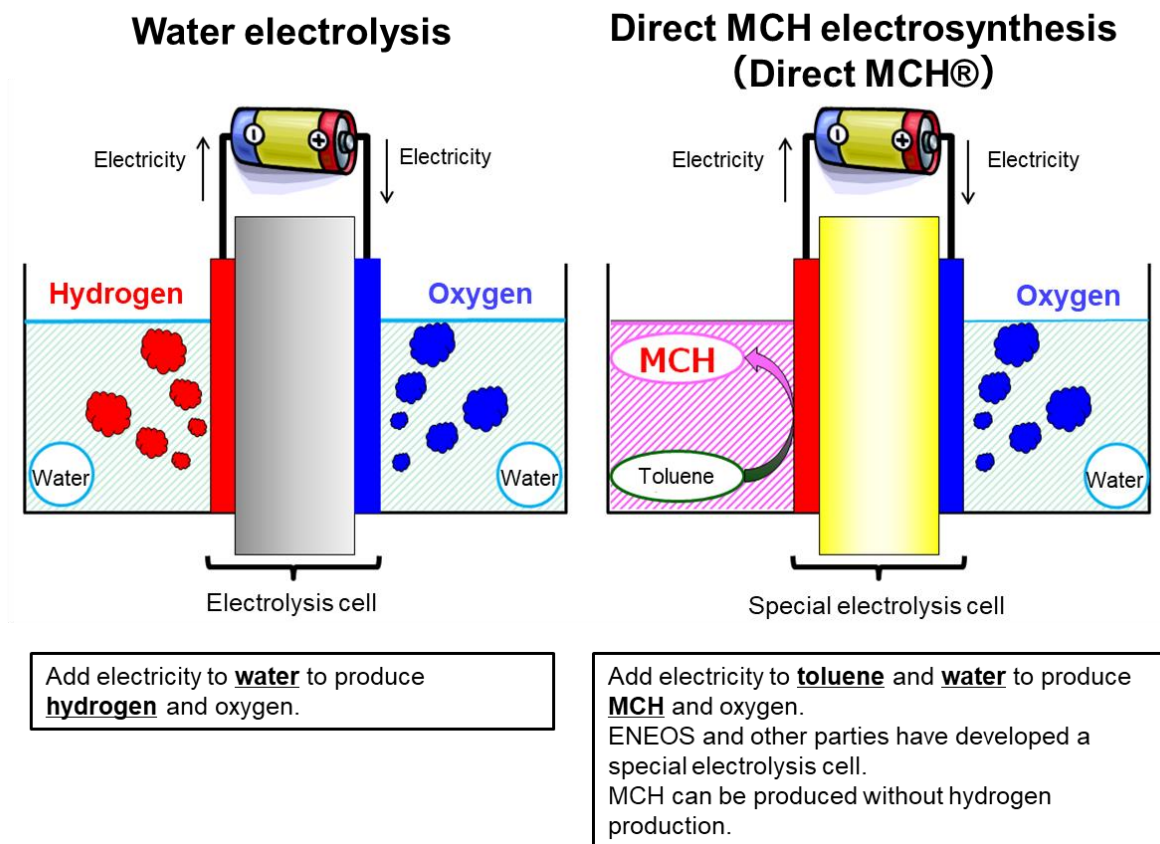
*7 Joint press release by ENEOS, Kawasaki Heavy Industries, Ltd. and Iwatani Corporation (currently, only available in Japanese)

<["Liquefied Hydrogen Supply Chain Commercialization Demonstration" Selected by NEDO Green Innovation Fund \(ENEOS, Iwatani Corporation, Kawasaki Heavy Industries\) \(August 26, 2021\)](#)>

<Overview of CO₂-free hydrogen supply chain demonstration project utilizing the Green Innovation Fund>



(Reference) Overview of “(2) Direct MCH electrosynthesis” (comparison with water electrolysis)



<Overview of CO₂-free hydrogen supply chain demonstration project utilizing the Green Innovation Fund>

(1) Large-scale demonstration of an MCH supply chain, (2) Direct MCH electrosynthesis (Direct MCH®) technology development

Objective/Overview	<p>(1) Develop dehydrogenation technology utilizing existing refinery equipment and conduct a commercialization demonstration project to enable the development of an MCH supply chain in order to achieve hydrogen supply cost of 30 yen/Nm³ in 2030. Aim to standardize MCH quality and package licenses including utilization of technology to promote the establishment of an international market.</p> <p>(2) Engage in technological development for direct MCH electrosynthesis, a technology that contributes to future cost reduction (20 yen/Nm³ or below by 2050).</p>
Project period	FY2021 to FY2030 (10 years)
Business scale etc.	<p>Business scale: Approx. 90 billion yen</p> <p>Subsidy rate (1): 2/3 or 1/2, (2): on consignment (10% commission)</p>

(3) Hydrogen single fueled power generation equipment demonstration

Objective/Overview	Hydrogen single fueled combustion equipment developed by a manufacturer will be installed and operated to verify combustion stability to commercialize hydrogen single fueled gas turbine power generation technology that will create large-scale demand by 2030. The project will be conducted by coordination with the MCH supply chain demonstration project.
Project period	FY2021 to FY2030 (10 years)
Business scale etc.	Business scale: Approx. 24 billion yen Subsidy rate: 1/2 (10% incentive)

(4) Demonstration project for the commercialization of liquefied hydrogen supply chain

Objective/Overview	Larger scale technology developed through existing businesses will be utilized to conduct a commercialization demonstration project for the development of a liquefied hydrogen supply chain (hydrogen supply volume: tens of thousands of tons per year for each chain) to become the first in the world to establish maritime transportation technology with hydrogen supply cost of 30 yen/Nm ³ by 2030.
Project period	FY2021 to FY2029 (9 years)
Business scale etc.	Business scale: Approx. 300 billion yen *Totalled with demonstration by other companies Subsidy rate: 2/3 or 1/2 (10% incentive)