COST-BENEFIT DEVELOPMENT OF DECENTRALIZED BATTERY STORAGE SYSTEMS – EVOLUTION OR REVOLUTION?

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Overview

Photovoltaics has been a success story in recent years. A technology that was ridiculed a few years ago and has since experienced a steep rise. In some countries, it is no longer just possible to easily supply single-family buildings, but also tenants of multi-family buildings with locally generated PV electricity. The fluctuating production has also increased the demand for decentralized battery storage. The question that arises here is whether a similar success story is possible for battery storages as well. In order to answer this question, the costsn relation to the benefit is decisive. What is the benefit of additional storages and what may this storage cost in different scenarios in order to be economically profitable? This paper focuses on the evolution of storage costs in recent years and the benefits for consumers in different scenarios..

Methods and assumptions

Based on an existing linear optimization model, different scenarios for battery supported PV systems will be evaluated regarding the maximum possible storage costs in order to operate profitably. For this purpose, a comparison of costs and benefits for different load profiles and different sizes of PV and storage systems is performed. In addition to a standard load profile, measured load profiles are used. Different developments in electricity prices and feed-in tariffs are taken into account. In addition, we differentiate between two operation strategies of the battery: First, covering mainly peak load and second, also covering total load. On the basis of a literature respective market research, the developments of the storage costs are presented. Subsequently, these real prices are compared with the modeled prices and necessary cost reductions in the different scenarios are pointed out. Based on the method of the internal rate of return, the maximum allowed additional battery storage costs are deducted at a fixed interest rate. It is assumed that the battery storage has to be replaced after 13 years and that the rebuy of these storage system gets significantly cheaper.
The economic calculation is done by

$$NPV = -I_{batt,tot} + \sum_{t=1}^{25} \frac{\Delta C_t}{(1+r)^t} = 0$$

$$I_{batt,tot} = \sum_{t=1}^{25} \frac{\Delta C_t}{(1+r)^t}$$

$$I_{batt} = \frac{I_{batt,tot}}{1 + 0{,}7 * (1+r)^{-13}}$$

Results

Figure 1 and Figure 2 show the investment costs (Carmen, 2013) and the calculated necessary reductions in 2013. It can be seen that battery storage systems are still significantly too expensive in the analysed year 2013 and that the necessary reductions are up to 95%. As shown in Figure 2, a minimum of necessary reductions is achieved at approximately 6-7 kWh storage capacity. This is the capacity in which an increase in self-consumption in an average single-family dwelling, taking into account a standardized load profile, is only possible to a limited extent. In this calculation it was assumed that at least an internal rate of return of 1% is achieved. If the expected annual rate of return should be higher, then the costs must decrease significantly more.
Figure 3 shows two charging strategies of the battery, the total load coverage on the left and peak load coverage on the rigth. In peak load mode the battery mainly covers a fixed peak load (e.g. 50% of the maximum load [kw]) but is also able to cover total load if battery capacity is left. Depending on the future composition of household electricity prices and on the charging strategy of the battery, the necessary cost reductions may also be significantly lower. When we think of increasing capacity or fixed components in retail electricity prices, peak load coverage can be an

appropriate instrument to lower peak load from the electricity grid and therefore save a lot of money due to capacity savings.

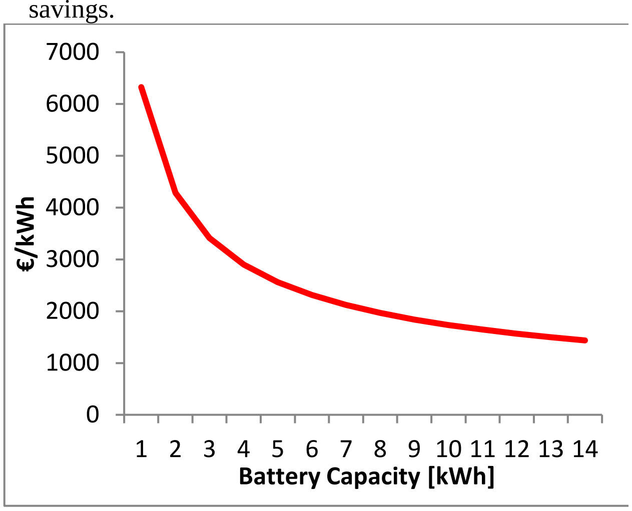

Figure 1: Battery Investment costs 2013
Source: Carmen (2013)

