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Spatial Analysis of Residential Combined Photovoltaic and Battery Potential: Case Study Utrecht, the Netherlands

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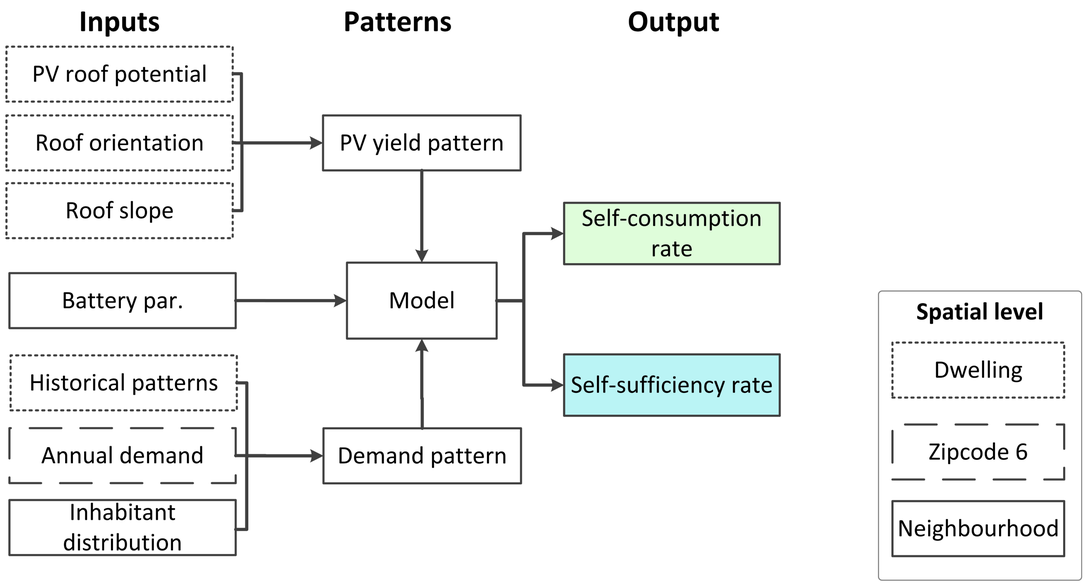
Introduction

This study aims to **analyse and identify the spatial potential of combined PV and battery systems** at neighbourhood level. We use the city of Utrecht in the Netherlands as case study to demonstrate the methodology. PV potential, demand data and socio-economic factors like household composition and house values were used to explore the self-sufficiency rates for 88 different neighbourhoods.

