

Fraunhofer-Institut für Bauphysik IBP

Forschung, Entwicklung,
Demonstration und Beratung auf
den Gebieten der Bauphysik

Zulassung neuer Baustoffe,
Bauteile und Bauarten

Bauaufsichtlich anerkannte Stelle für
Prüfung, Überwachung und Zertifizierung

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Practical comparison of different storage strategies for plus-energy houses in exemplary housing estates - Living Lab plus-energy settlement Wuppertal

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Contents

1	Title	3
2	Initial situation	3
3	Subject of the research project	3
4	Conclusion	4
5	Basic information	5

1 Title

Title: "Practical comparison of different storage strategies for plus-energy houses in exemplary housing estates (Living Lab plus-energy settlement Wuppertal)"

2 Initial situation

So far, 'efficiency house plus' projects focused on the decentralized approach (one battery storage per house) in response to modified feed-in tariffs. In districts, however, the cost efficiency of these individual concepts is on trial. City districts require solutions for economically optimal storage concepts to maximize on-site self-consumption of locally generated energy in 'efficiency house plus' buildings and to relieve power grid stress.

3 Subject of the research project

On its 18,000 m²/ 193,750 sq. ft. site at Wuppertal, the FertighausWelt Wuppertal presents 19 exemplary, innovative residential buildings made by German manufacturers of prefabricated homes. Here, homes of different styles were built, all of which comply with the 'efficiency house plus' standard as defined by BMUB (i.e. the German Federal Ministry for Environment, Nature Conservation and Nuclear Safety). All homes in this residential district are part of a network, sharing a centralized battery storage, which makes this estate the first sustainable, climate-neutral city quarter achieving the 'efficiency house plus' standard. In addition, an information and event building and the settlement's infrastructure (settlement lighting, information pylon, etc.) have been integrated, to which renewable electricity is supplied from the other buildings. In this way it is also possible to examine the networking of various types of buildings featuring different usage scenarios. Besides, another 6 non-network 'efficiency house plus' homes can be subjected to detailed measurements at the FertighausWelt Köln site in Cologne. In three of these buildings, decentralized electricity storage units of different sizes were installed, while three homes feed surplus electricity directly into the public grid. This situation allows to compare solutions featuring district-centralized battery storage with decentralized battery storage units.

In the scope of the research project "Practical comparison of different storage strategies for plus energy buildings in exemplary residential districts - Living Lab plus-energy settlement Wuppertal", which receives funding from the German Fed. Institute for Research on Building, Urban Affairs and Spatial Development's research initiative "Future Building", numerical and experimental investigations are carried out under practical boundary conditions in order to identify potential synergies that may be achieved by interconnecting 'efficiency house plus' buildings on a district level. The first year of the 2-year monitoring phase will be dedicated to analyzing the impact of networking the 'efficiency house plus' buildings among each other and with the information and events building. In the second year, an additional central battery storage unit for the

district will be integrated into the district grid. The direct comparison of the different supply concepts implemented at the FertighausWelt estates at Wuppertal and Cologne allows to immediately compare the degrees of self-consumption implied by the different approaches. Subsequently, statements regarding the cost-effectiveness of the storage approaches can be derived.

Besides performing measurements, a numerical analysis is being conducted to determine the potential held by further enhancing the district-central storage capacity. Moreover, several options are explored for increasing the energy potential still further by implementing active energy management with the public utility grid. This is done by evaluating different supply variants with the aim to identify strategies to achieve maximum cost efficiency and high savings in primary energy. Starting with conventional decentralized solutions, the supply variants will be further advanced towards innovative, centralized district-level concepts.

The results obtained from this research project are intended to help reduce the costs for the 'efficiency house plus' energy concepts as well as reduce electricity costs by raising the share of self-generated electricity. This will contribute to a more economical market launch of practical approaches and relieve the public grids.

In this context, the FertighausWelt Wuppertal with its district-like Living Lab estate of plus-energy buildings is an ideal disseminator to transfer the findings from the scientific investigations into general building practice. Since the project was launched in 2016, more than 100,000 visitors collected detailed information on the project at FertighausWelt Wuppertal. Moreover, the experience gained from the investigations is intensively discussed with all the exhibitors of prefab homes, thus ensuring that the results of the project can be immediately taken into account when advancing and optimizing the respective building concepts.

