

Analysis of the performance and operation of a photovoltaic-battery heat pump system based on field measurement data

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Abstract

Photovoltaic-heat pump (PV-HP) combinations with battery and energy management systems are becoming increasingly popular due to their ability to increase the autarchy and utilization of self-generated PV electricity. This trend is driven by the ongoing electrification of the heating sector and the growing disparity between growing electricity costs and reducing feed-in tariffs in Germany. Smart control strategies can be employed to control and optimize the heat pump operation to achieve higher self-consumption of PV electricity. This work presents the evaluation results of a smart-grid ready controlled PV-HP-battery system in a single-family household in Germany, using 1-minute-high-resolution field measurement data. Within 12 months evaluation period, a self-consumption of 43 % was determined. The solar fraction of the HP amounts to 36 %, enabled also due to higher set temperatures for space heating and domestic hot water production. Accordingly, the SPF decreases by 4.0 % the space heating and by 5.7 % in the domestic hot water mode. The combined seasonal performance factor for the heat pump system increases from 4.2 to 6.7, when only considering the electricity taken from the grid and disregarding the locally generated electricity supplied from photovoltaic and battery units.

Keywords: Heat pump, Photovoltaic, Battery, Energy-efficiency, Monitoring, Self-consumption, Sg-ready

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