Short report of the research project

Decentralized, modular power stores to increase the self-sufficiency of on-site generated electricity in EnergyPLUS buildings

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FORSCHUNGSINITIATIVE Zukunft BAU

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Institute for Building Services and Energy Design

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Editing: Dipl.-Ing. F. Bockelmann

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1. MOTIVATION AND INITIAL SITUIATION

It is an indisputable fact, that power stores will play a key role concerning the energy system transformation. However, the research question arises, which scope the discussion of the demand, competitive solutions and deployment scenarios should have. Storage systems are essential components to ensure the balance and decoupling between supply and demand of electricity. By using solar batteries and an energy management system, for example peak loads of the grid, caused by building-integrated photovoltaic systems, can be reduced, which results in an important contribution to a smart grid.

2. GOAL AND SCOPE DEFINITION OF THE RESEARCH PROJECT

Past projects outlined, that previous approaches to increase the self sufficiency quota of on-site generated PV-electricity (power-to-heat) are not entirely suitable for all application areas and time periods of the year. Therefore, power stores in small decentralized units could be applied to accomplish the important task of a significant increase of consumption of self generated electricity in EnergyPLUS buildings.

Besides the annual surplus of electrical energy the increase of the on-site generated PV-electricity, by implementation of an load management and the use of thermal building mass, is evaluated in the two-storied residential building Berghalde, which was constructed, based on the the EnergyPLUS standard in October 2010. Furthermore, it should be focussed on the integration and utilisation of solar batteries to enhance the directly consumed electricity from photovoltaic system of approx. 30 % (Mean value of the last years of operation) to a higher level > 50 %. Economic analyses and the application of batteries in the considered residential building under real conditions shall be used to develop a marketable and adaptable implementation of storage batteries into the concept beyond the scientific approach. Another objective of the research project is, to advance a sufficient comparable elaboration for electrical storage systems towards thermal alternatives with respect to technical, economical and ecological requirements for the EnergyPLUS concept. In this context, the costs among the integration of solar batteries are analysed and the various typologies of storage systems and their application are evaluated with respect to assess the reproducibility for future construction projects, including existing buildings with PV systems.

Another focal point of the research project is the consideration of existing plants whose contracts for feed-in tariffs will expire in the coming years. The lion share of these plants feed-in the regenerative generated electricity into the public grid. This circumstance has to be shifted to an increase of self-consumption by developing and elaborating different new concepts. Great potential is seen for the integration of electricity storage systems as an essential component for the use of self-generated electricity.

3. CONCLUSION

The results of the research project prove that both the use of PV systems and electrical storage systems are essential building modules for achieving the goal of a nearly climate-neutral building stock by 2050 as defined by the Federal Government. As part of an energy concept with a heat pump as a heat generator, the electrical energy of the installed PV systems can be used to primary cover the different local heat and power requirements, save fossil energy resources and reduce CO_2-emissions.

Buildings will increasingly operate not only as consumers, but also as energy producers and storage as well as network service providers. These buildings constitute as active components in smart grids. However, it is necessary that the decentralized energy producers, the electrical storage systems as well as the consumers work together in harness, are coordinated and have been properly dimensioned and designed in advance.

4. BENCHMARK DATA

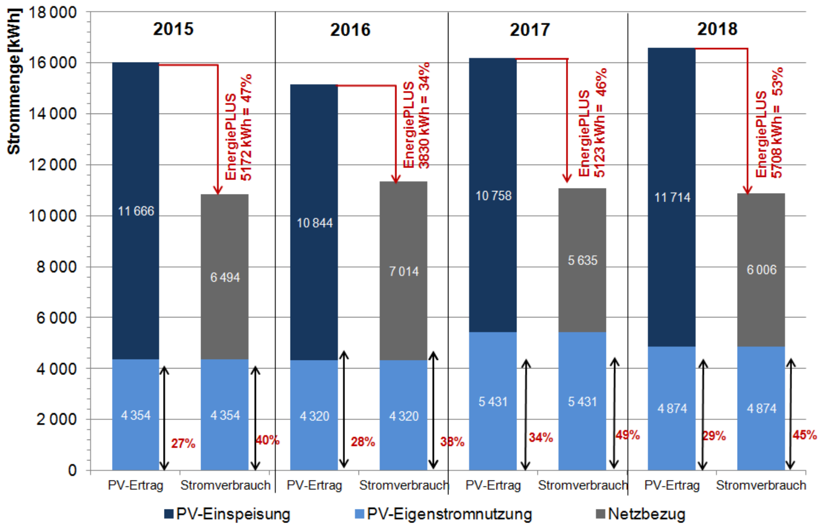
Short title

Electrical storage systems in EnergyPLUS buildings

Researchers and project management:

