The European Commission's science and knowledge service

Joint Research Centre

Location data enabling urban sustainable energy planning

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European Commission

Outline

- Overview of Use Case 4 of the EULF Energy Pilot
- Role of INSPIRE
- Energy Efficiency driven retrofit planning
- Mapping energy consumption
- Urban context variables
- Feasibility index
- Energy saving scenarios
- Input data

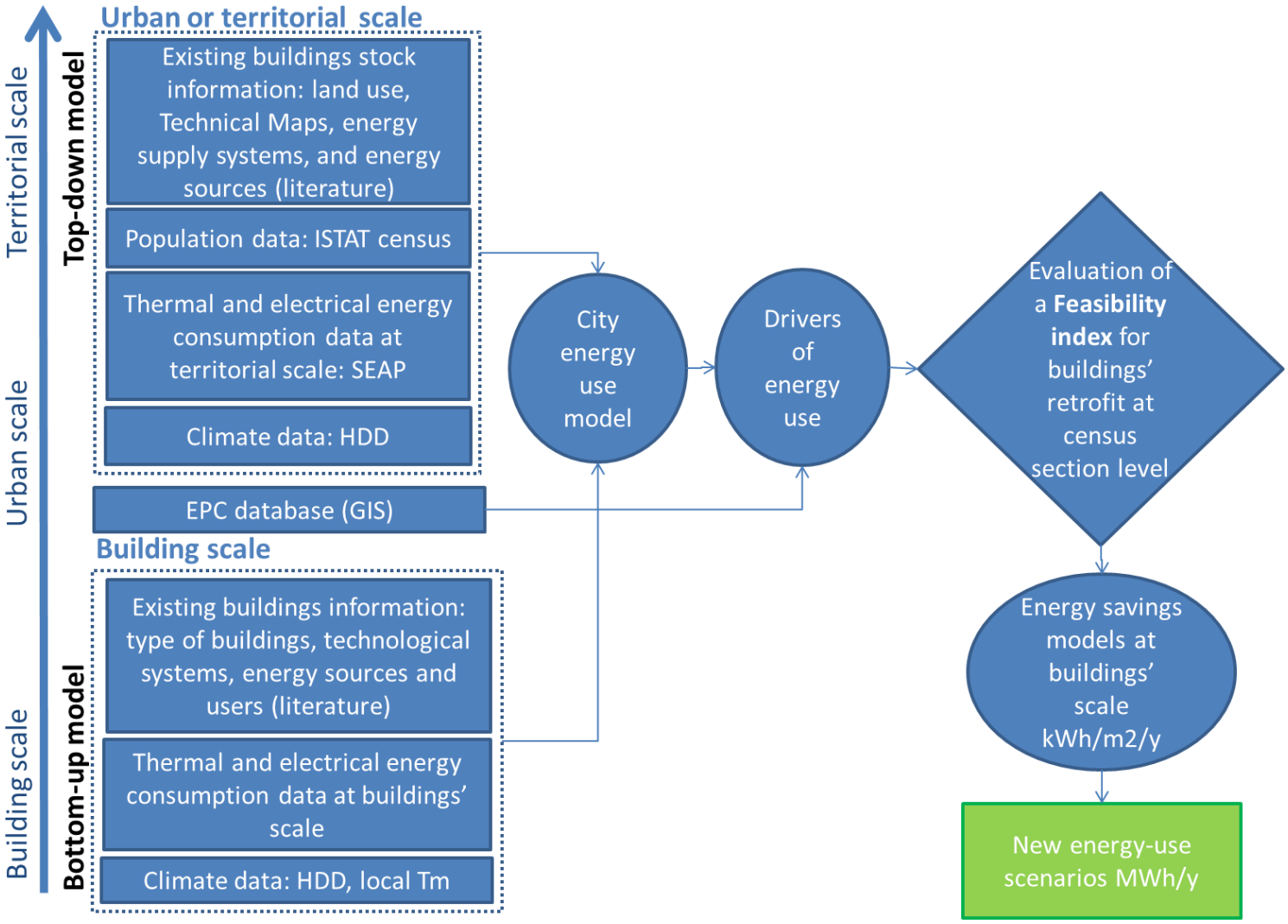
Overview of the EULF Energy Pilot UC4

- Goal: To support policy makers to design and implement Energy Efficiency driven renovation plans of building stock at urban level.
- Description: Use of existing models, from bottom-up to top-down approach, for the estimation of energy needs at urban level, based on real energy consumption data of a sample of buildings:
  - for building stock renovation planning and prioritization of interventions, e.g. by class of buildings and/or geographical area of interventions (e.g. in areas having energy distribution networks or in historical centres);
  - to enable Public Authorities (e.g. Municipalities) to assess the energy saving potential related to the building stock and to local conditions (e.g. climate);
  - to allow reuse of scaling-up models (from building to urban level) in different climatic conditions and with different characteristics of the building stock.

Role of INSPIRE

- Introduce INSPIRE into a methodology already applied to a test area (without INSPIRE), in order to facilitate the re-use of the methodology in other geographical contexts

