

# Research

## Establishing a Hydrogen Society in Asia

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The 21st session of the Conference of the Parties to the 1992 United Nations Framework Convention on Climate Change (COP21), held in Paris in December 2015, adopted the Paris Agreement. As the first legal framework since the Kyoto Protocol was adopted in the COP3 in 1997, this was welcome news for the first time in many years in terms of global warming issues.

It is believed the Paris Agreement will have a significant impact on the future policy and business trends in the areas of energy and the environment, as it sets out a fundamental course for greenhouse gas reduction from 2020 onwards. As attention on the problem of global warming again comes to the fore, we can assume that the role of hydrogen, which does not emit CO<sub>2</sub> during the utilization stage, will increase. Foreseeing innovation that is likely to take place in the area of energy from the three perspectives of domestic development, technological development, and overseas deployment, we at Hitachi Research Institute are directing our research efforts to considering the form a hydrogen society should take.

### **1. Domestic development: Expansion of local hydrogen production for local consumption**

Unlike transmission and distribution networks for the supply of electricity or pipeline networks for the supply of utility gas, there is no supply infrastructure for hydrogen. In other words, it is a distributed form of energy that can be distributed and expanded to suit regional characteristics without the constraints of an existing supply infrastructure.

The Tokyo Metropolitan Government aims to take the lead in creating a hydrogen society as it prepares to host the 2020 Tokyo Olympic and Paralympic Games, and to provide this as a legacy for future

generations. To achieve this, it is currently focusing on the use of hydrogen for the following purposes:

(1) reducing environmental load (hydrogen does not emit CO<sub>2</sub> during use), (2) diversifying energy supply sources (hydrogen can be generated from various types of primary energy including fossil fuels, renewable energies, woody biomass, and water, etc.), (3) promoting ripple effects in the economy and industry (Japan's high level of expertise in product technologies and breadth of its industrial base), and (4) emergency readiness (ability to supply electricity to emergency shelters in public facilities, such as hospitals and schools, using hydrogen in stationary fuel cells and fuel cell vehicles). (Table 1).

Cities such as Kitakyushu, Shunan, and Kawasaki all have industrial complexes where the utilization of hydrogen byproduct is possible. Tsukuba City and the Goto Islands aim to utilize hydrogen derived from renewable energy. Fukuoka City is aiming to use modified sewage gas as energy. The city of Yokohama has plans to utilize hydrogen as the mainstay form of energy in the Yokohama Smart City project. In this way, various local governments in Japan are moving ahead with diverse energy initiatives, and competition among them to establish a hydrogen society is increasing.

Table 1: Tokyo Metropolitan Government Initiatives to Create a Hydrogen Society

Measure	2020 Goal
• Establish hydrogen stations	• 35 locations
• Expand use of fuel cell (FC) vehicles, and FC buses	• 6,000 FC vehicles • At least 100 FC buses
• Expand use of domestic FCs and Commercial and industrial FCs	• Domestic use: 150,000 units • Commercial and industrial use: all-out promotion
• Provide stable supply of hydrogen	• Hydrogen price equal to or lower than the cost of hybrid vehicle fuel

Source: Prepared by the Hitachi Research Institute from Tokyo Metropolitan Government data

The national government is also supporting initiatives of local governments, and the Hydrogen and Fuel Cell Promotion Office at the Agency for Natural Resources and Energy is requesting a budget (including subsidies, etc.) of 37.1 billion yen for FY2016 for (1) personnel training for research and development, (2) training of business operators, and (3) enhancement of social receptivity.

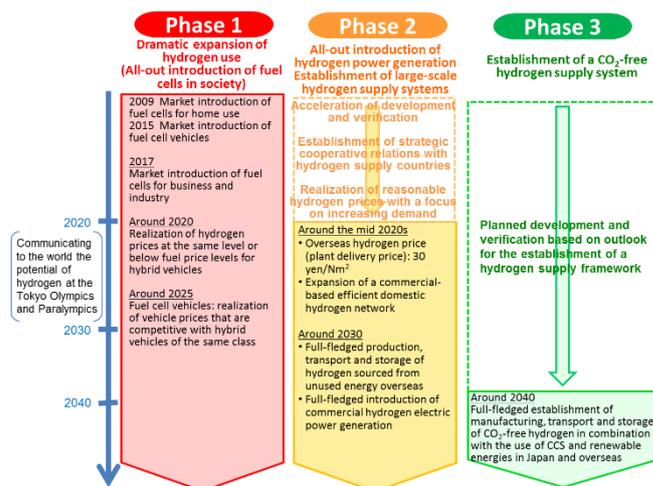
Hitachi Research Institute is currently examining effective policies for the deployment of knowledge and experience accumulated in the course of its mutual cooperation in initiatives of local governments to enable the free interchangeability and sharing of these resources.

