

Open data for sustainable energy infrastructure in cities - Insights from FlexiGIS

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Research Overview

FlexiGIS is an open source GIS-based platform for modeling energy systems and flexibility options in urban areas.

- It generates datasets of the urban energy infrastructure, simulates consumption and generation and optimizes local energy systems.
- FlexiGIS provides insights into the planning of sustainable future urban energy systems using solely open datasets
- A central component is an interactive database used by the entire platform
- All used datasets, tools, simplifications and assumptions are open

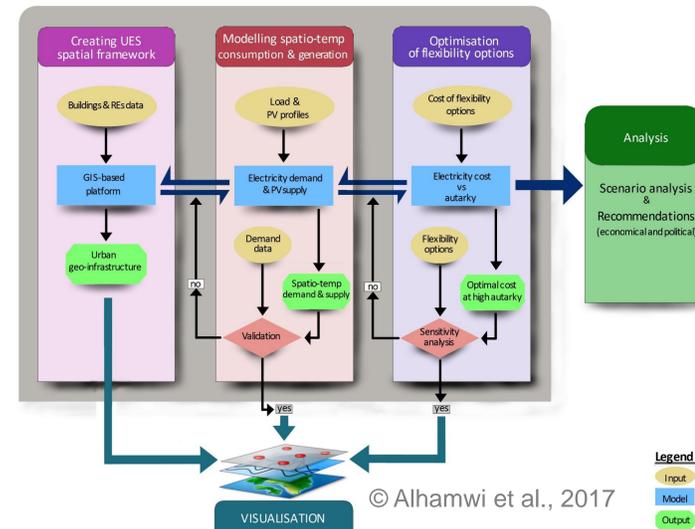
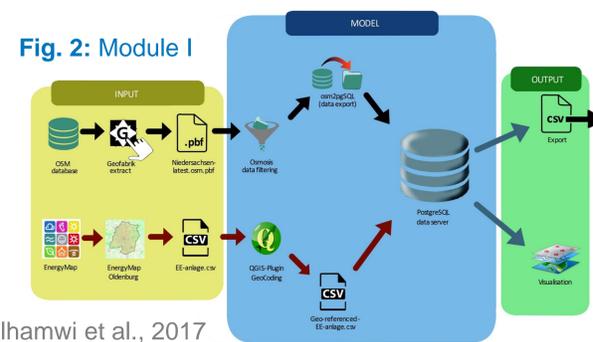


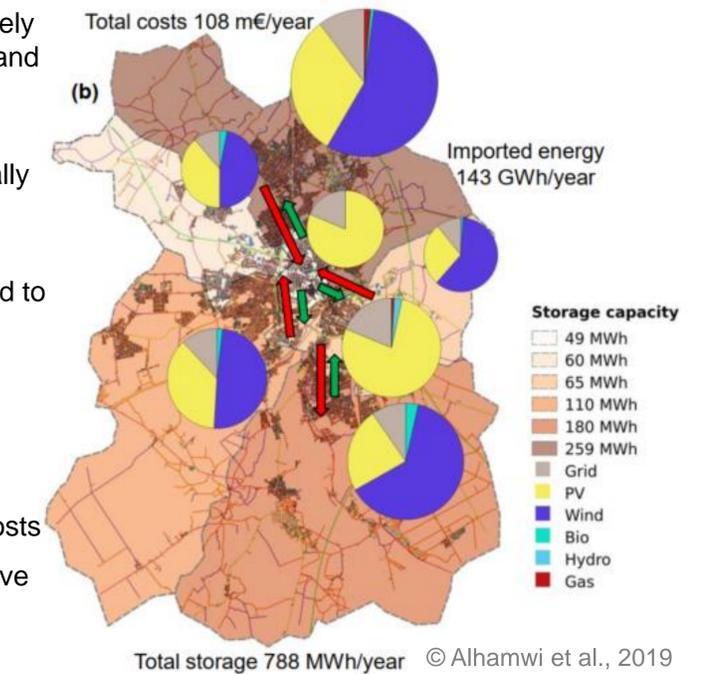
Fig. 1: FlexiGIS Platform outline

FlexiGIS model components

- **Spatial urban energy system platform:** establishes urban energy infrastructure. It extracts, acquires and processes urban geo-referenced data extracted from OpenStreetMap datasets.
- **Modeling urban energy requirements:** simulates urban energy requirements. The spatio-temporal demand and supply from PV and wind are modeled.
- **Flexibilisation optimisation:** the spatial-temporal generated datasets will be used by the *urbs* model as inputs to the linear optimisation problem.



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Total storage 788 MWh/year © Alhamwi et al., 2019

Fig. 4: For a "Future" scenario in Oldenburg: power generation mix and storage configurations in each district.