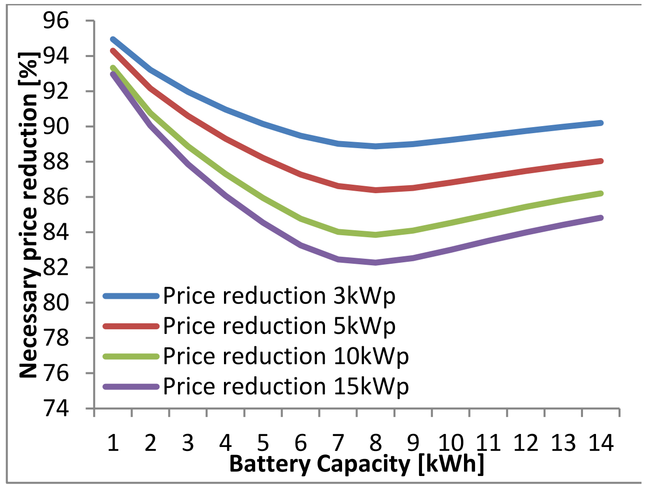

Figure 2: Necessary investment cost reduction for different sizes of PV-Systems

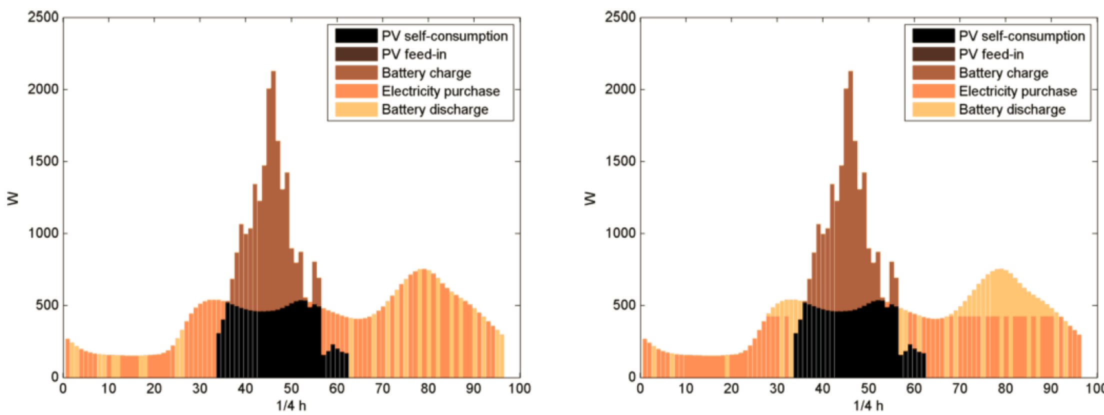

Figure 3: Charging Strategies of the battery for a standardized household load profile: left: total load coverage, right: peak load coverage

In recent years, prices for battery storage have dropped significantly. However, the profitability of battery storages not only depends on the direct investment costs, but also on the calendaric life, the cycle life, the discharge depth and also on the efficiency and, as discussed before, on the charging strategy and the future development of retail electricity prices, which will be pointed out in the final paper as well. The maximum charge / discharge capacity plays a slightly subordinate role. This changes if the battery should be able to cover all load peaks.

Conclusions

Due to technological learning and alternative tariffs, battery storages can become an economic attractive solution for decentralized use. The development of investment costs for battery storages as well as changes in necessary investment cost reductions in different scenarios will be presented in the final version of this paper.

References

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