Basic Hydrogen Strategy (key points)

METI Ministry of Economy, Trade and Industry

This strategy lays out the vision for the common target that public and private sectors should pursue together with an eye on 2050.

1. Structural challenges involving Japan's energy supply and demand

(1) Energy security and self-sufficiency rate

- Japan depends on overseas fossil fuels for about 94% of its primary energy supply. Oil-based fuels account for 98% of automobile fuels, of which approximately 87% is from the Middle East.
- Japan's energy self-sufficiency rate has remained at 6-7% due primarily to the shutdown of nuclear power plants since 2011's Great East Japan Earthquake. This is the second lowest among the 34 OECD countries.

(2) CO_2 emission restrictions

- Japan's target is to cut GHG emissions by 26% by FY2030 from the FY2013 level (or by 25.4% from FY2005).
- In accordance with the Paris Agreement, Japan will attempt to cut GHG emissions by 80% by 2050.

2. Significance and importance of hydrogen

(1) Diversification of supply/procurement sources to fundamentally reduce procurement/supply risks

- Hydrogen can be **produced from renewable energy and various other energy sources, stored and transported**. Japan's primary supply structure must be diversified to reduce its dependence on specific, individual energy sources.

(2) Reducing carbon in power generation, transportation, heating and industrial processes

- Hydrogen does not emit CO_2 during use. CCS and renewable energy technologies can be used to make hydrogen a **completely CO2-free** energy source.
- Conventional fuels or fuel cells can be combined with hydrogen to ultimately reduce carbon in every area.

(3) Significance as seen from 3E+S viewpoint

- **A hydrogen-based society is a means to an end**. By realizing a hydrogen-based society, Japan will seek to achieve the "3E+S" goal.

(4) Contributions to the international community through world-leading innovation

- **Japan will expand its hydrogen technologies overseas** to lead global carbon reduction.

(5) Industrial promotion and competitiveness enhancement

- Japanese hydrogen and fuel cell technologies are the world's most advanced. Japan will proactively expand these technologies domestically and overseas to **create a new growth industry**.

(6) Leading hydrogen initiatives in foreign countries

- While maintaining a close watch on global trends, **Japan should lead the world in realizing a hydrogen-based society.**

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3. Basic strategy for realizing a hydrogen-based society (i)

(1) Realizing low-cost hydrogen use

: Utilizing unused energy and renewable energy from overseas

- **Reducing the hydrogen procurement and supply costs is indispensable** in realizing a "hydrogen-based society".
- **A basic approach** is to combine cheap, unused energy from overseas with CCS, or **procure massive amounts of hydrogen** from cheap, renewable energy electricity in parallel to the establishment of international supply chains through the development of storage and transportation infrastructure.
- Japan will develop commercial-scale supply chains by around 2030 to procure 300,000 tons of hydrogen annually and ensure that the cost of hydrogen reaches **30 yen/Nm3.**
- In the later future, Japan will try to lower the hydrogen cost to **20 yen/Nm3** to allow hydrogen to have **the same cost competitiveness as traditional energy sources when environmental cost adjustments are incorporated**.

(2) Developing international hydrogen supply chains

- Japan will develop energy carrier technologies to enable efficient hydrogen transportation and storage.
- Japan will demonstrate a **liquefied hydrogen** supply chain by the mid-2020s for commercialization around 2030.
- Japan will establish basic technologies for an **organic hydride** supply chain by FY2020 and commercialize the chain in or after 2025.
- Japan will resolve such challenges as reducing the emission of nitrogen oxide in the direct combustion process and ensuring safety in handling of flammable and deleterious substances in a bid to introduce the use of CO2-free **ammonia** by the mid-2020s.
- Japan will consider how best to disseminate **methanation** technology **that employs** CO2-free hydrogen.

(3) Renewable energy expansion in Japan and regional revitalization

a. Expanding the use of hydrogen from renewable energy in Japan

- To further expand renewable energy use, it is necessary to not only ensure the power supply is regular and stable, but also develop technologies for storing surplus power
- **The power-to-gas technology** that stores renewable energy electricity as hydrogen is a promising method of controlling long-cycle renewable energy power generation fluctuations that are difficult for storage batteries to address.
- The key point is cost reduction. Japan will attempt to develop a technology that cuts the unit cost for water electrolysis systems as core power-to-gas equipment to **50,000 yen/kW** by 2020 in order to realize the world's highest cost competitiveness.
- Japan will attempt to **commercialize** power-to-gas systems by **around 2032**, and reduce the cost of hydrogen from renewable energy to **as low as that of imported hydrogen** in the later future.

