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Spatial Energy modelling for sustainable city development



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Workshop ADE Energy - 27.05.2014



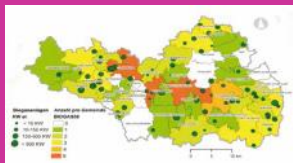
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- Non-Profit Institute, cooperation with the KIT und EDF (EEIG)
- Research fields: decentralized energy systems, bioenergy, geothermal energy, sustainable development for cities

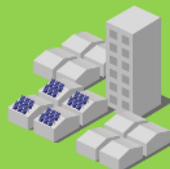
Research group “Energy Planning and Geosimulation”

- GIS based energy planning for regions or cities
- 3D City Modelling and energy modelling for cities
- Agent Based Modelling of energy systems and infrastructure
- Land use and mobility concepts

Energy Planning



Urban Form



Electrical Systems



Electromobility



Case study 1

Heat energy modelling from the 3D city model of Grand Lyon



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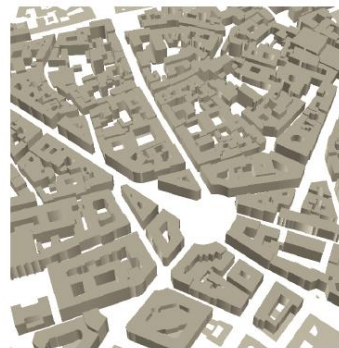
Urban texture



Cadaster + 3D CM



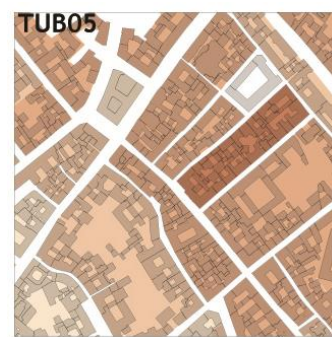
3D building model



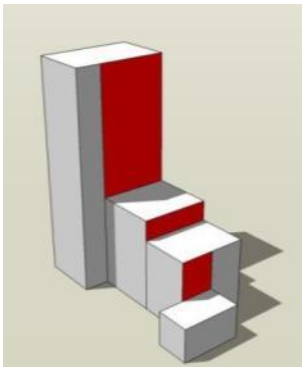
Land use



Building age



Morphology



Solar analysis



Classification / Typology



Building typology

- Others
- Block
- Court
- Big court
- detached
- Multifamily-terraced
- Slab - tower
- Terraced housing
- Slab housing
- Tower housing

Monthly energy balance (ISO-NF 13790)

