Development of an evolving digital tool based on a multi-scale and dynamic energy mapping

DS²BE Doctoral Seminars on Sustainability Research in the Built Environment

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RESEARCH FIELD

- **Smart city**: an urban area integrating information and communication technology to optimize city efficiency services while supplying electronic data information to citizens and decision makers [1]
- **Wal-e-Cities-ENR** project concerns the smart, integrated energy performance and management of buildings (residential, tertiary and industrial) in Wallonia

OBJECTIVES OF THE RESEARCH

- Transformation of buildings energy consumption into intelligent built environment
- Create an evolving digital tool based multi-scale energy mapping and dynamic energy consumption/demand profiles for strategic decision support and energy management in Wallonia
- Visualization scales: spatially from statistical sector (SS) scale to a region and temporary from an hour to a year.

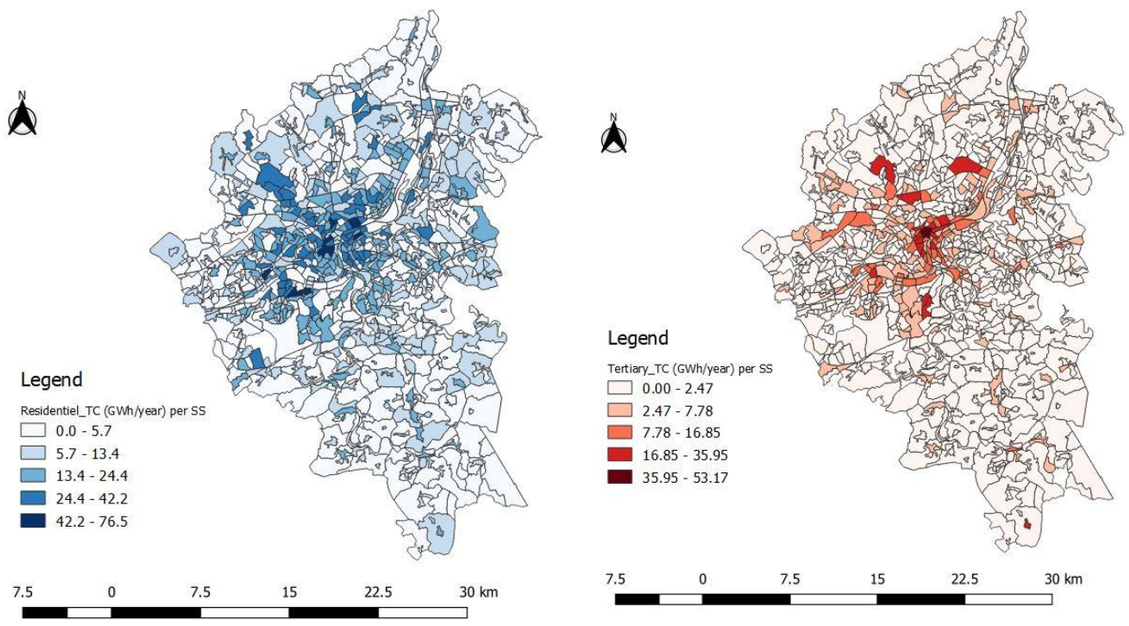
METHODOLOGY AND INNOVATION

- Data collection (cadastre, energy reports [2], monitoring, etc.); data cleaning and database creation with R)
- Only kept: all closed buildings & shape area > 15 m^2
- Energy cadastre spatialization/building energy mapping
  - Heat consumption (HC): value of invoice
  - Heat demand (HD): heat quantity of the system
  - Electricity and cold consumption
- Energy GIS platform creation (with QGIS & python software)
  - Dynamic
  - Evolving linking many stakeholders
- Statistical/spatial analyses of energy consumption, demand, and CO2 emissions on different temporal and spatial scales (creating statistical/spatial models, with R & QGIS software)
- Improve of strategic decision in urban energy planning using energy maps, forecast scenarios, energy indicators and PROMETHEE method [3] to attain European objectives
- Tools test (in Liège and Charleroi) and tools validation.