b. Utilizing regional resources and regional revitalization

- The utilization of unused regional resources (including renewable energy, waste plastics, sewage sludge and by-product hydrogen) will contribute not only to **expanding the use of low-carbon hydrogen** but also to improving regional energy self-sufficiency rates, **creating new regional industries** and establishing dispersed renewable and other energy systems.
- Relevant challenges include (1) the expansion of regional hydrogen demand and the optimization of regional supply and demand, (2) the reduction of costs of hydrogen facilities, and (3) the reduction of power generation and raw material procurement costs.
- Adopting the findings of ongoing demonstration projects, the central government will **support the development of low-carbon hydrogen supply chains utilizing regional resources.**

Basic Hydrogen Strategy (key points)

3. Basic strategy for realizing a hydrogen-based society (ii)

(4) Hydrogen use in power generation

- Like natural gas power generation, hydrogen power generation can play a major role as a **regulated power supply and backup power source** required for expanding renewable energy.
- Hydrogen power generation is useful in terms of ensuring stable and large-scale use of hydrogen, bringing stability and economy to the market.
- Japan seeks to **commercialize** hydrogen power generation as well as international hydrogen supply chains and cut the unit hydrogen power generation cost to **17 yen/kWh around 2030**. Japan's annual hydrogen procurement may have to reach **around 300,000 tons (amounting to 1 GW in power generation capacity)**.
- In the future, Japan will attempt to make hydrogen power generation including environmental values as **cost competitive as LNG power generation**. To this end, Japan's annual hydrogen procurement may have to be **5-10 million tons (amounting to 15-30 GW in power generation capacity).**
- For the introduction of hydrogen power generation, Japan must improve economic efficiency of hydrogen power generation and **the assessment of its environmental value** while monitoring discussions on other institutional designs.
- CO2-free methane and ammonia can be used directly. Japan will attempt to mix ammonia with coal at coal power plants by around 2020.

(5) Hydrogen use in mobility

- Japan aims to increase the number of FCVs in Japan to 40,000 units by 2020, to 200,000 units by 2025 and to 800,000 units by 2030. Japan also aims to increase the number of hydrogen stations in Japan to 160 by FY2020 and to 320 by FY2025 and make **hydrogen stations independent by the second half of the 2020s**.
- To this end, Japan will promote **regulatory reform, technological development, and joint, strategic hydrogen station development by the public and private sectors**.
- To secure the optimum locations for hydrogen stations, Japan will attempt to develop renewable-based hydrogen stations in conjunction with commercial hydrogen station development.
- Japan aims to increase the number of FC buses in Japan to around 100 by FY2020 and to **around 1,200** by FY2030.
- Japan aims to increase the number of FC forklifts in Japan to around 500 by FY2020 and to **around 10,000** by FY2030.
- Japan also aims for the development and commercialization of **FC trucks**.
- Japan will promote fuel cells for **small ships**.

Basic Hydrogen Strategy (key points)

3. Basic strategy for realizing a hydrogen-based society (iii)

(6) Potential hydrogen use in industrial processes and heat utilization

- CO2-free hydrogen can (a) be **used as fuel** for energy areas where electrification is difficult, and (b) **replace industrial-use hydrogen from fossil fuels**, contributing to cutting carbon emissions.
- In the future, Japan will attempt to use CO2-free hydrogen for **reducing carbon emissions in the industry sector**.

(7) Utilizing fuel cell technologies

- As for Ene-Farms, Japan will seek to lower the price to 800,000 yen for a standard polymer electrolyte fuel cell (PEFC) and to 1 million yen for a standard solid-oxide fuel cell (SOFC) by FY2020 to secure their later **autonomous diffusion**.
- Japan will explore markets for apartment buildings, cold regions, and Europe and other regions with high heat demand.
- From 2030, Japan will attempt to diffuse **pure hydrogen fuel cell co-generation systems** using CO2-free hydrogen.

(8) Utilizing innovative technologies

- With an eye on 2050, it is necessary to develop innovative technologies for highly efficient water electrolysis for **hydrogen production** as well as low-cost, highly efficient **energy carriers** and highly reliable, low-cost **fuel cells**.
- Relevant government organizations will seamlessly implement individual projects.

(9) International expansion (standardization, etc.)

- Japan will lead **international standardization** through international frameworks. Japan will promote technological development and cooperation with relevant organizations.

(10) Promoting citizen's understanding and regional cooperation

- It is necessary that the understanding of the safety of hydrogen and the significance of hydrogen use is shared among citizens. To this end, **the central government will adequately provide information in cooperation with local governments and business sectors**.
- The central government will proactively exploit "the conference on local governments' cooperation in diffusing and promoting FCVs" and regional councils to share information with local governments and facilitate information sharing between local governments.

Scenario for Basic Hydrogen Strategy

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