



# An Analysis on Utilizing SOFC to Provide Reserve Capability for Power Systems

There are concerns that the mass introduction of renewable energy sources may reduce the ability to regulate power systems which are currently powered primarily by thermal power. For this reason, the possibility of utilizing solid oxide fuel cells (SOFC) with a relatively slow tertiary reserve capability was analyzed. Kyushu was used as an example for estimating the reserve capability price via a stochastic unit commitment planning model that included all power generation plants, taking errors in projecting photovoltaic outputs into account. Using the reserve capacity price, an energy cost minimization model for residential SOFCs showed that rewards for providing reserve capacity change operational patterns of residential SOFCs. This result reveals the high possibility of these SOFCs providing an upward reserve capability.

- The grid-wide stochastic unit commitment planning model was based around a typical electric utility company. The model was used to estimate the upward reserve capability price by determining the unit cost of electricity generation for the entire year in the Kyushu region, the amount of solar power curtailment, and the amount of reserve capability procured from the market.
- Figure 1 shows that there are seasons and times of year when the price of upward reserve capability exceeds the cost of providing upward reserve by typical SOFC-using households especially in summer weekday. This confirmed the economic rationale for providing reserve capability from home mounted SOFCs.
- When the resulting upward reserve capability power price estimates were entered into the SOFC energy cost minimization model, it became clear that the rewards for providing reserve capability cause changes to SOFC operational patterns on summer weekdays in particular (Figure 2) revealing the high possibility that a scheme such as this could provide upwards reserve capability.

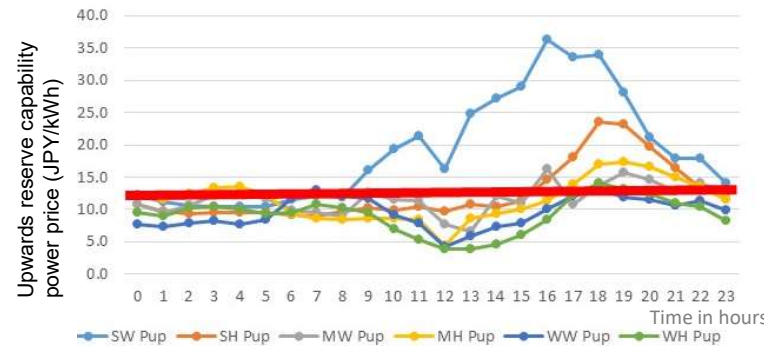


Figure 1: Estimation of the price of upward reserve capability through a stochastic unit commitment planning mode.

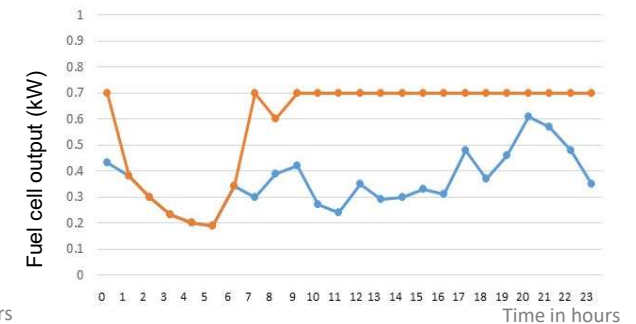


Figure 2: Difference in fuel cell outputs with and without rewards for providing upwards reserve capability (summer weekdays).

## Proposals for Policy Development

- 1) Household SOFC-based reserve capability provision systems that allow for remote network control by power retail companies have future promise and are likely to become a reality. Further proof through a demonstration experiment is likely to further expand and energize this concept.
- 2) A business model for a system that compensates for forecasting errors in photovoltaic power generation through SOFCs should be verified through a government-led initiative that combines actual regional meteorological data, actual measurement data, and remotely controllable SOFCs.