Energy Efficiency driven retrofit planning



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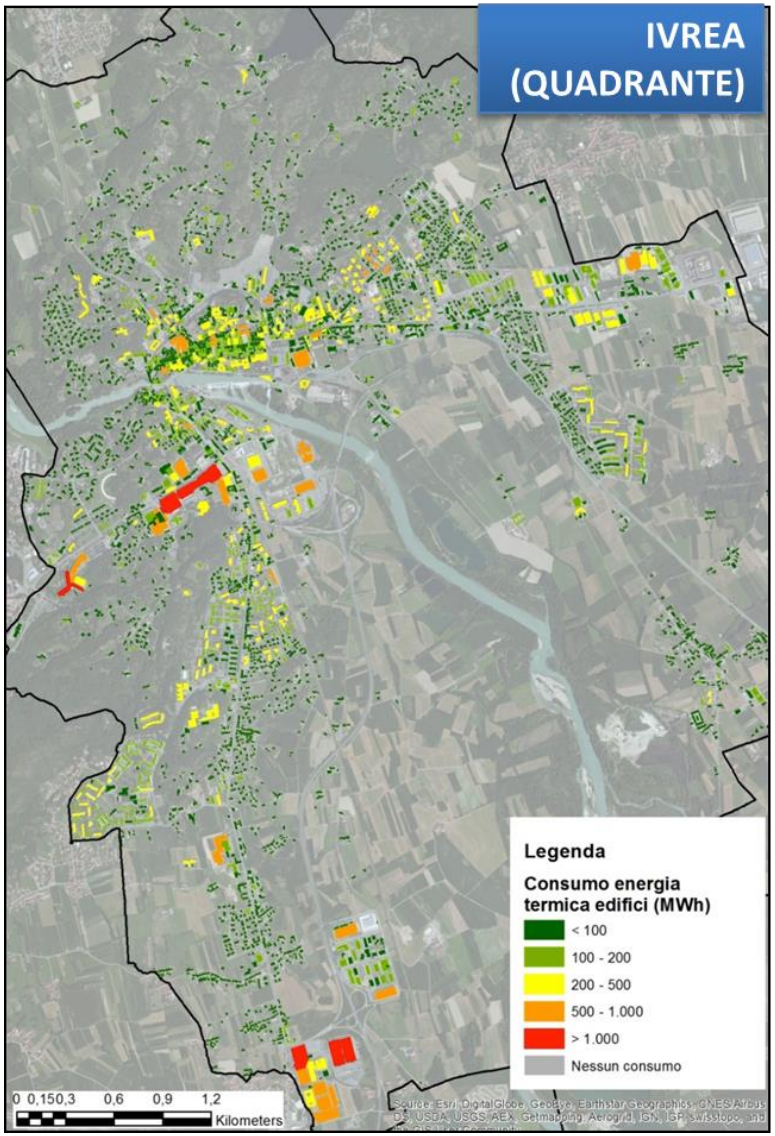
