The 23rd General Meeting and Singapore Forum
November 21–24, 2023

Impact of Household Electrification on the Investment Drivers of PV-Battery Systems

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Keywords: *PV-battery systems, optimization, electrification, electric vehicle, heat pump*

Abstract

The electrification of heating and transportation is key to a successful energy transition. As an increasing number of households is adopting a heat pump (HP) for space heating or an electric vehicle (EV) for transportation, the question arises whether the electrification of household loads has an impact on the investment decision of households to install a PV-battery system and, if so, which factors drive this investment.

In this study, a convex optimization model is used to optimize the sizing and operation of PV-battery systems for 200 households while minimizing the equivalent annual cost (EAC) for four scenarios: 1) no EV/HP, 2) EV only, 3) HP only, and 4) both EV and HP. A capacity-based network tariff is implemented based on the tariff currently in place in the Flemish region of Belgium. This tariff charges households for their monthly peak grid withdrawal power, which is averaged over the course of a year.

The investment drivers are studied by determining the electricity bill component that leads to the highest amount of savings. These drivers change from the savings due to the feed-in remuneration with no electrification to the savings due to the reduction of energy consumption from the grid for the full electrification case. In the EV only scenario, the EAC, annual monthly averaged peak power and battery size are larger than in the HP only scenario. This could be explained by the fact that the EV is used consistently throughout the year whereas the HP is used more intensively during the cold winter months.

Results show that the influence of the capacity-based network tariff as an investment driver is very limited. In fact, all households that electrify their loads benefit from installing a PV-battery system, as their equivalent annual cost will be lower under the given assumptions. Furthermore, the introduction of the capacity-based tariff does not deter households from investing in a PV-battery system from a financial perspective and incentivizes them to operate their PV-battery system in a way that cuts the high peak power demand due to electrification in half which contributes to reducing the burden on the grid.