Results

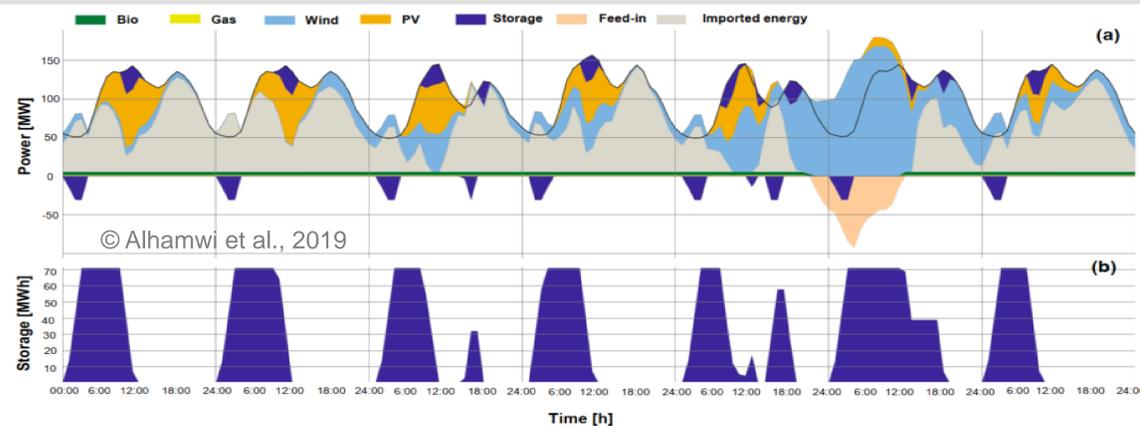


Fig. 3: In a "Renewable Mix" scenario: (a) time series of demand (black) and supply from available RE sources and (b) the optimal storage at the min. costs resulted from *urbs* in Oldenburg.

Results and key messages

- Using only open source datasets we can effectively replicate the spatial urban energy infrastructure and the temporal distributions of urban energy requirements
- Off-Grid or 100% self-sufficient city is economically unaffordable and technically not realistic
- High renewables share in cities (up to 80%) can reduce the total system costs (by 50%) compared to reference scenario
- "Energy cells" concept lends support to the self-sufficient system but the total system costs increases by 10%
- Open source platforms can be used to create alternative scenarios to reduce overall system costs
- GIS systems were used to allocate the perspective sites for battery storage in urban settings

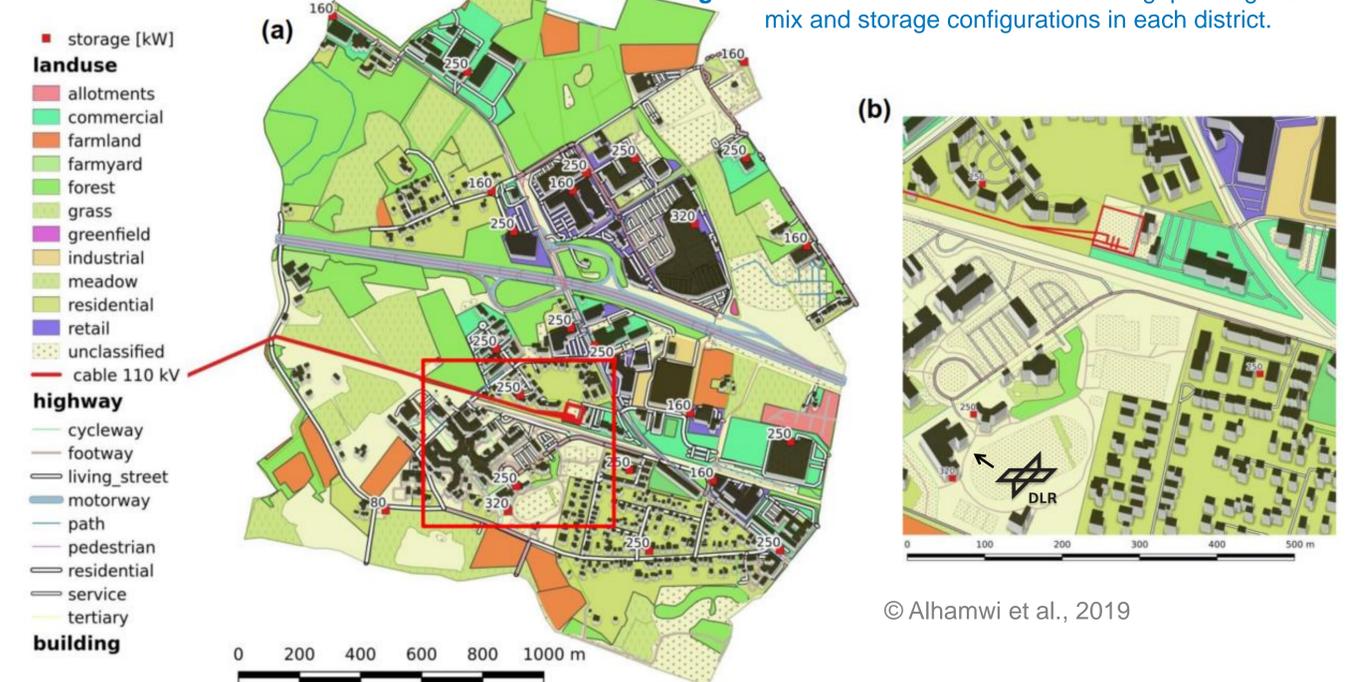


Fig. 5: Urban fabric and allocation of battery storage in (a) Wechloy district in Oldenburg and (b) zoomed area

Outlook

- **FlexiGIS-light:** Modelling electricity demands for urban streetlights
- **FlexiGIS-suite:** Simulation of sector coupling in urban energy systems