$$Q_H = \sum (\theta_i - \theta_{eP}) \cdot t_P \cdot (H_T + H_V)$$

$$- \sum \eta_P \cdot (\varphi_{S,P} + \varphi_{I,P}) \cdot t_P$$



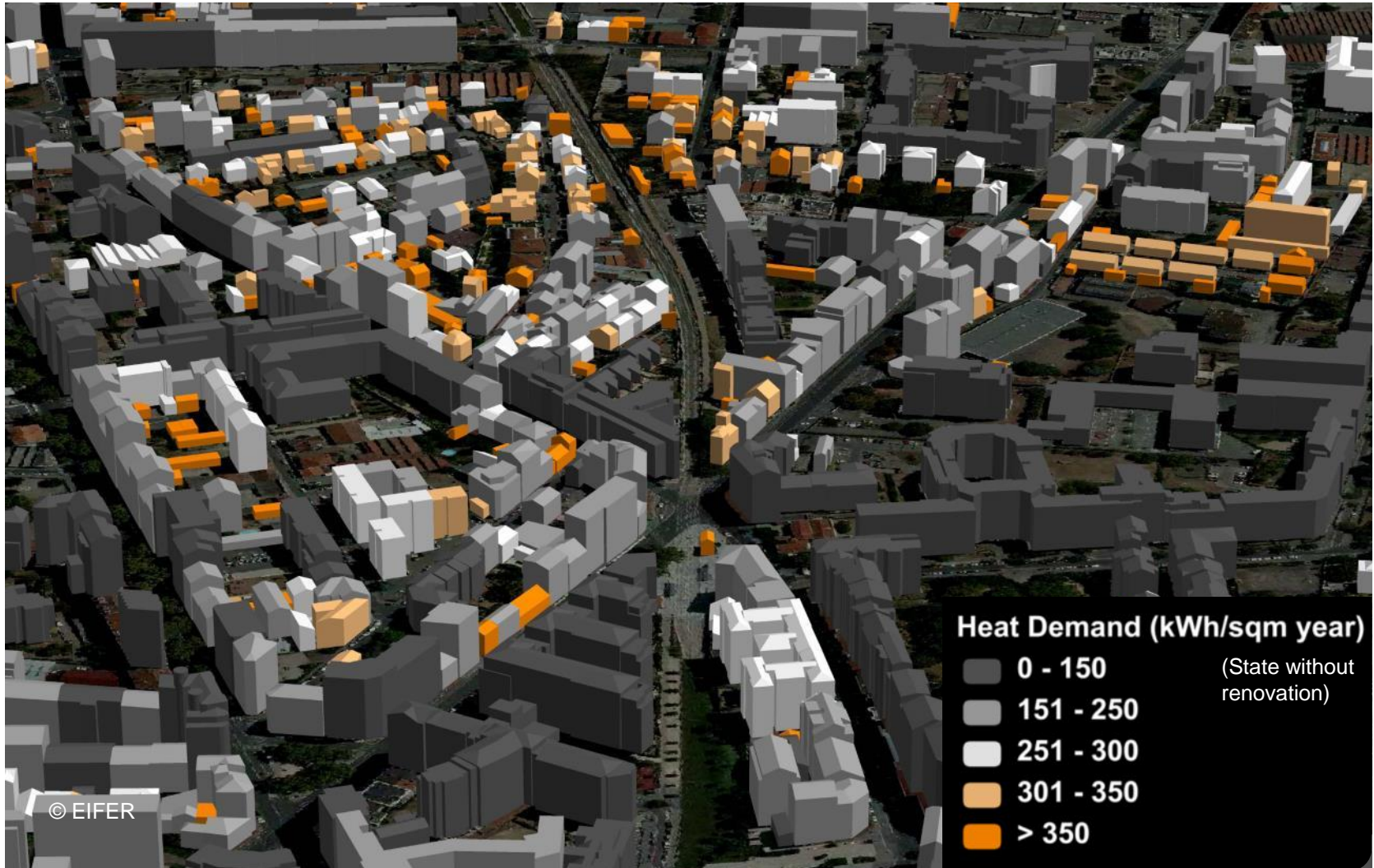
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Case study 1