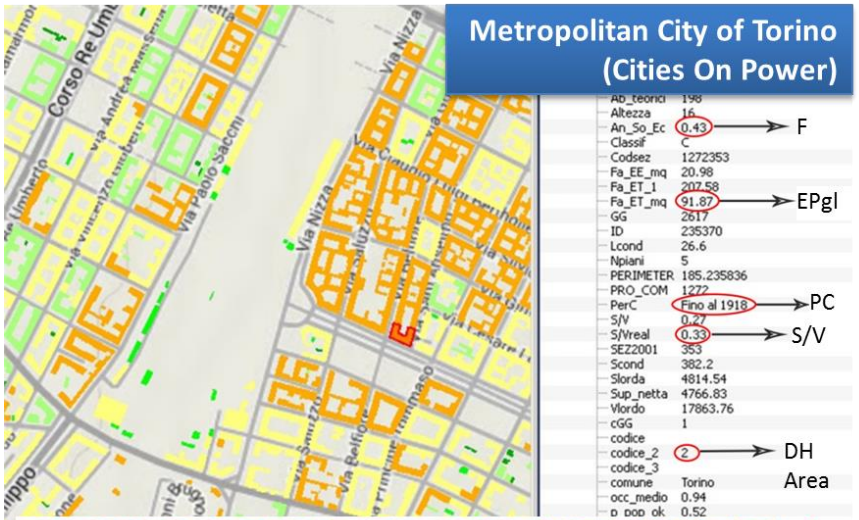
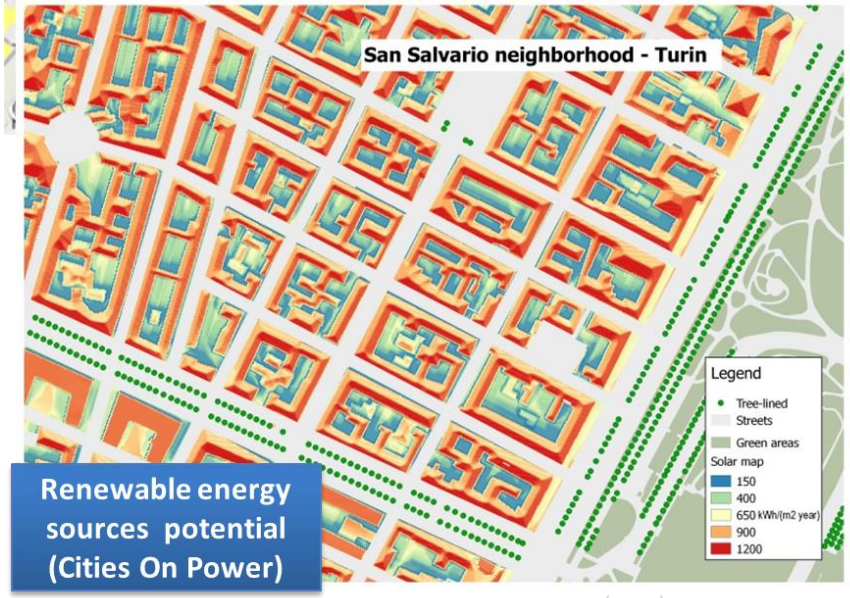
Mapping energy consumption







Renewable energy sources potential (Cities On Power)

