May 16, 2024
Central Japan Railway Company
ENEOS Corporation
Hitachi, Ltd.

Establishment of a hydrogen supply chain for the introduction of hydrogen-powered train

Central Japan Railway Company (President and Representative Director: Shunsuke Niwa; hereinafter referred to as “JR Central”), ENEOS Corporation (Representative Director, President: Atsuji Yamaguchi, hereinafter referred to as “ENEOS”), and Hitachi, Ltd. (President and CEO: Keiji Kojima, hereinafter referred to as “Hitachi”) have signed a memorandum of understanding to collaborate on establishing a hydrogen supply chain including production, transportation and use, necessary for the introduction of hydrogen-powered train.

The three companies will work together to ensure a stable supply of hydrogen on JR Central’s nonelectrified routes, with a view to introducing hydrogen-powered train, which JR Central is developing as a means of decarbonizing its diesel trains and will also take on the challenge of developing new technologies.

1. Issues facing the establishment of a hydrogen supply chain
   - JR Central’s goal of operating hydrogen-powered train requires a stable and large supply of hydrogen. Accordingly, in addition to developing hydrogen-powered train, it is necessary to establish a hydrogen supply chain that covers the transportation and storage of produced hydrogen and its filling, installation, and use in trains.
   - Candidates for hydrogen carriers used for transporting and storing hydrogen include liquefied hydrogen and methylcyclohexane (MCH),* and it is necessary to select a hydrogen carrier, taking into account the characteristics and technical issues of each carrier.
   - The three companies will consider the optimal hydrogen supply chain for railways, targeting various hydrogen carriers, including liquefied hydrogen and MCH. Moreover, we will also attempt to develop technology that has no precedent in Japan and overseas to extract hydrogen from MCH on trains.

   * Methylcyclohexane (MCH): A liquid at room temperature and atmospheric pressure with a volume 1/500 that of hydrogen gas. Hydrogen can be extracted from transported and stored MCH.

2. Collaboration to establish a hydrogen supply chain

   [JR Central]
   - It conducts research on the amount of hydrogen needed to operate hydrogen-powered train, hydrogen filling frequency and locations, and hydrogen installation methods, with a focus on the “use” of hydrogen.

   [ENEOS]
   - It is involved in developing and demonstrating technologies for large-scale hydrogen production and transportation to establish a CO_2- free hydrogen supply chain.
   - In this collaboration, it focuses on the “production” and “transportation” of hydrogen for hydrogen-powered train, taking into account the characteristics of hydrogen carriers and their compatibility with existing infrastructure.