Heat energy modelling from the 3D city model of Grand Lyon



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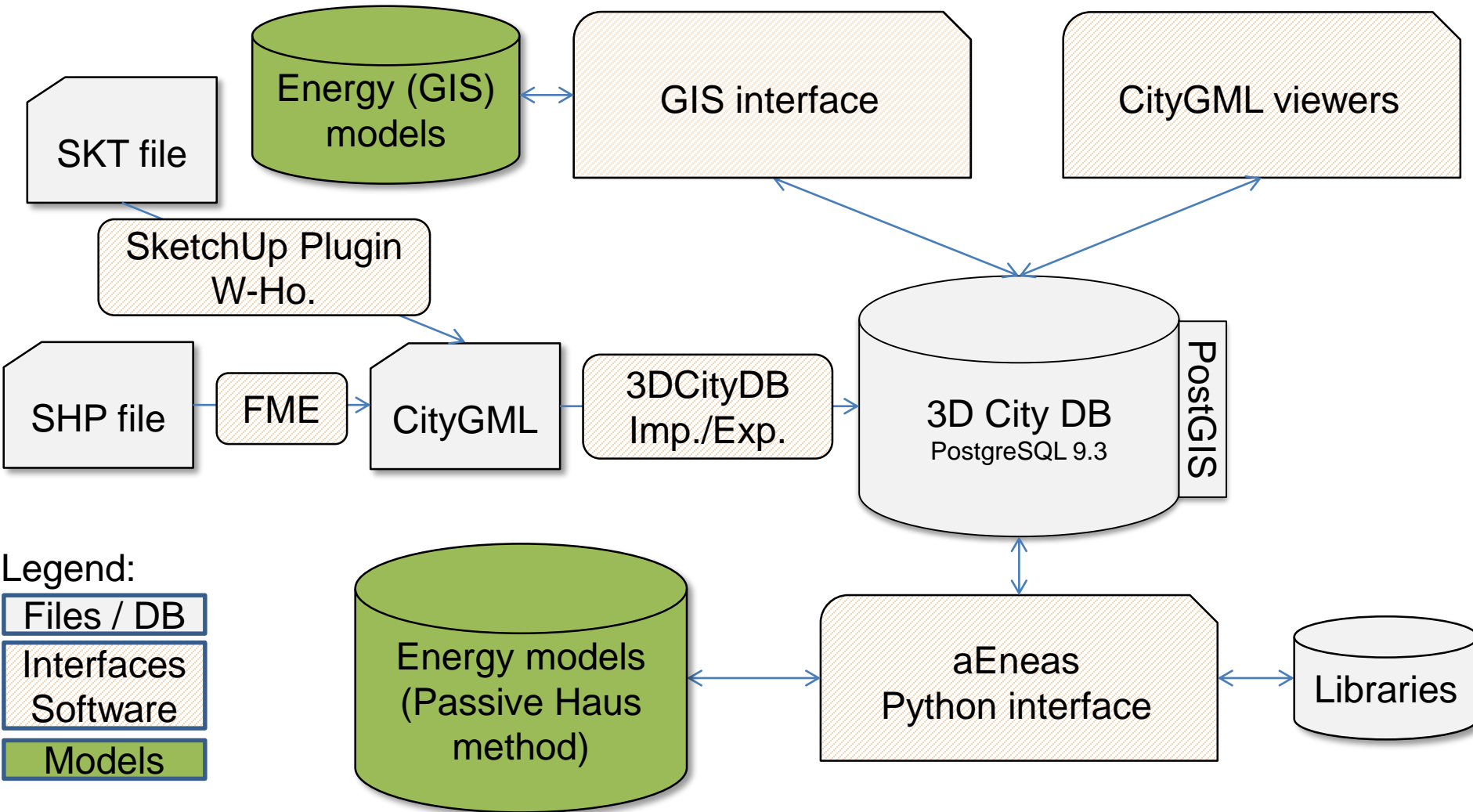


Case study 2

3D Geo-Data Infrastructure & energy modelling



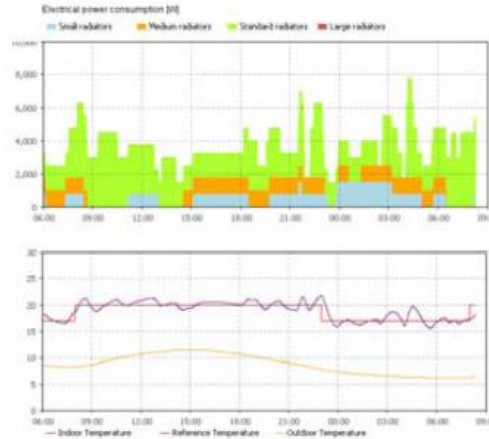
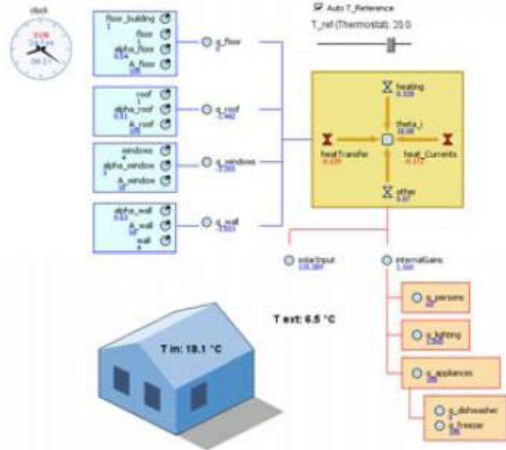
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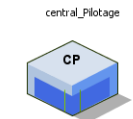
Case study 3