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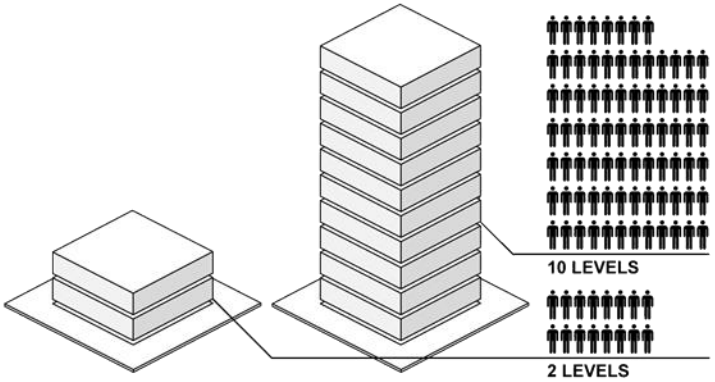
Urban context variables

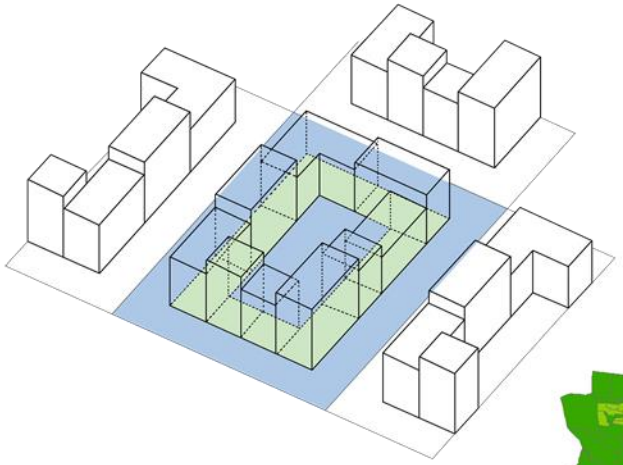
$$kWh/m^3_{[CONTEXT]} = f(\mathbf{BD}, \mathbf{BCR}, H/W, H/Havg, MOS, A)$$

BD – Building Density [m^3/m^2]

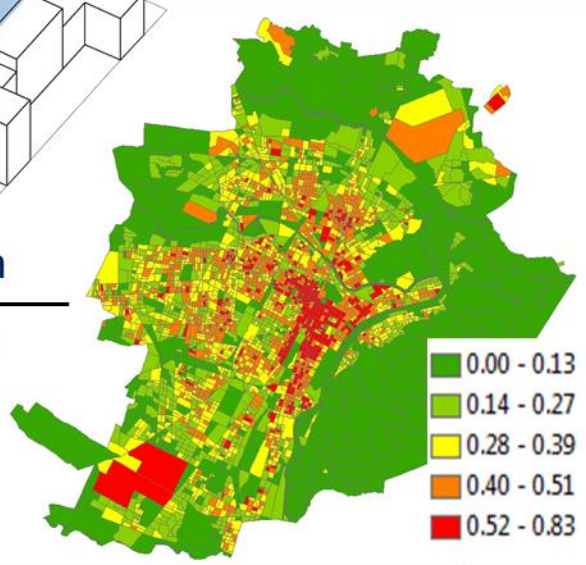


$$BD = BCR \cdot \text{Building Height}$$

BCR – Building Coverage Ratio [m^2/m^2]



$$BCR = \frac{\text{Built Area}}{\text{Site Area}}$$



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Mapping energy consumption

$$\left.\frac{kWh}{m^3}\right|_{measured} = \left.\frac{kWh}{m^3}\right|_{building} \pm \left.\frac{kWh}{m^3}\right|_{context}$$

Case study: Turin (IT)

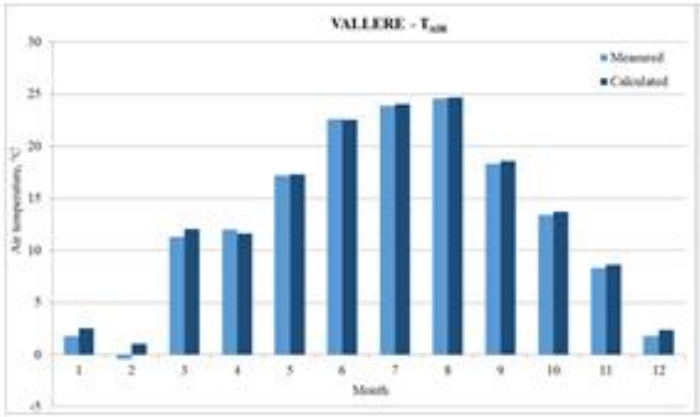
Space heating energy-use of 59 residential buildings
22 census sections