4 Conclusion

Currently only a few storage concepts pay off though energy benefits are actually achieved, e.g. by increasing the own consumption of PV electricity. To render district solutions financially attractive for users, two conditions should be met in future:

- A network including only plus-energy buildings (with/without quarter electricity storage) is currently not economically feasible as purchase quantities are too small. Settlements should integrate other buildings with different load profiles.
- As the combination of several PV systems deteriorates the conditions for electricity feed-in and own consumption, the EEG (Germany's Renewable Energy Sources Act) should be amended.

5 Basic information

Short title:	Living Lab Plusenergiesiedlung Wuppertal/ Living Lab plus-energy settlement Wuppertal
Project management:	Hans Erhorn, Dipl.-Ing. (Fraunhofer IBP)
Total cost:	€ 580,539.54
Share of federal subsidy:	€ 406,377.67
Project timeline:	29 months



Figure 1:
Aerial photo FertighausWelt Wuppertal.

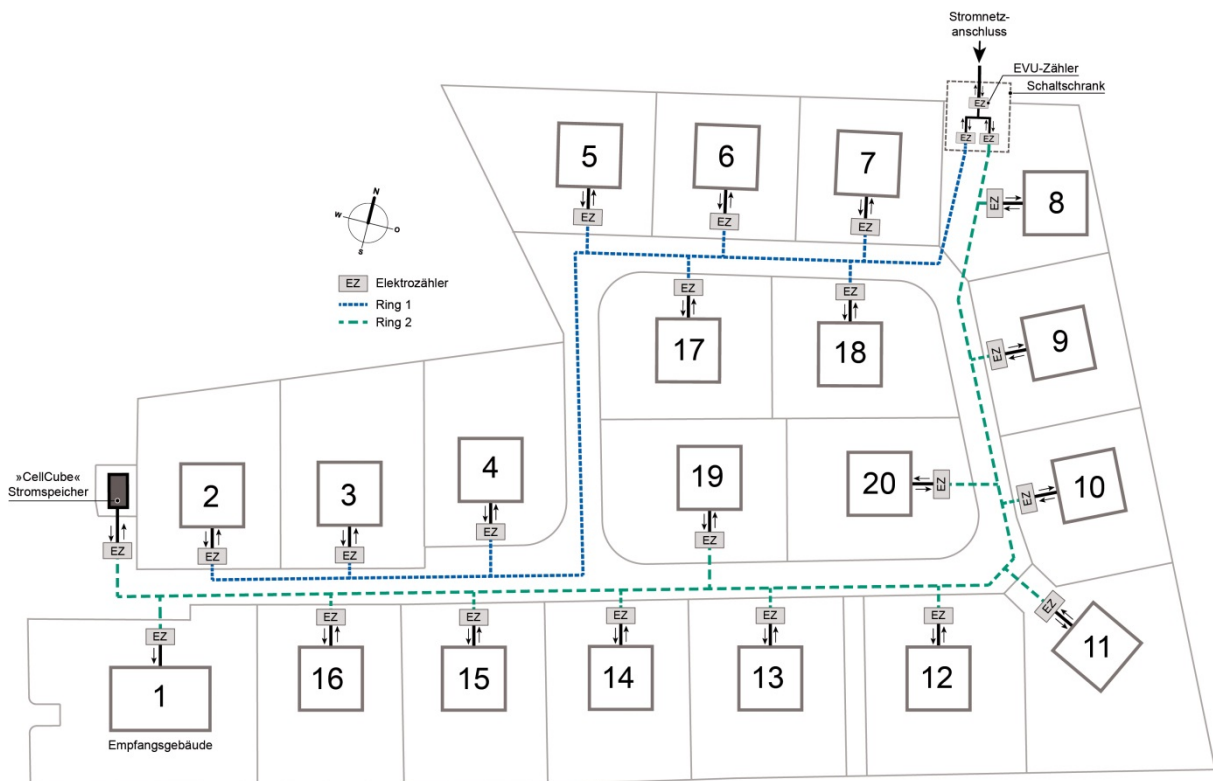


Figure 2:
Settlement structure FertighausWelt Wuppertal.