Geo-referenced modelling of Smart Energy Systems



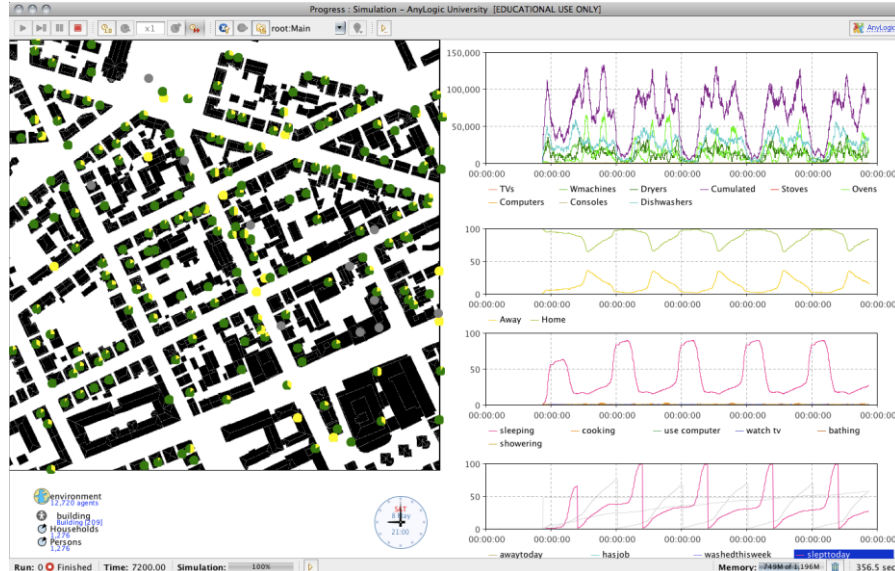
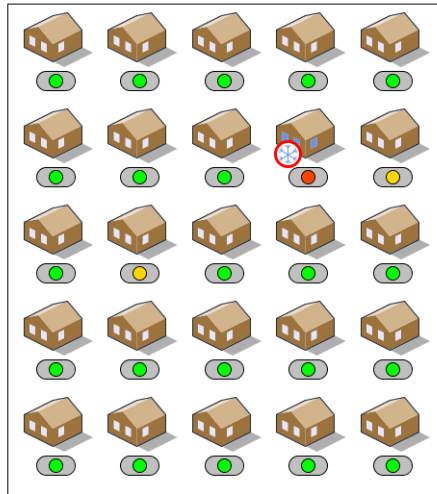
- Object oriented / agent based system representation
- Replication of agents with specific behaviours in an environment
- Link between energy demand and energy production
- Representation of system wide effects of management strategies