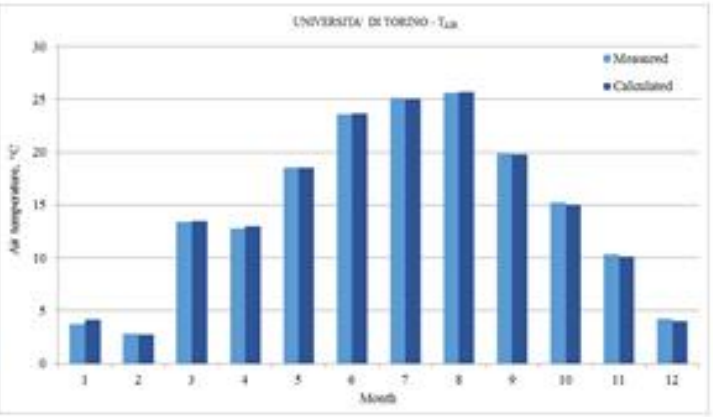
Heating season 2012/2013 = 2348 HDD

Heating season 2013/2014 = 1962 HDD

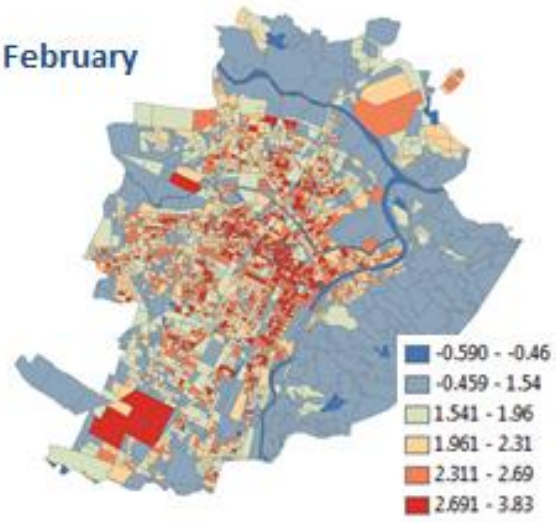
Weather station ARPA – via della Consolata

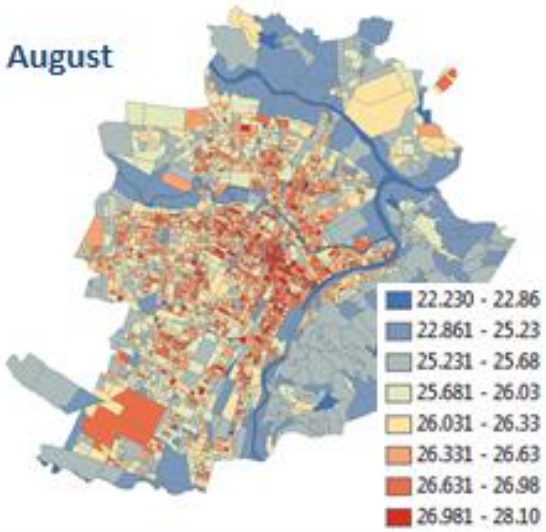
Mapping energy consumption





$$T_{air} = 23.05 \cdot G_{mT} + 2.69 \cdot BCR + 0.03 \cdot H/W + 0.65 \cdot MOS + 1.07 \cdot H/H_{avg} - 1.17 \cdot A - 0.6 \cdot H_2O$$