Project management:	Univ. - Prof. Dr. – Ing. M. Norbert Fisch Dipl.- Ing. Arch. Thomas Wilken
Editing:	Dipl.- Ing. F. Bockelmann
Total cost	194.541,00 €
Share of federal subsidy	136.141,00 €
Project duration	01.09.2016 – 31.12.2018 (24+4 months)

5. IMAGES / ILLUSTRATIONS



picture 1: Single family house Berghalde: Annual balance of final energy and own use shares in comparison (2015 to 2018)

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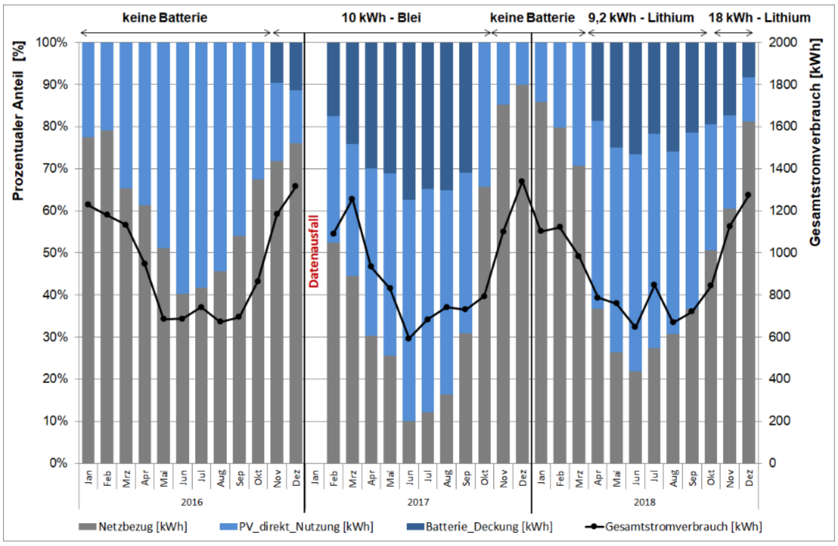


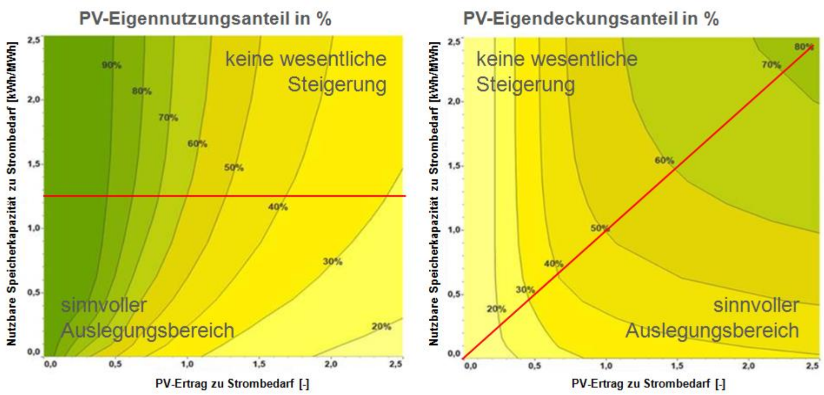
picture 2: Single family house Berghalde: monthly shares of power consumption by PV, battery and grid, 2016 to 2018

Bilddateiname: Monatliche_Deckungsanteile.bmp

PV-Anlage mit 15 kWp und elektrischen Speicher mit 27 kWh$_{Nenn}$	Eigenstrom-nutzung	statische Beladung	dynamische Beladung
Eigennutzungsanteil	54,4 %	52,5 % - 2 %	47,8 % - 6 %
Deckungsanteil	61,2 %	59,4 % - 2 %	55,2 % - 6 %
Netzeinspeisung / Einspeisespitzen	70 – 80 %	65 – 75 %	60 – 70 %
Netzbezug	4,41 MWh/a	4,61 MWh/a + 5 %	5,10 MWh/a + 16 %
Netzdienlichkeit			

picture 3: Influence of battery charging strategies on PV own use and PV ratio (according to Kley)

