SOFC Systems (Vol. 7): Technology and Cost Assessments of High-Temperature Steam Electrolysis

High-temperature steam electrolysis using solid oxide electrolysis cells (SOEC) is believed to be a highly efficient way of producing hydrogen. Reversible power generation and electrolysis systems that use SOEC as a solid oxide fuel cell (SOFC) for hydrogen power generation are hoped to have a role in power conditioning and storage systems linked to renewable energy. A comparison of energy storage costs between lithium ion batteries (LIBs) and SOECs revealed that SOECs have advantages, but still face challenges.

- The cost of SOEC steam electrolysis systems can be significantly reduced by replacing hydrogen storage tanks with low-pressure spherical tanks.
- In a comparison of charging and discharging costs with LIBs, the longer the discharge times and the cheaper the power usage costs are, the more advantageous SOECs/SOFCs will be. It's believed this will create differentiation with LIBs for long-term storage needs.
- The assessment revealed that hydrogen production costs of 30 JPY/Nm^3-H_2 can be achieved in the future. This can be achieved with a 50% operation rate and an electricity price of 5 JPY/kWh, with steam electrolysis performed for 15 hours (Figure 1).

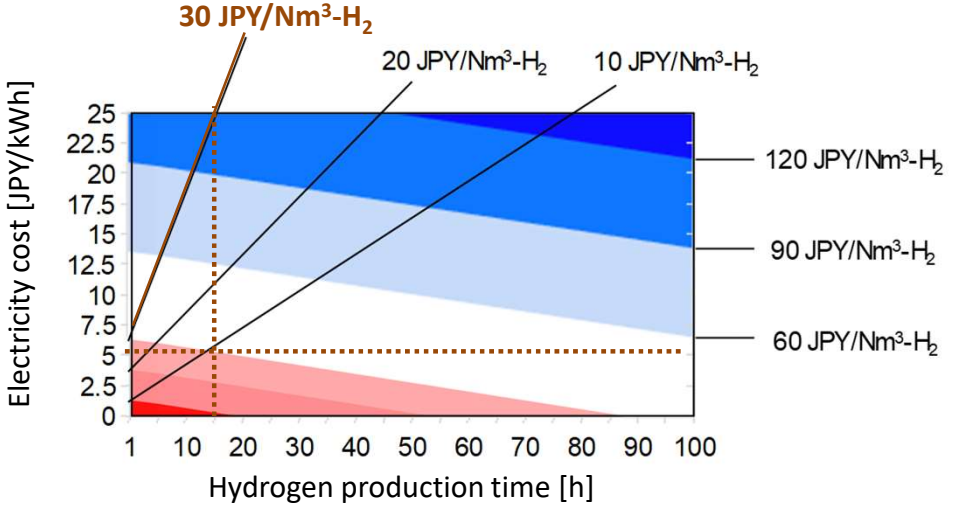

Figure 1: The interdependence between hydrogen costs and storage times using SOECs.
Future case: Steam electrolysis operation rate of 50%

Proposals for Policy Development

For SOFC/SOEC systems to have a role in controlling output fluctuation and storing power from renewable energy sources, technological revolutions will be required in cell design and materials, along with improvements to manufacturing processes and the development of technologies to improve lifetime.

1) Expanding the use of SOEC systems will require cost reductions of comprehensive systems, which combine auxiliaries such as compressor, hydrogen storage tanks and heat exchangers, along with longer lifetimes and decreased sizes of SOEC modules.
2) Developments of SOEC systems assuming actual usage cases will also be required. These cases, in which SOEC systems are beneficial, include hydrogen storage system corresponds to time constants of fluctuations of renewable energies as well as small to medium sized SOEC systems for hydrogen stations.

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