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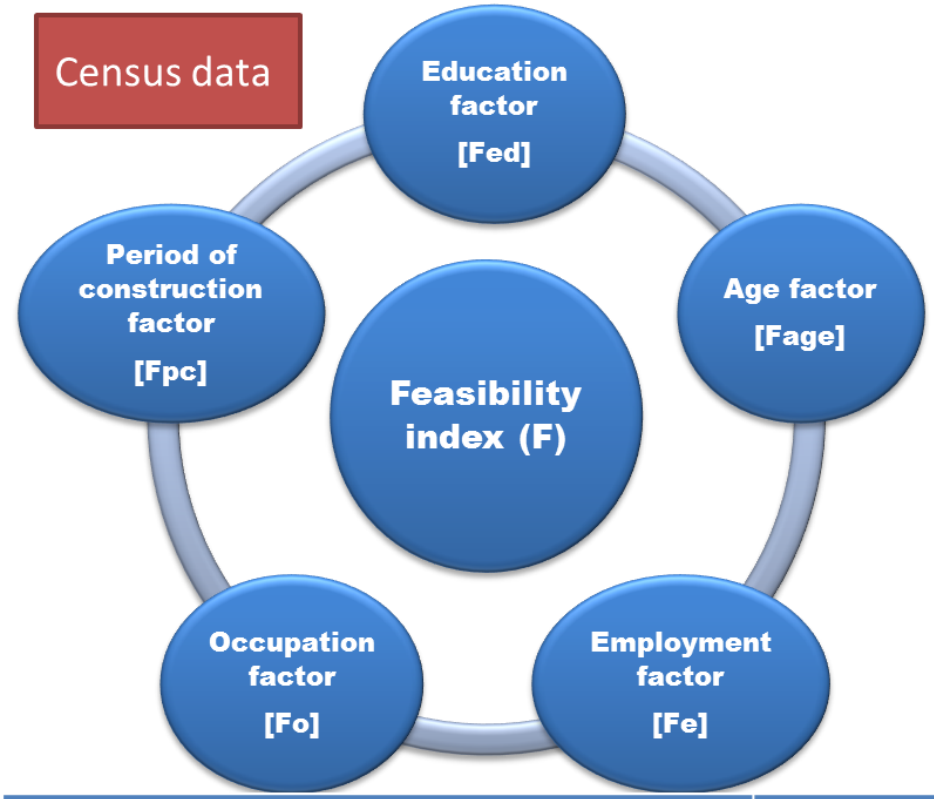
Feasibility index



Age factor:
active population (24-65) / total population
Variables: ECONOMIC, DECISION, INTEREST

Education factor:
population with scholastic graduation / total population
Variables: AWARENESS

