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.

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.

Results
- 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.
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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.

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

Fig. 1: FlexiGIS Platform outline
Fig. 2: Module I
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.
Fig. 4: For a “Future” scenario in Oldenburg: power generation mix and storage configurations in each district.
Fig. 5: Urban fabric and allocation of battery storage in (a) Wechloy district in Oldenburg and (b) zoomed area.