Leipzig Model to integrate PV electricity into the general power supply

Partial results of the tenant electricity study conducted by WSL Wohnen Service Leipzig GmbH

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About SPARCS

Sustainable energy Positive & zero cARbon CommunitieS demonstrates and validates technically and socioeconomically viable and replicable, innovative solutions for rolling out smart, integrated positive energy systems for the transition to a citizen centred zero carbon & resource efficient economy. SPARCS facilitates the participation of buildings to the energy market enabling new services and a virtual power plant concept, creating VirtualPositiveEnergy communities as energy democratic playground (positive energy districts can exchange energy with energy entities located outside the district). Seven cities will demonstrate 100+ actions turning buildings, blocks, and districts into energy prosumers. Impacts span economic growth, improved quality of life, and environmental benefits towards the EC policy framework for climate and energy, the SET plan and UN Sustainable Development goals. SPARCS co-creation brings together citizens, companies, research organisations, city planning and decision making entities, transforming cities to carbon-free inclusive communities. Lighthouse cities Espoo (FI) and Leipzig (DE) implement large demonstrations. Fellow cities Reykjavik (IS), Maia (PT), Lviv (UA), Kifissia (EL) and Kladno (CZ) prepare replication with hands-on feasibility studies. SPARCS identifies bankable actions to accelerate market uptake, pioneers innovative, exploitable governance and business models boosting the transformation processes, joint procurement procedures and citizen engaging mechanisms in an overarching city planning instrument towards the bold City Vision 2050. SPARCS engages 30 partners from 8 EU Member States (FI, DE, PT, CY, EL, BE, CZ, IT) and 2 non-EU countries (UA, IS), representing key stakeholders within the value chain of urban challenges and smart, sustainable cities bringing together three distinct but also overlapping knowledge areas: (i) City Energy Systems, (ii) ICT and Interoperability, (iii) Business Innovation and Market Knowledge.

Partners

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1. Introduction

Rising electricity prices and climate change pose major challenges for the energy supply. The German government has set itself the target of reducing CO2 emissions by 55 % by 2030 and by 80 to 95 % by 2050 compared to 1990. Sustainable energy supply through renewable energies and energy efficiency plays a key role in this.

The expansion of renewable energy for tenants in particular is an important part of this strategy. One possible sustainable and efficient response to rising electricity prices is the use of solar energy on residential buildings to produce electricity. While photovoltaic systems (PV systems) on roof surfaces are primarily suitable for homeowners, as they can benefit from solar power due to the self-supply privilege, the majority of the population lives in apartment blocks and cannot benefit from this. They generally only have the option of paying attention to energy consumption and efficiency.

In order to find possible solutions, WSL Wohnen & Service Leipzig GmbH carried out a study on tenant electricity, a model with which the electricity generated on site can also be used by the resident tenants. As part of the SPARCS project, which aims to transform existing districts in Leipzig into positive energy districts (PEDs), the Leipzig model was developed, which will be presented in more detail in this report. The Leipzig model is a balance sheet model that aims to integrate PV electricity as a volume component into the general electricity supply through an intermediate virtual power plant.

2. Description of the German tenant electricity model

Tenant electricity is electricity that is generated from PV systems on the roof of a residential building and supplied directly to the end consumers on site without being routed through the public distribution grid. This concept is based on the idea of using locally generated energy locally, which minimises transmission losses and reduces the load on the grid infrastructure. As the electricity does not flow through the public grid, certain cost components such as grid-side levies, electricity tax and grid charges are eliminated, which lowers the labour price for this electricity.

For practical implementation, electricity suppliers and end consumers, usually tenants, must conclude a supply contract. Tenant electricity is regulated by the German Renewable Energy Sources Act *[Erneuerbare-Energien-Gesetz]* (EEG) and the German Energy Industry Act.

The EEG stipulates that tenant electricity must be at least 10 % cheaper than the standard local basic supply in order to receive subsidies such as the tenant electricity surcharge. This subsidy supports the expansion and use of locally generated, renewable electricity and is intended to incentivise investment in PV systems. In addition, tenant electricity contributes to achieving climate targets by improving the local carbon footprint and increasing the share of renewable energies in total electricity consumption.

3. CURRENT STATUS AND EVALUATION OF THE MODEL

This chapter describes the current status of the existing tenant electricity model and assesses the challenges for housing companies in implementing the German model.