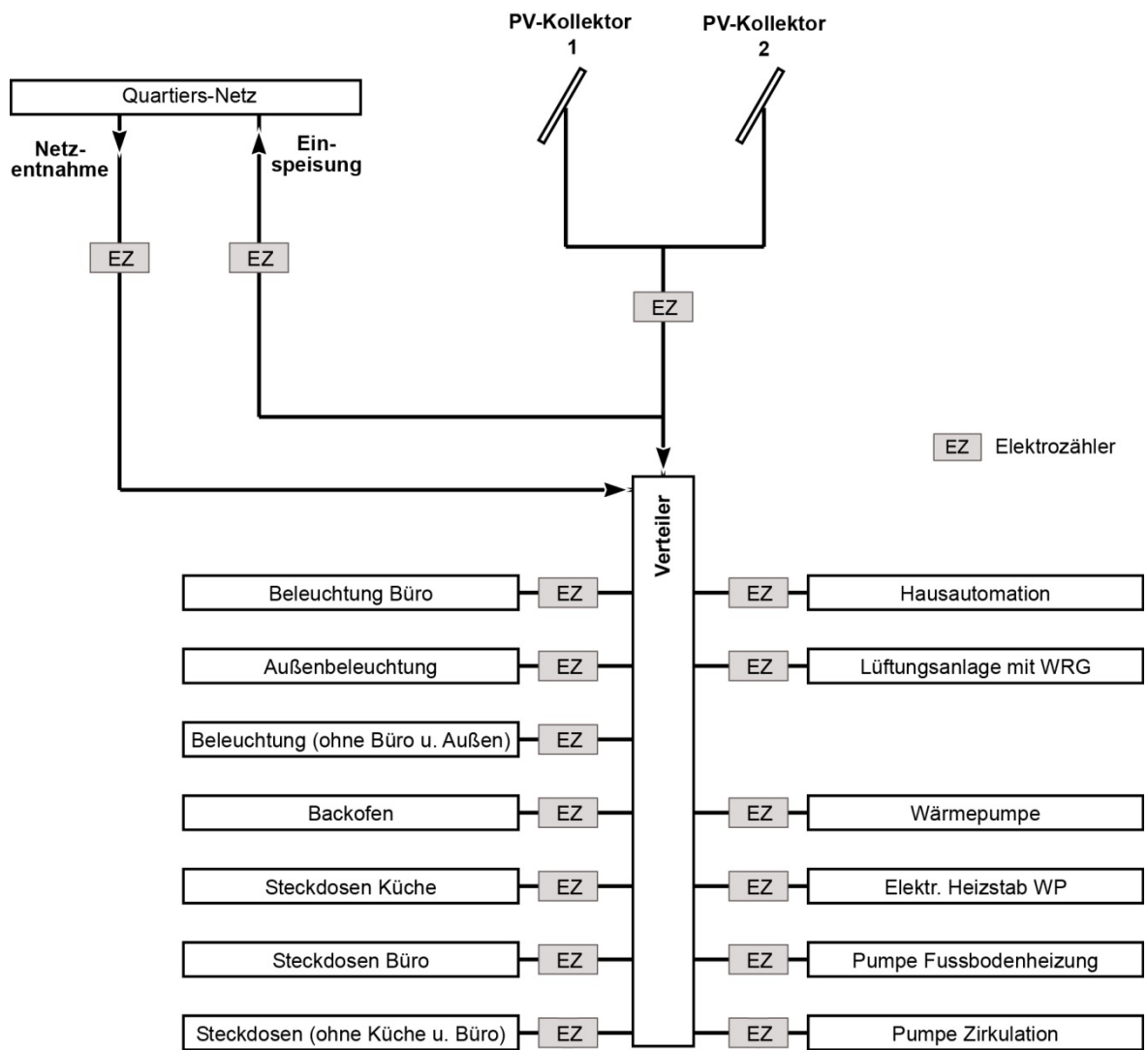


Figure 3:
Measuring scheme for electrical supply.

