INCENTIVES FOR SELF-CONSUMPTION AND FUTURE PENETRATION OF RESIDENTIAL PV BATTERY STORAGE SYSTEMS: THE GERMAN CASE

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Overview

Decreased prices for photovoltaic (PV) installations and risen household´s electricity prices have led to the advent of so-called grid parity in Germany. At the same time feed in tariffs have been reduced substantially, providing strong incentives for PV owners to maximize self-consumption instead of feeding electricity into the public grid. For this purpose, battery storage systems are suitable, but high investment cost is regarded as one of the main obstacle for market breakthrough. Despite this cost current estimates suggest that about 20,000 PV storage systems are installed in German households. A common expectation is that this number will rise due to falling batteryprices; furthermore German government has introduced a subsidy scheme for PV battery storage systems in 2013.

This research identifies the conditions for profitability of the storage system and determines rates of self-consumption and self-sufficiency of an exemplary houshehold. The results are also discussed from an overall economic perspective: If it becomes more prevalent that households cover parts of their electricity demand by self-production, the question arises if this should be charged by taxes, levies and other fees.

Methods

The analysis in this work is based on the following basic economic consideration: an investment in a PV battery storage system is beneficial for the owner if the expected (discounted) total revenue generated from self-consumption and grid-infeed at least equals the expected total cost associated with its installation and operation throughout its lifetime. Revenues are calculated by a linear optimization model that uses a load- and a PV-generation profile. These data are measured 5 minute values recorded over one year in a three-person household that is equipped with a 5 kWp PV-installation, located in southern Germany. The model determines the optimal charge-discharge-schedule of a simulated Li-Ion-battery storage system assuming various capacities, electricity prices and subsidy amounts. Average costs are calculated separately by LCOE-approach using the specific annual quantities of electricity turnover and charge-discharge-cycles as well as current and potential future cost parameters.

Results

The main drivers for profitable operation are investment costs, household electricity prices and battery utilization rates (annual load cycles). For the exemplary household it is shown that a small storage capacity of 2.5 kWh leads to a self-sufficiency rate of about 55 %. Capacities of 5, 10 and 20 kWh increase the self-sufficiency rates to 66, 74 and 76 %. However, this increase is associated with a significant drop in utilization rates and correspondingly has a negative impact on profitability. Small battery systems reach 220 to 284 annual load cycles, large capacity batteries only 73 to 95. The results indicate that under today´s market conditions batteries are not an economical solution to maximize self- consumption of PV electricity. In most cases, the average profit of a standalone PV system is much higher compared to a PV battery storage system. Only if the governmental investment subsidies are taken into account and if optimistic assumptions are made about future estimated electricity prices, storage systems with capacities between 5 and 10 kWh could be a viable option. Additionally it must be assumed that indirect subsidy schemes in the form of tax and levy exemptions remain unchanged. If battery investment costs fall below 250 €/kWh, profitable operation of small storage systems becomes possible without the direct investment subsidies. Furthermore, the calculations for the exemplary household reveal that the PV self-consumption during a 20 year system lifetime sums up to considerable amounts of electricity: Even without battery storage, about 25 MWh are self-consumed. Small storage units with capacities between 2.5 and 10 kWh allow for selfconsuming 41.7 to 56.8 MWh and thus avoid a similar amount of grid supply. Assuming unchanged grid fees it turns out that the household´s grid charges are 1,500 to 3,400 Euro lower than without PV self-consumption. Correspondingly, his contribution to the financing of the public electricity infrastructure is lowered by the same amount.

Conclusions

Under the current legal framework, self-production and consumption of PV-electricity becomes more and more attractive for German households. If costs for Li-Ion batteries continue to fall, economic incentives will be strengthened further. This might lead to a situation in which large proportions of household´s electricity comes from own production. As long as owners of PV storage systems still use the public electricity infrastructure as a backup function, solutions for an adequate charging of grid costs are of special interest. We suggest a stronger orientation towards individual fees, based on performance components.