6th International Conference on Smart Energy Systems
6-7 October 2020
#SESAAU2020

A REGRESSION MODEL TO ESTIMATE THE DWELLING-NETWORK CONNECTION LENGTH STARTING FROM AGGREGATED INFORMATION PER CENSUS AREA

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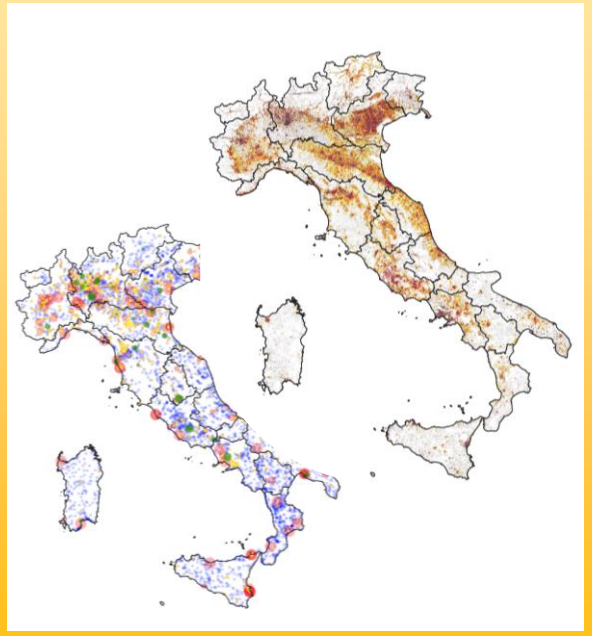
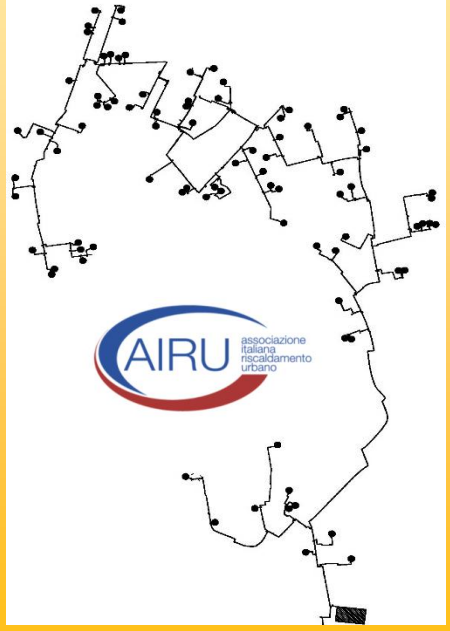
FRAMEWORK

Assessing the potential diffusion of renewable based district heating in Italy through energy mapping





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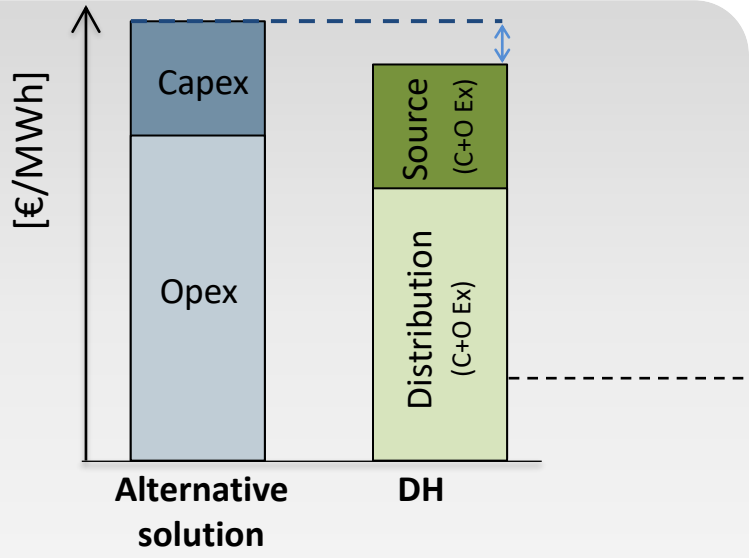
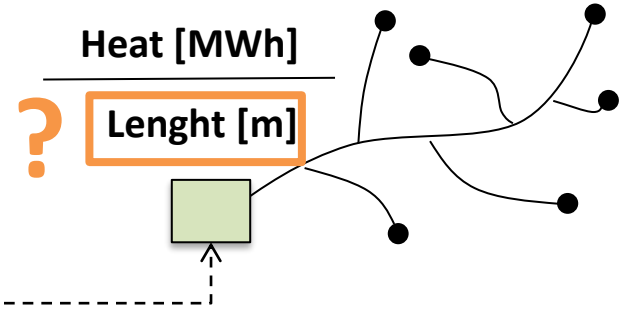
Overarching goal