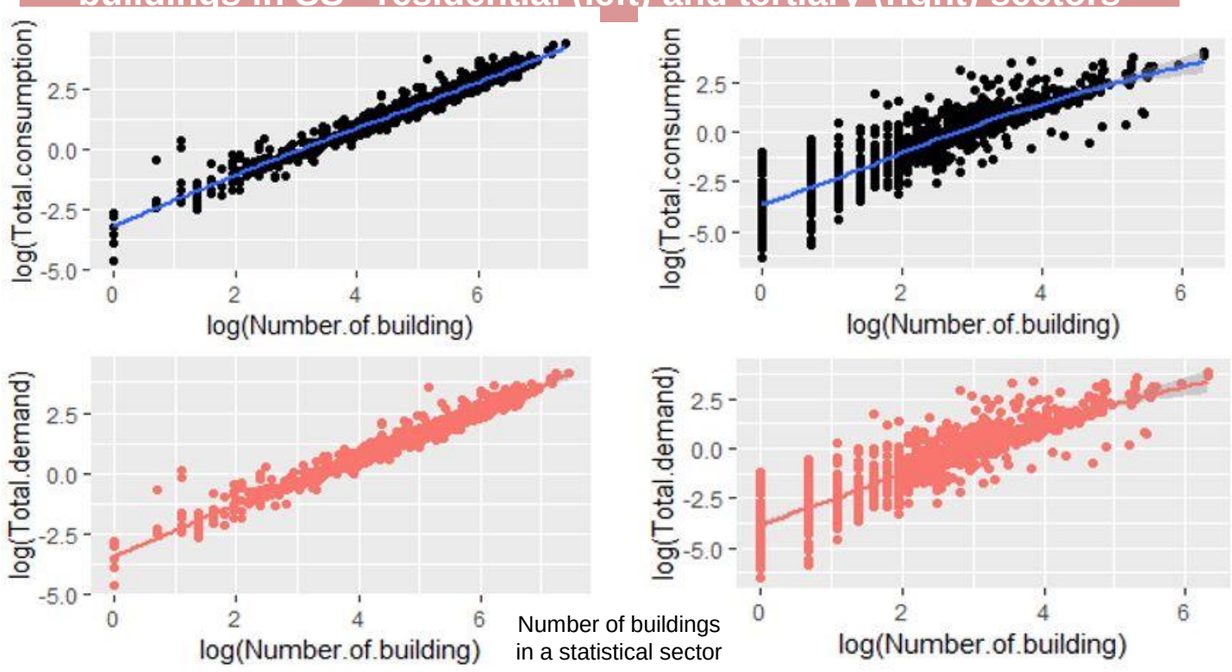
FIRST RESULTS

The results obtained in the first year: the energy cadastral spatialization of residential and tertiary buildings for Liège area shows that the difference of heat consumption (HC) and heat demand (HD) varies between 15 and 18% for residential buildings and between 16 and 18% for tertiary buildings. Liège municipality has the higher heat consumption and demand for both residential and tertiary sectors. Next, the method will cover all Wallonia. The results will be used for the dynamic evolution assessment, for statistical/spatial analysis models, for multi criteria analysis and evolution scenarios of the built environment (2040 & 2050).

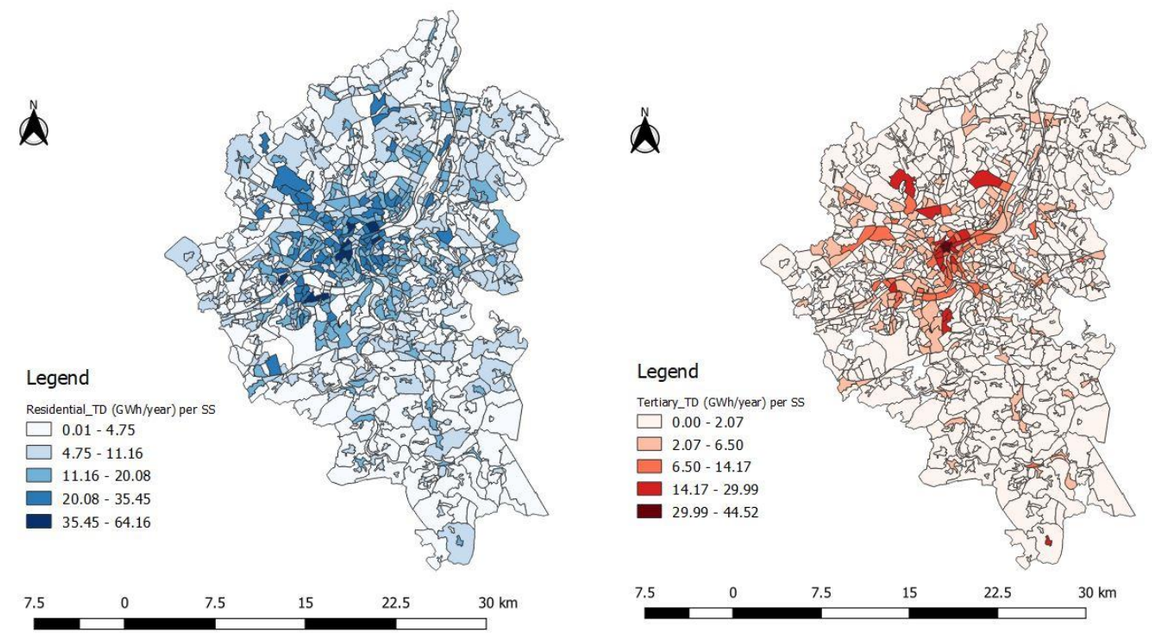
Total heat consumption - residential (left) and tertiary (right) sectors