Method

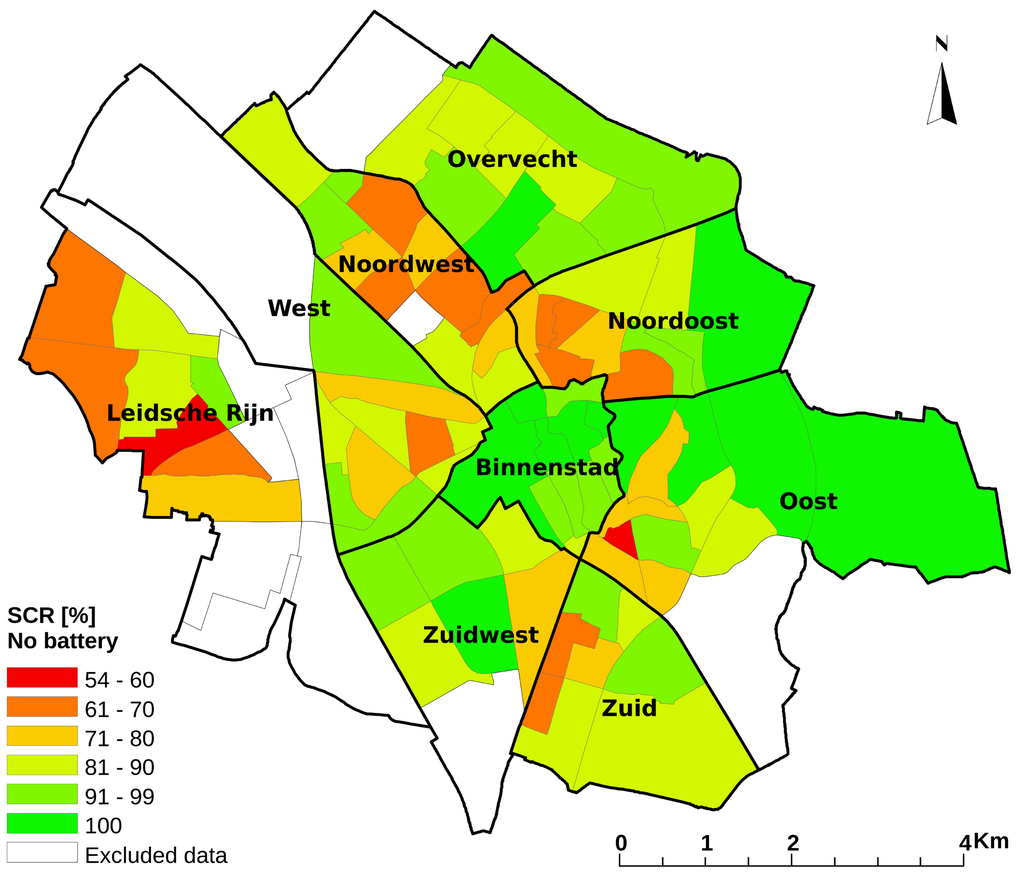


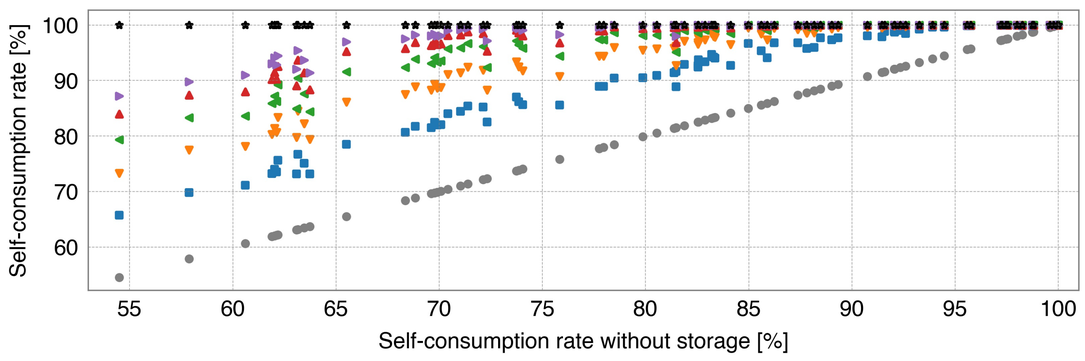
The self-consumption rate is defined as the ratio between the direct consumed electricity and the total produced electricity. The self-sufficiency rate is defined as the ratio between the direct consumed electricity and the total consumed electricity. PV potential analyses and used battery storage algorithms are explained in previous studies [1,2].

Conclusions

- Large difference in PV potential and energy consumption between neighbourhood
- High self-consumption values are indicated in most neighbourhoods, representing limited PV potential.
- Net import of electricity is required for each neighbourhood under the full PV roof potential.
- Areas identified were relatively small battery capacities increase self-sufficiency.
- Neighbourhoods which could act as potential battery sites for providing electricity to adjacent neighbourhoods are indicated.
- The obtained knowledge is valuable for local governments and developed method can be easily adapted to other areas.
- Energy storage policies should focus on neighbourhoods with high PV potential and relative low energy consumption