Legal framework

The current German government, made up of the SPD, Bündnis90/Die Grünen and the FDP, has decided on legal changes in favour of the energy transition. With the "Easter package" in May 2022, measures were adopted to accelerate the expansion of renewable energies in order to achieve the goals of the Paris Agreement. The EEG levy was reduced to 0 cents per kWh as of 1 July 2022 and a new law on energy financing was passed, which came into force in 2023. In July 2022, the EEG was revised again (EEG 2023) with the aim of achieving almost greenhouse gas-neutral electricity generation by 2035 and covering 80 % of electricity consumption from renewable energies by 2030.

Challenges with the introduction of tenant electricity projects

Despite the advantages, there are many regulatory hurdles to implementing tenant electricity projects in Germany. The legal framework varies greatly between the federal states, regions and local authorities. This creates a complex and often opaque landscape that makes it difficult for landlords to develop clear guidelines for action. Liability issues in the event of damage or accidents can deter landlords from investing. The profitability of tenant electricity projects is not always guaranteed, as it depends on the location, local energy prices, availability of subsidies and the structure of the tenant electricity model.

The initial investment in renewable energy infrastructure, particularly solar panels, can be a financial hurdle for homeowners and landlords. The cost of purchasing, installing and maintaining such technologies must be weighed against the long-term benefits and savings. Funding programmes and subsidies play a crucial role in this process. Landlords may be reluctant to invest in technologies that offer long-term environmental benefits but may not promise an immediate and significant return on investment. Billing models for tenant electricity are complex and can be met with resistance: Although the model involves little effort on the part of tenants, the change in regulation is complex for system operators, as they are automatically considered full suppliers. This means that, among other things, grid connection, metering equipment and the metering concept must be taken into account.

4. Possible solution: the Leipzig model

The findings from the WSL's tenant electricity study were further developed into the Leipzig model in the SPARCS project. The SPARCS project is dedicated to the development and testing of measures to transform neighbourhoods into PEDs, *i*.e. energy-efficient and flexible districts that produce zero net greenhouse gas emissions.

The Leipzig model is being further developed beyond the SPARCS project. The initial situation was that a PV system cannot be installed on every roof due to the roof orientation, roof pitch, statics, condition or regulations, for example regarding monument protection. The tenants for whom installation is not possible would therefore be at a clear disadvantage, resulting in social injustice.

In particular, the Leipziger Wohnungs- und Baugenossenschaft (LWB), another partner in the SPARCS project, has focussed on social equality in terms of housing. For this reason, the Leipzig model was developed, which summarises the electricity generated from renewable energies in a virtual power plant in order to then be able to make green electricity available to all tenants by using the electricity generated for the general electricity supply. This reduces the cost of general electricity for all tenants, while at the same time enabling them to use green electricity. In the future, this model can be used to increase the supply of green general electricity by integrating heat pumps.

The diagram below (see Figure 1) illustrates how the model works. The virtual power plant connects all decentralised PV systems with each other and distributes the electricity to all LWF buildings. The electricity generated is used for general electricity. General electricity describes the electricity for communally used parts of the building such as stairwell lighting and pump electricity.