Bilddateiname: Einfluss_Batterieladung.bmp



picture 4: Design diagrams: PV self consumption share and solar fraction of single family houses (with e-mobility) [Kley]

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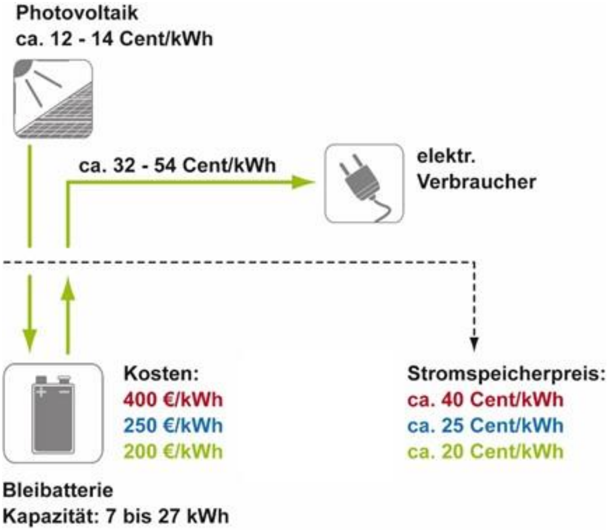

picture 5: Economic evaluation of batteries [Kley]
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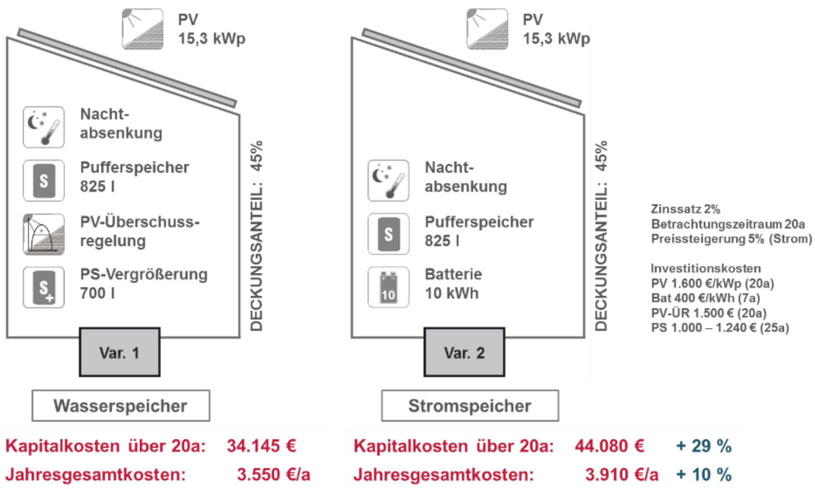

picture 6: Cost comparison between buffer extension and battery [Kley]
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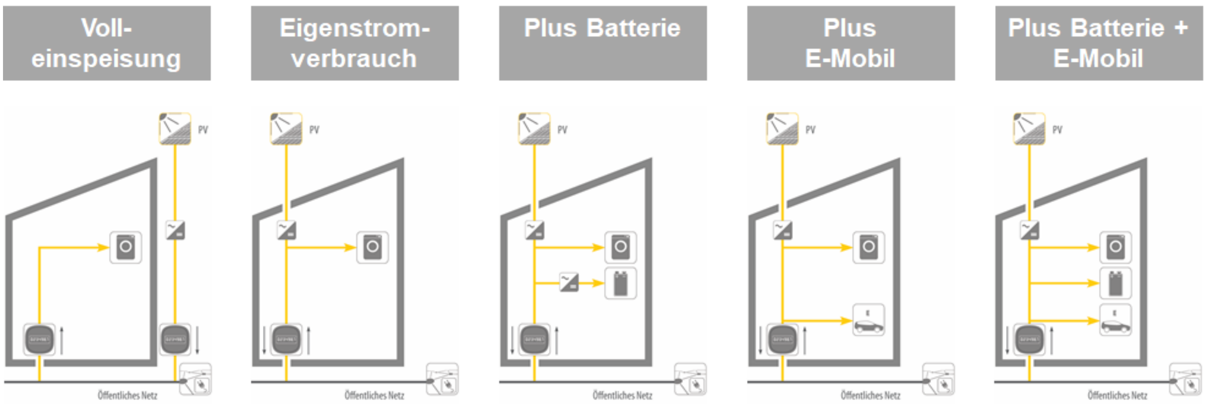

picture 7: Concept variants for existing systems
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