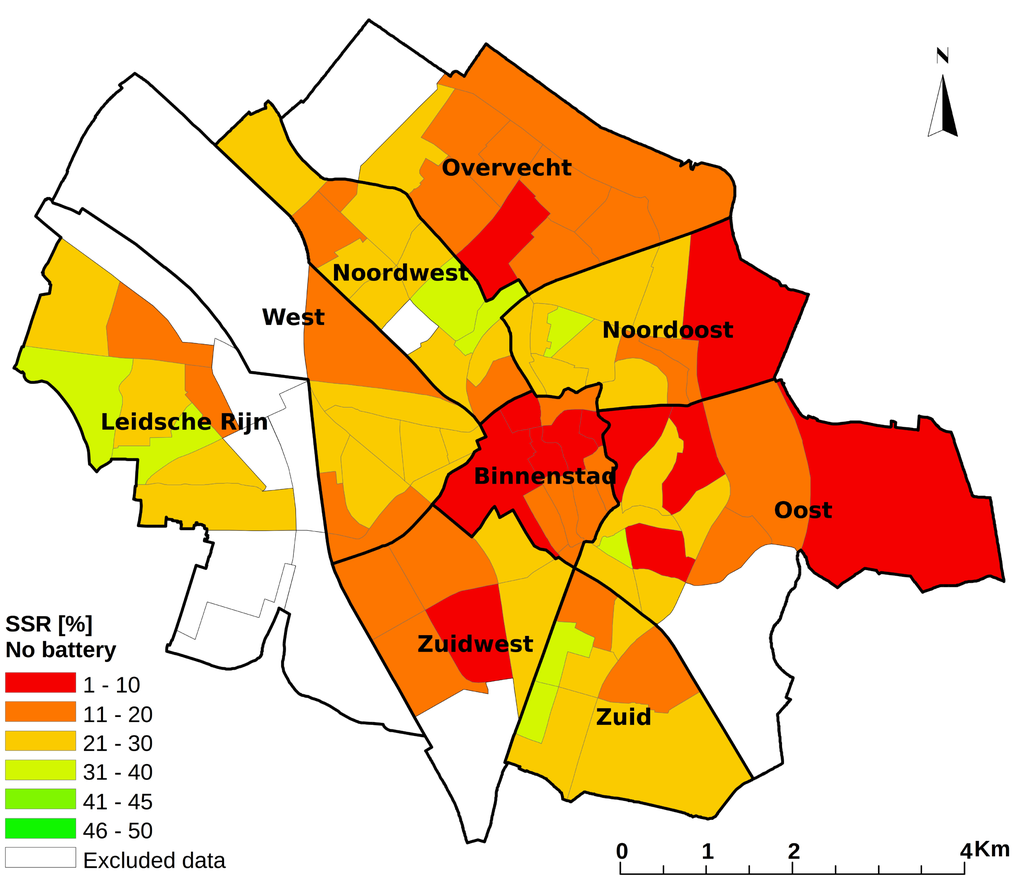
Self-consumption rate





Color-coded potential self-consumption rate (SCR) **(top)** and influence of battery capacities (**bottom**) for each neighbourhood. The white areas are neighborhoods containing less than 100 households, and are excluded. The battery capacity was normalized with the number of grid connections per neighbourhood.

Self-sufficiency rate



Color-coded potential self-sufficiency rate (SSR) **(top)** and influence of battery capacities (**bottom**) for each neighbourhood. The white areas are neighborhoods containing less than 100 households, and are excluded. The battery capacity was normalized with the number of grid connections per neighbourhood.

[1] B. Kausika, O. Dolla, W. Folkerts, B. Siebenga, P. Hermans, and W. van Sark, "Bottom-up analysis of the solar photovoltaic potential for a city in the Netherlands - A working model for calculating the potential using high resolution LiDAR data," in 2015 International Conference on Smart Cities and Green ICT Systems (SMARTGREENS), May 2015, pp. 1–7.
[2] G. Litjens, W. van Sark, and E. Worrell, "On the influence of electricity demand patterns, battery storage and PV system design on PV self-consumption and grid interaction," in 2016 IEEE 43rd Photovoltaic Specialists Conference (PVSC), June 2016, pp. 2021– 2024.