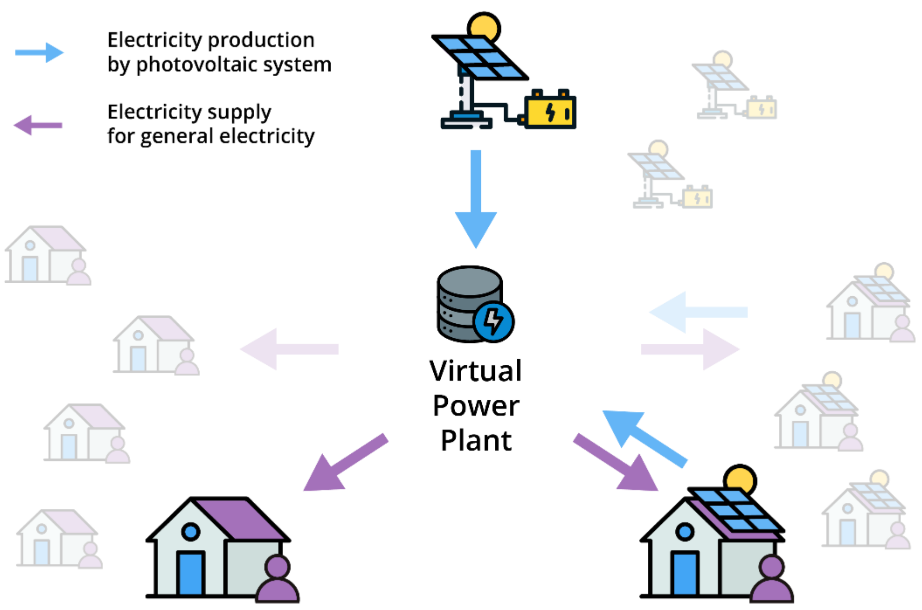

Figure 1 Diagram of electricity PV system / Customer – virtual power plant (source: WSL)

The model aims to utilise the electricity generated from PV systems as an integral part of the general electricity supply for housing companies. Three central players are involved:

- the owner and operator of the PV systems, who is also the producer of the energy generated
- the housing company as the main consumer, which comprises all the points of purchase of the general electricity
- a service provider or electricity supplier, which purchases the PV electricity and distributes it to the various points of purchase of the housing company and organises the remaining electricity.

In many cases, the housing company itself can be the owner and operator of the PV systems. These systems are then organised in a virtual power plant, which means that 100 % of the electricity generated and fed into the grid by the PV systems is purchased by the service provider and distributed to the housing company's various consumption points. These consumption points can include offices, for example, which are supplied independently.

The implementation of this model is simplified by a joint contract between the three parties involved, which regulates the financial framework for the electricity to be sold, which the buildings receive as general electricity. The service provider or electricity supplier assumes responsibility for the distribution and billing of the energy volumes. This model is very similar to the concept of the Power Purchase Agreement, but also utilises elements of the supply chain model by establishing a direct link to the end consumer.

The advantages of the Leipzig model for housing companies are manifold. Firstly, the roofs of the properties actively contribute to the energy transition and climate protection by producing renewable electricity. This has a positive impact on the fulfilment of ESG criteria (environmental, social, governance) and improves the valuation of the properties for lending and credit purposes.

The CO2-free electricity generated by the PV systems is not only actively used, but also distributed in a socially responsible manner at all of the housing company's locations, even those that are unsuitable for PV systems. This means that all tenants benefit indirectly from the PV systems, as the electricity flows into the general electricity supply and is therefore included in the service charge bill.

Another key advantage of the Leipzig model is the stabilisation of operating costs for general electricity. The electricity generation costs of the PV systems remain relatively stable over a period of 20 years, as they are largely independent of fluctuations on the spot market and other market influences. This cost stability results from the investments made in the systems, which guarantee predictable and secure yields over the long term. Within a radius of five kilometres between generation and consumption, there is no electricity tax, which provides additional financial relief.

In addition, the guarantee of origin for the PV electricity, which proves that it is green energy, is easy to provide. This is an important aspect for the transparency and credibility of the model vis-à-vis tenants and other stakeholders. Finally, the model offers predictable costs and revenues for both consumers and producers, ensuring a long-term and sustainable energy supply.

5. Conclusion

Tenant electricity offers a sustainable and effective way of counteracting rising electricity prices and contributing to the energy transition at the same time. Despite the existing challenges and regulatory hurdles, the Leipzig model shows that an effective and sustainable use of PV electricity in the general electricity supply is possible through innovative approaches and cooperation between different players.

This model could serve as an example for other German cities and housing companies that want to pursue similar goals and contribute to achieving national and international climate targets. By combining technical, financial and organisational solutions, the Leipzig model offers a comprehensive response to the challenges of the energy transition in urban areas.

The virtual power plant means that although the sustainably generated electricity is only used as general electricity, it is accessible to all households in the existing area. This enables all tenants to participate in the energy transition. This contributes to PED transformations, as it not only pursues the goal of climate neutrality, but also implements aspects of social justice. Models such as the Leipzig model can play a key role in the energy transition in the future due to their high replication potential.

6. ABBREVIATIONS

EEG: Erneuerbare-Energien-Gesetz (German Renewable Energy Sources Act)

LWB: Leipziger Wohnungs- und Baugenossenschaft

PED: Positive Energy District

PV: Photovoltaic

WSL: Wohnen & Service Leipzig GmbH