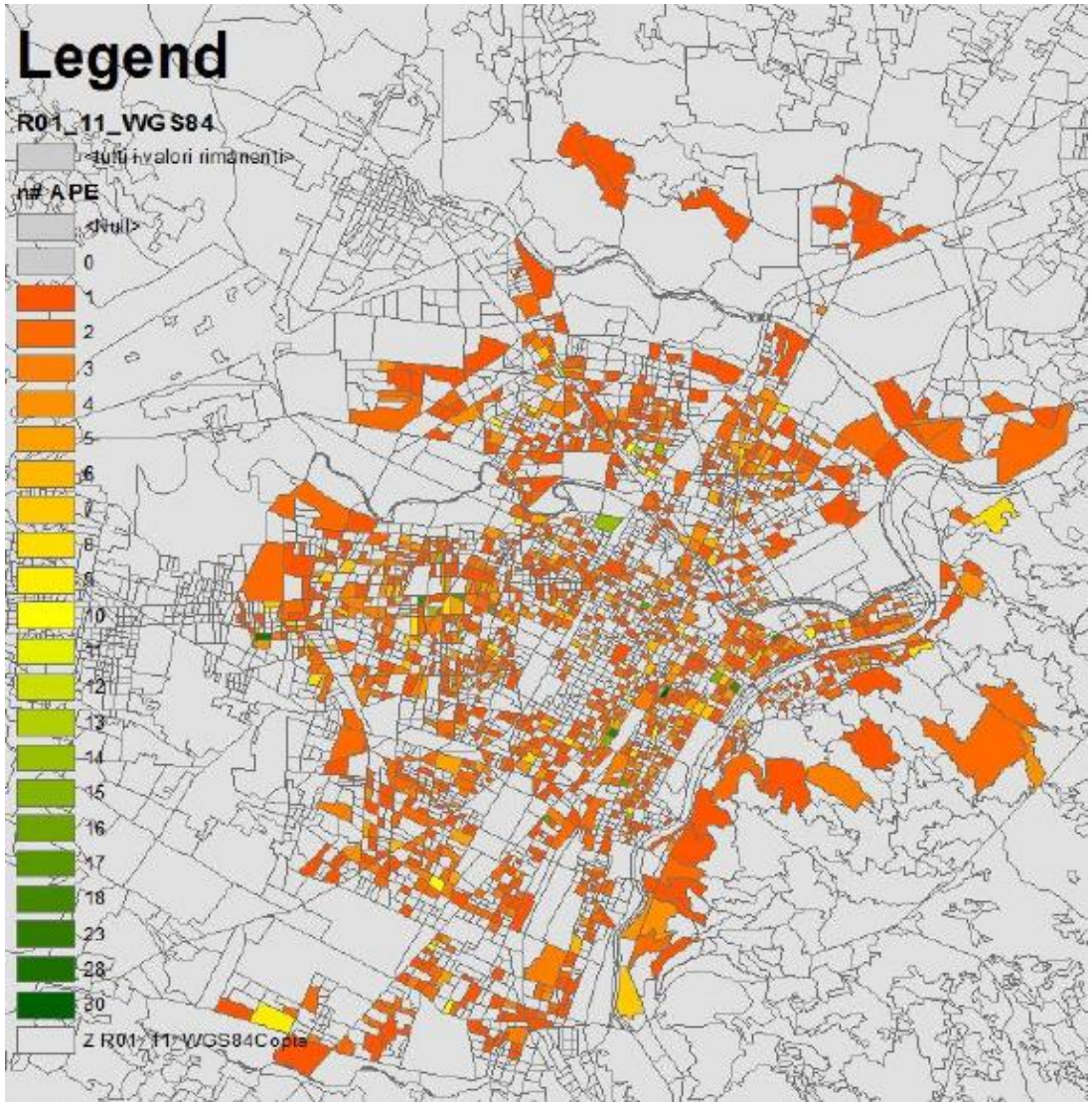
Employment factor:
employed people / total population
Variables: ECONOMIC, CREDIT ACCESS

Building's occupation factor:
percentage of occupied buildings
Variables: DECISION, INTEREST

Period of construction factor:
buildings built before 1945
Variables: DECISION, INTEREST PROCESS

	First class	Second class	Third class	Fourth class
Feasibility index	<0.42	0.42 - 0.50	0.50 - 0.58	> 0.58
Number of buildings in the Metropolitan City of Torino	13%	42%	39%	6%
Number of buildings in Torino	20%	54%	23%	3%
Renovation level	windows substitution	+ boiler substitution	+ thermal insulation of slab and roof	+ thermal insulation of facades

