FROM SINGLE FAMILY BUILDINGS TO ENERGY COMMUNITIES - ECONOMIC VIABILITY OF UPSCALING BATTERY STORAGE SYSTEMS

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Overview

The number of prosumers has risen sharply in recent years, especially in Germany and Austria. Decentralized battery storage systems have also moved more and more into focus in order to increase own consumption and to feed less electricity into the grid. In various countries it is now also possible not only to supply single-family buildings with self-generated photovoltaic electricity, but also to include tenants of multi-family houses.. Concepts also envisage entire blocks or regions and merge them into energy communities. The main question for prosumers whether a battery storage should be installed is strongly related to the economic performance. What is the monetaryenergetic benefit of additional storages and what are acceptable storage investment costs in order to become economically viable? This paper focuses on the evolution of storage costs in recent years and assess the economic/energetic benefits for consumers in single family buildings, multi-family buildings and energy communities in different scenarios.

Methods and assumptions

Based on an existing linear optimization model, different scenarios regarding single family buildings, multi-family buildings and energy communites for battery supported PV systems will be evaluated regarding the maximum possible storage costs in order to operate economically profitable. For this purpose, a comparison of costs and economic 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. On the basis of a literature and 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 repurchase of this storage system will take place at 70% of the original cost.

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

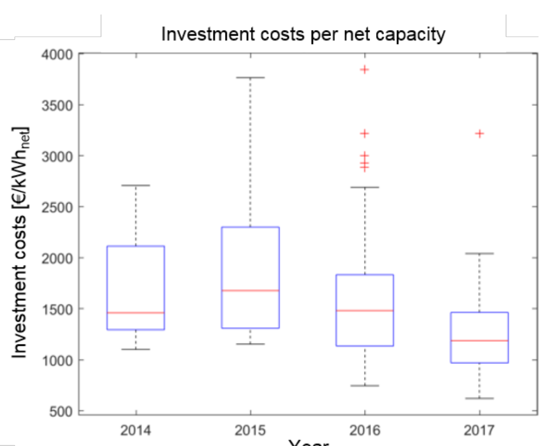

Figure 1: Development of battery investment costs
Source: C.A.R.M.E.N e.V., own calculation

Figure 1 shows the development of the investment costs for lithium battery storage systems between 2014 and 2017 without installation costs. It can be clearly seen that the battery storage costs for lithium batteries have dropped in this period of time. While the median price in 2014 was still around 1500 €/ kWh, the median price in 2017 was about 1200 €/kWh. However, it is also evident that the price range is relatively broad and that there are also some outliers, especially upwards. One relevant aspect is, that the figure shows system costs. A comparison with other publications can be difficult as often only the costs for battery cells are listed. However, the size dependence of battery costs cannot be derived from Figure 1 and is therefore shown in Figure 2.. Figure 2 and Figure 3 show the specific investment costs for 2017 and the calculated necessary reductions for single family buildings. It turns out that battery storage systems are still far too expensive in 2017 and that the necessary reductions can be as high as 89% considering acutal retail electricity prices of 19c/kWh and feed in remunerations of 3 c/kWh. Depending on the size of the PV system, the necessary reduction in investment costs varies between 73% and 89%. The larger the PV system, the smaller the necessary reduction in investment costs for battery storage systems. In this calculation it was assumed that at least an internal rate of return of 1% is achieved for an energy consumption of 4000 kWh/a. If the annual rate of return is expected to be higher, the costs will have to fall significantly more than this calculated reduction.

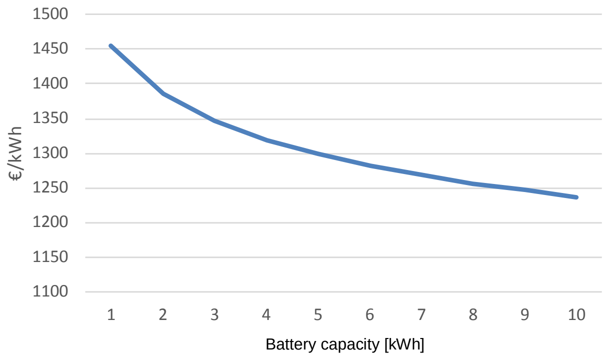

Figure 2: Battery Investment costs 2017
Source: C.A.R.M.E.N e.V., own illustration

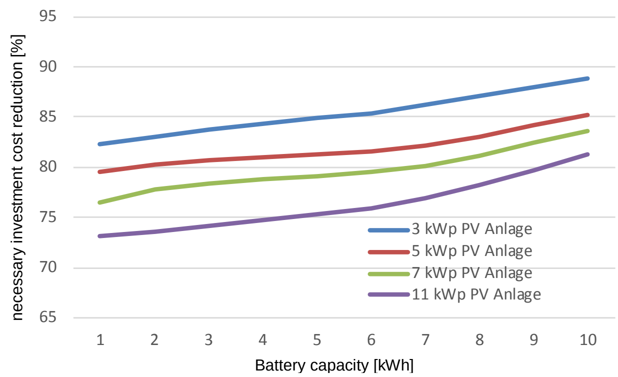

Figure 3: Necessary investment cost reduction for different sizes of PV systems

In recent years, prices for battery storage have dropped significantly. However, the economic viability of battery storages not only depends on the direct investment costs, but also on the calendaric life, the cycle life, the discharge depth. The efficiency, the charging strategy and the future development of retail electricity prices also has an essential impact on the economic viability 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 also all load peaks of a specific load profile.

Conclusions

Due to technological learning and alternative retail energy tariffs, battery storages can become an economic attractive solution for decentralized use. However, there is still a relatively long way to go, especially for single family buildings, as we have already shown. In the final version of this paper, we will also discuss the economies of scale of battery storages in a multi-family building and in the context of energy communities. Due to decreasing specific investment costs, different load profiles and an optimized operation it will be possible that battery storage systems will show an even higher benefit and the investment costs can be correspondingly higher.

References

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