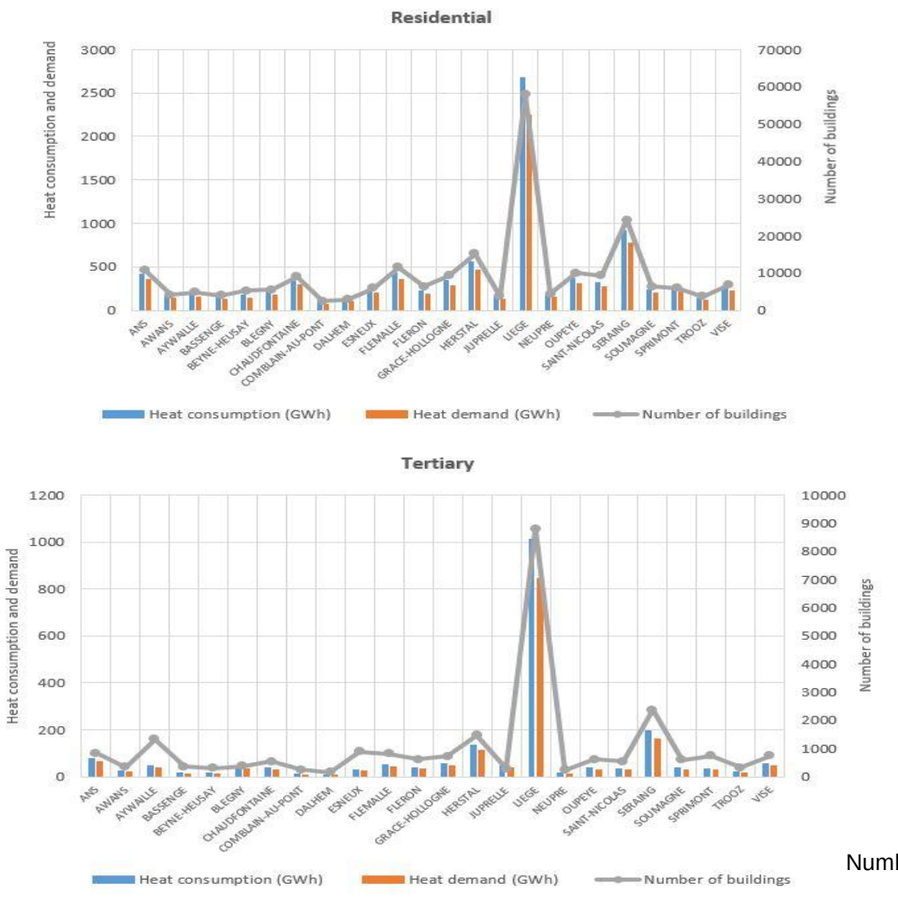
Total heat consumption and total heat demand per number of buildings in SS - residential (left) and tertiary (right) sectors



Total heat demand - residential (left) and tertiary (right) sectors



Heat consumption and heat demand per number of buildings per municipality - residential (up) and tertiary (down) sectors



Number of buildings in a municipality

References:

[1] Peris-Ortiz, M., Bennett, D., Pérez-Bustamante Y. D., 2017. Sustainable Smart Cities: Creating Spaces for Technological, Social and Business Development. Springer : Switzerland

[2] ICEDD, 2014. Bilan énergétique de la Wallonie - Secteur domestique et équivalents

[3] Oberschmidt, J., Geldermann, J., Ludwig, J., Schmehl, M., 2010. Modified PROMETHEE Approach for Assessing Energy Technologies. International Journal of Energy Sector Management 4 (2): 183–212

LIÈGE université LEMA # Wal-e-Cities

FEDER UNION EUROPEENNE Wallonie

LE FONDS EUROPEEN DE DEVELOPPEMENT REGIONAL ET LA WALLONIE INVESTISSENT DANS VOTRE AVENIR