

**Study on Operational Optimization of a
Combined Energy System with
Photovoltaic Power Generation**

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Abstract

The optimization of the operation planning of a micro-grid with diesel engine generator or a combined fuel cell with the photovoltaic (PV) power generation is proposed. Energy supply characteristics of a PV and a diesel engine generator combined system are studied.

The objective of this study involves developing an algorithm based on neural network (NN) to predict the power output from the PV system and optimizing the operation planning of combining a PV and a diesel engine generator system. The analysis error of the operation prediction is also considered. Energy is supplied to a demand side of three households in Sapporo, in Japan from the proposed system. Furthermore, the operation plans of a PV and a solid-oxide fuel cell (SOFC) and a proton -exchange membrane fuel cell (PEFC) combined system is proposed. In this system, the SOFC-PEFC combined system with a time shifting of the reformed gas is proposed to supply energy to a micro-grid consisting of 30 residences in Sapporo city, Japan. Three cases are proposed for the operation plan of the SOFC-PEFC combined system: 0%, with 50% and 100% of solar power. Three types of system operation of using the SOFC independent operation, PEFC independent operation and SOFC-PEFC combined system are used to supply the demand side. A comparative study between the types of system operation is illustrated.

The power generation efficiency and fuel consumption are investigated for different load patterns. The results of this study show that, the optimized operation of an energy system with a PV power generation reduced the time operation of the diesel engine generator. The proposed energy systems with PV power generation are proved to be effective to achieve the purpose of supplying energy to a micro-grid with high performance without any external source.