Feasibility index



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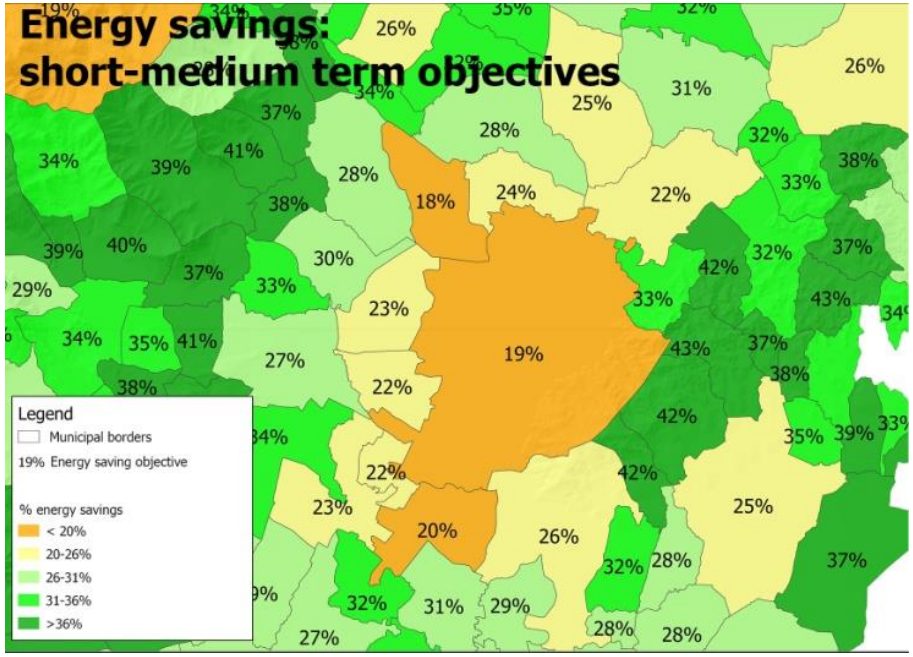
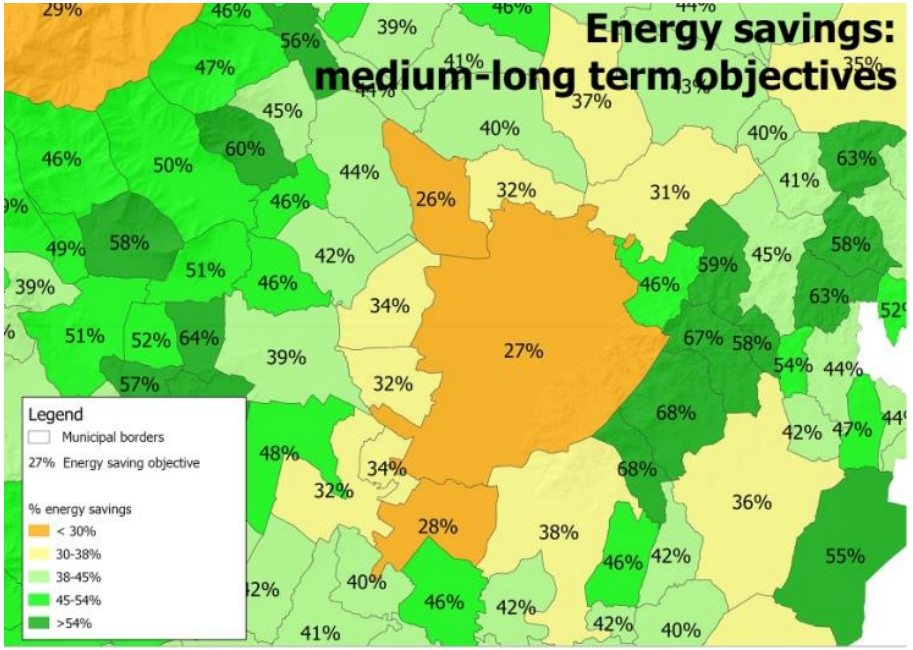
Energy savings scenarios





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Input data

- energy consumption data at building level
- building characteristics

BU ext

- energy networks

US

- land use

LU, LC

- population distribution
- socio-economic variables

SU+PD

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http://inspire.ec.europa.eu/

eulf European Union Location Framework

website: http://ec.europa.eu/isa/actions/02-interoperability-architecture/2-13action_en.htm

EULF Joinup Community: https://joinup.ec.europa.eu/community/eulf/description

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