## 2. Technological development: Establishment of a hydrogen value chain

The Strategic Energy Plan (April 2014) of the Ministry of Economy, Trade and Industry (METI) clearly states that hydrogen is expected to play a key role as a secondary energy in the future in addition to electricity and thermal energy (p. 26). Therefore, we can expect the formation of a “hydrogen value chain”

that encompasses the production, storage, transportation, supply, and use of hydrogen, the manufacture of various related products, and the establishment of a business model high in commercial potential.

For example, fuel cells for home use and fuel cell vehicles are already in use. In the future, we can also expect to see new applications such as forklifts and buses powered by fuel cells, and electricity generated by hydrogen as a substitute for LNG generation. Moreover, when hydrogen is imported from overseas as an energy source for generating electricity, the supply chain for LNG, which is also a gas, can serve as the model for the hydrogen supply chain.



Source: Table 2. Ministry of Energy, Trade and Industry: Three Phases for Creating a Hydrogen-based Society (Road Map)

With the “Energy Carrier” research and development plan, which is already a Strategic Innovation Promotion Program (SIP) of the Cabinet Office, cross-ministerial development of technology is already underway in Japan. Under this plan, a decision has been made to establish by 2018 scenarios and technology for introducing hydrogen in demonstrations during the Tokyo Olympic and Paralympic Games, and the government is currently

injecting an annual budget of about 3.0 billion yen for this purpose.

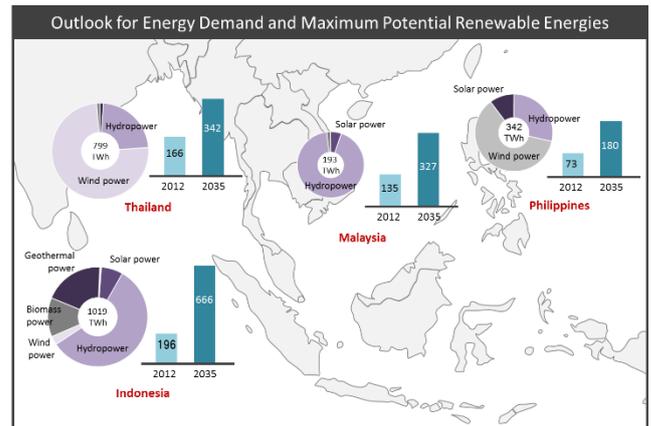
Meanwhile, as METI's road map indicates (Table 2), the price of fuel cell vehicles and the price of hydrogen as fuel must be further reduced by the target years of 2025 and 2030.

### 3. Overseas deployment: Contributing to the establishment of a hydrogen society in Asia

The goal is not only to establish a hydrogen society in Japan alone but also to expand it to ASEAN countries, one of the engines of the future global economy, where its establishment will be effective in addressing global warming issues.

To meet increasing energy demand in the ASEAN countries in the future, the effective use of renewable energy, about 97% of which is not being utilized at present, is essential. For example, if a low-cost CO<sub>2</sub>-free hydrogen supply system can be introduced by producing cheap hydrogen through water electrolysis using electricity generated by renewable energy, it will be possible to utilize this as a distributed power source in areas that grid electricity cannot reach.

Some countries are capable of collaborating and cooperating with Japan including Malaysia, which has been researching the production, storage and use of hydrogen (fuel cells) since 1996, and Singapore, which has launched the Fuel Cell Community forum based on industry-government-academia collaboration. Therefore, Hitachi Research Institute believes that the local production of energy for local consumption using hydrogen will also be possible in ASEAN countries.



Source: Prepared by the Hitachi Research Institute based on Ministry of Energy data from IEEJ, ADB, and ASEAN

Table 3. Electricity Demand Forecast (bar graph), Potential Volume of Renewable Energy (Pie Chart)

### 4. Conclusion

While there are many issues that still need to be addressed, hydrogen has the potential to become a third form of secondary energy after electricity and thermal energy.

Hitachi Research Institute will continue its research efforts to clarify the path towards a hydrogen society in Asia.