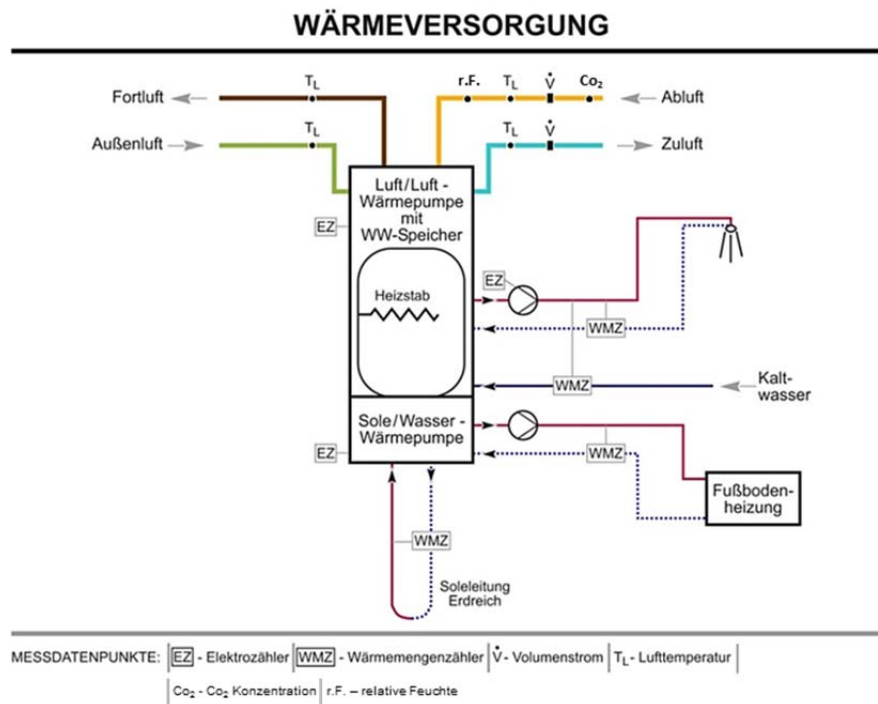


Figure 4:
Exemplary measuring scheme for heat supply and ventilation system.

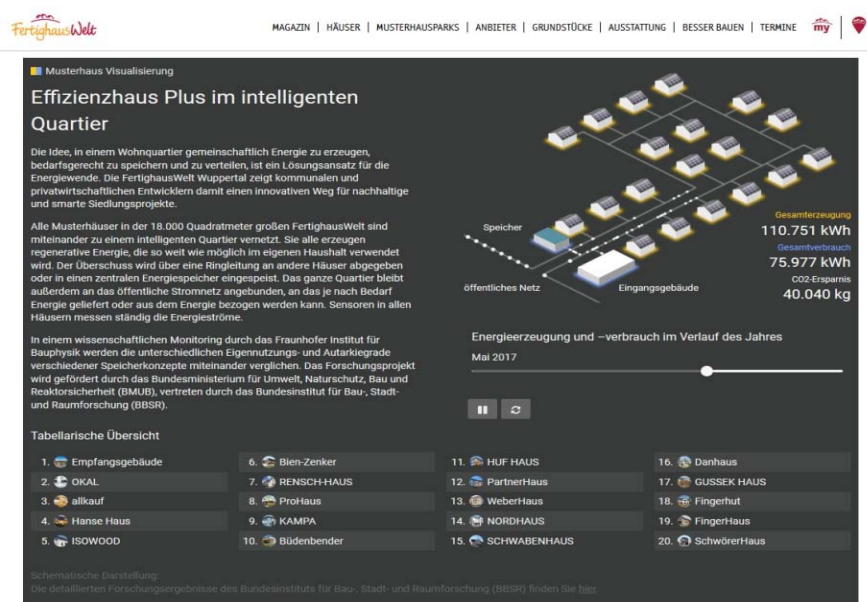


Figure 5:
Interactive visualization of the Living Lab.

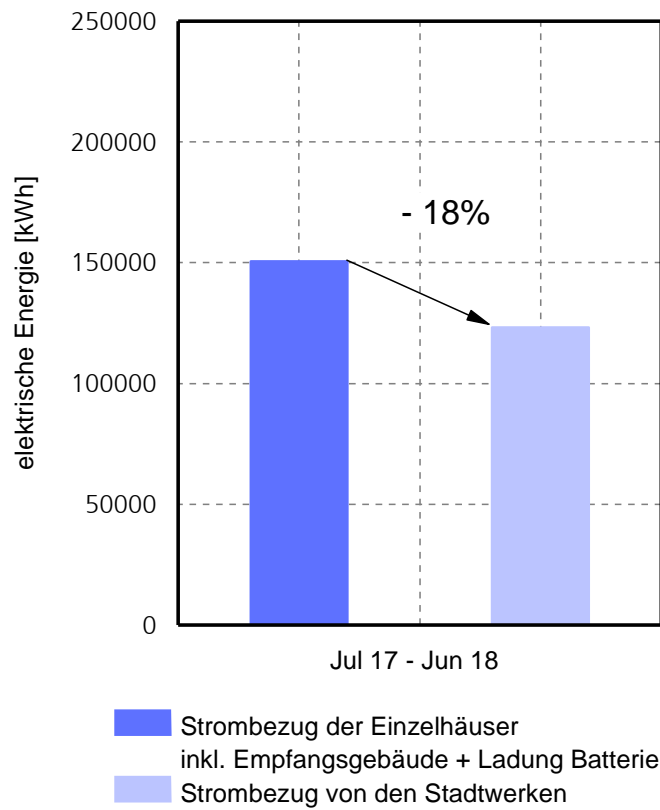


Figure 6:
Electricity displacement between the individual buildings of the exhibition area (FertighausWelt Wuppertal); Period July 2017 till June 2018.