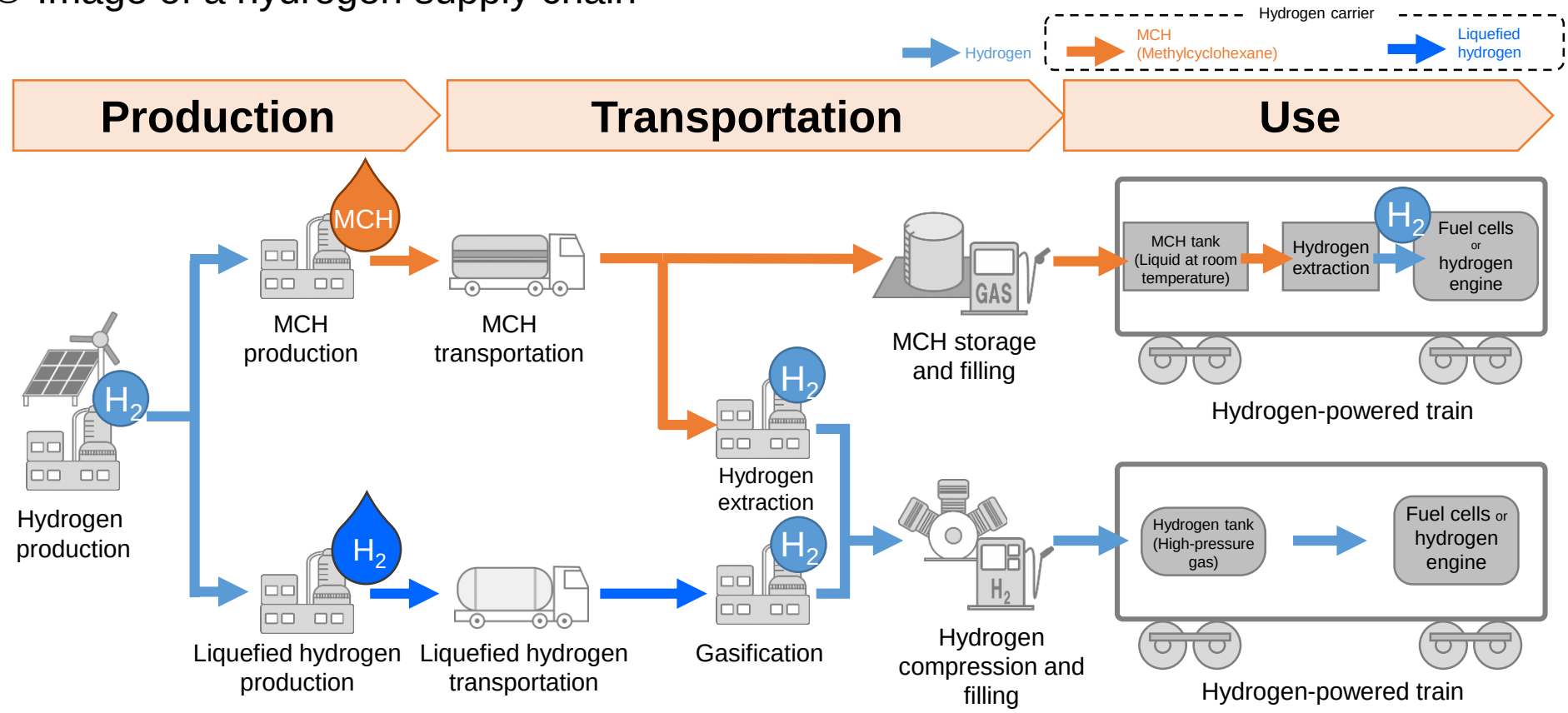
   [Hitachi]
   - It works on technological development and demonstration to establish a supply chain covering hydrogen production to transportation and use.
   - In this collaboration, it uses knowledge gained from a wide range of demonstration experiments, such as those of a system for extracting hydrogen from MCH for use, focusing on the “transportation” and “use” of hydrogen for hydrogen-powered train.

By leveraging their strengths and working together, JR Central, ENEOS, and Hitachi will contribute to promoting the use of hydrogen in the railway business and realizing a carbon-neutral society.

Attachment

Establishment of a Hydrogen Supply Chain for the Introduction of Hydrogen-Powered Train

○ Image of a hydrogen supply chain



ENEOS

“Production” and “Transportation” of Hydrogen

- Characteristics of hydrogen carriers
- Compatibility with existing infrastructure

HITACHI
Inspire the Next

“Transportation” and “Use” of Hydrogen

- Technology to extract hydrogen from MCH
- Ground and on-board equipment for MCH

JR-CENTRAL

“Use” of Hydrogen

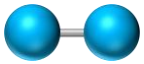
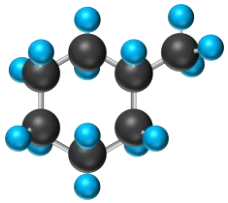
- Amount of hydrogen required for operation
- Hydrogen filling frequency/locations
- Hydrogen installation methods

Reference

Hydrogen Carrier

○ Examples and characteristics of hydrogen carriers

H Hydrogen C Carbon

Liquefied hydrogen	・Hydrogen cooled to -253℃ and liquefied ・Capable of transporting and storing high-purity hydrogen	
MCH (Methylcyclohexane)	・A substance in which hydrogen is combined with toluene,(*) which is liquid at normal temperature and pressure ・Its properties are similar to those of gasoline, making it possible to use existing transportation and filling facilities. ・Toluene can be reused after hydrogen is extracted. (*) Toluene: A liquid substance that combines with hydrogen to become MCH	

○ Image of MCH use in trains

- Produce MCH from hydrogen and toluene for transportation in the form of MCH
- Extract hydrogen from MCH and use it in trains (= Develop technology that has no precedent in Japan and overseas)
- Toluene after hydrogen extraction is reused as a raw material for MCH.