Environment

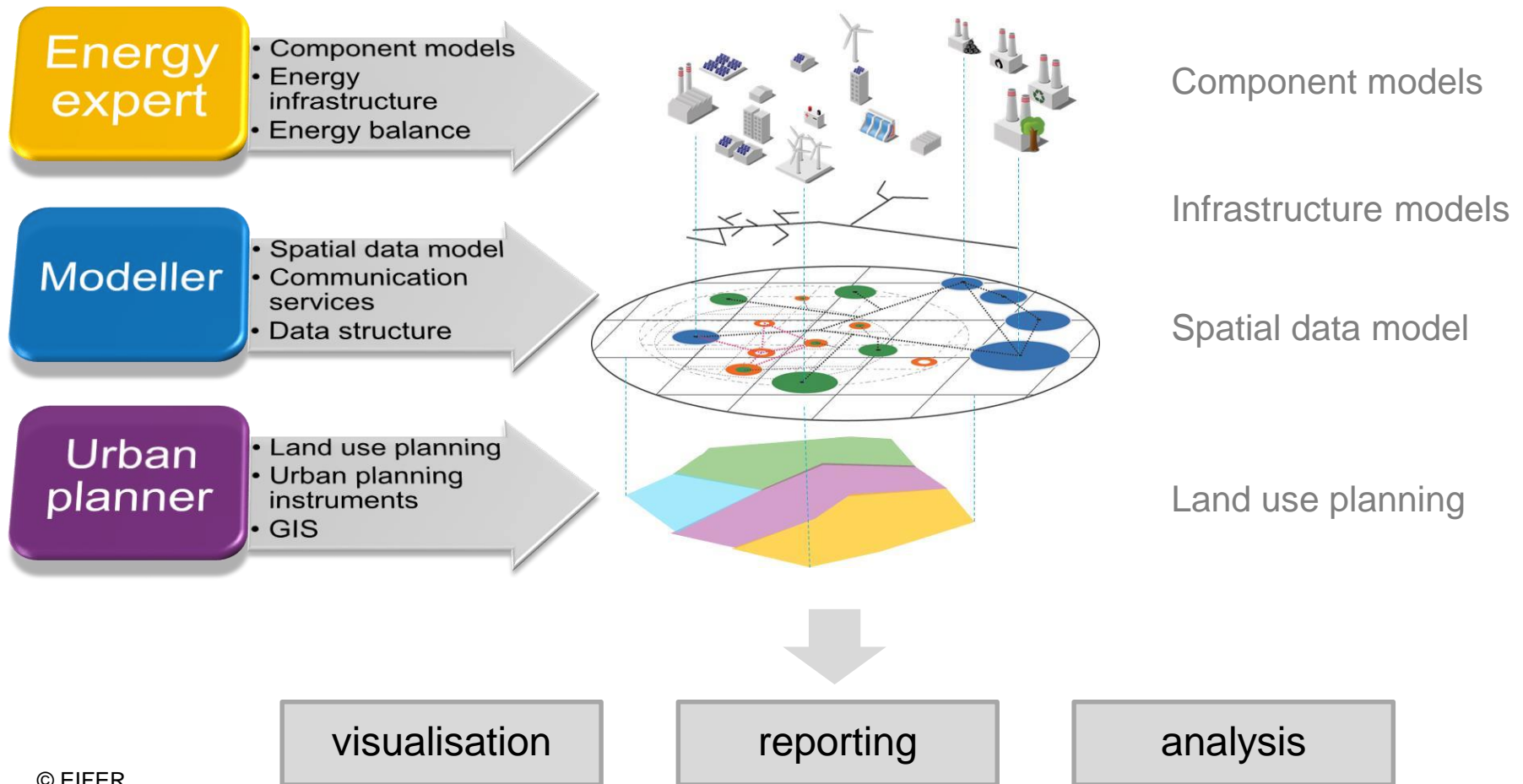


Legend

- Below confort level
- Optilesteur heat load shedding:
 - Normal operation
 - Partial shedding
 - Complete shedding



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Thank you for your attention!

Some literature...

- Bahu, J.-M. (2013). **Applied Energy Geo-Simulation for Cities from 3D Urban Data**. In: Chancen der Energiewende : wissenschaftliche Beiträge des KIT zur 1. Jahrestagung des KIT-Zentrums Energie, 19.06.2012. D. W. Breh and D. K. Schätzler. Karlsruhe, KIT Scientific Publishing, Karlsruhe.
- Bahu, J.-M., Koch, A., Kremers, E., Murshed, S.M. (2013), **Towards a spatial urban energy modelling approach**. 3D Geoinfo 2013- 8th 3D Geoinfo Conference, 27-29 November 2013, Istanbul.

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