Assessing the potential diffusion of district heating from a technical, environmental and economic point of view



Persson U., Wiechers E., Moller B., Werner S., *Heat Roadmap Europe: Heat distribution costs*. Energy 176 (2019) 604-622



Specific problem

Estimating infrastructural network cost in areas in which there's no DH

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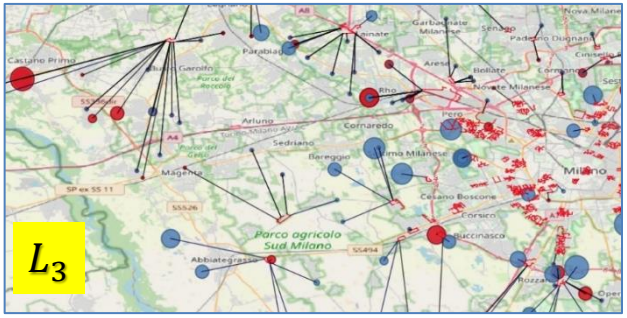

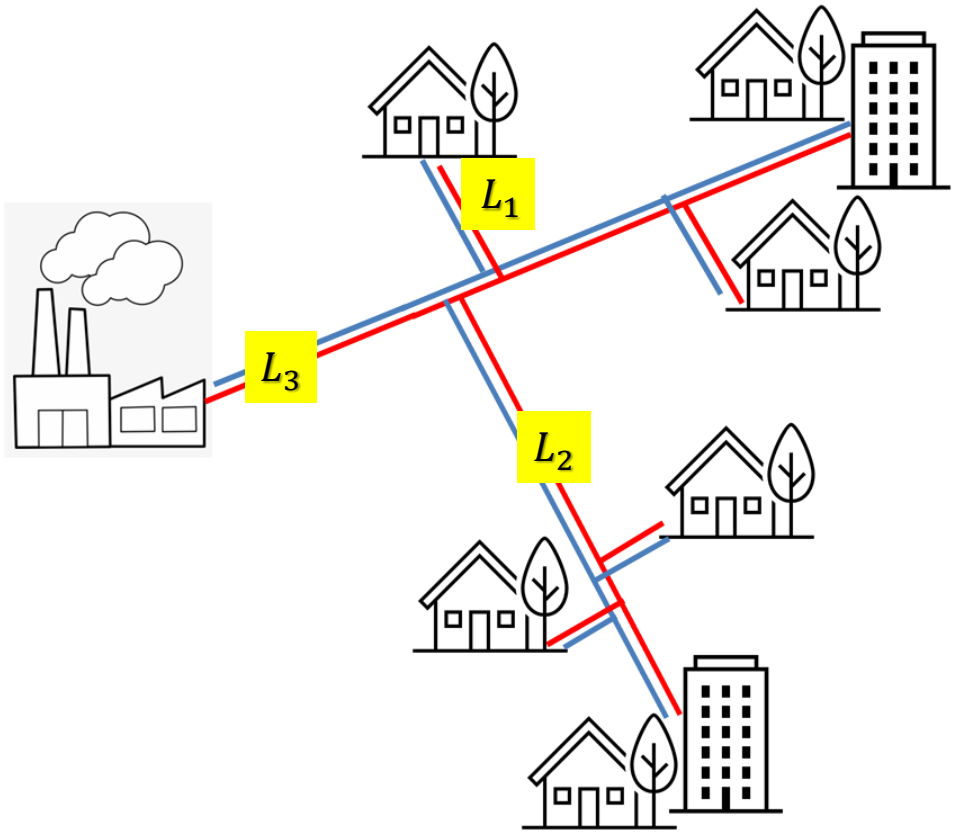

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Approach: Simulation of DH dwelling-network connections topology through GIS environment starting from open data

Main idea:

- connections length can be approximated to the distance between the road and the building
- GIS –based measures of road-building distance can be used to generate synthetic samples to finally build a statistical model
- Possibly based on **open tool** (QGIS) and **open datasets** (ISTAT census and OpenStreetMap)

Case study

Lombardy Region (Italy) – potentially valid for the rest of Italy and region with similar definition of census area

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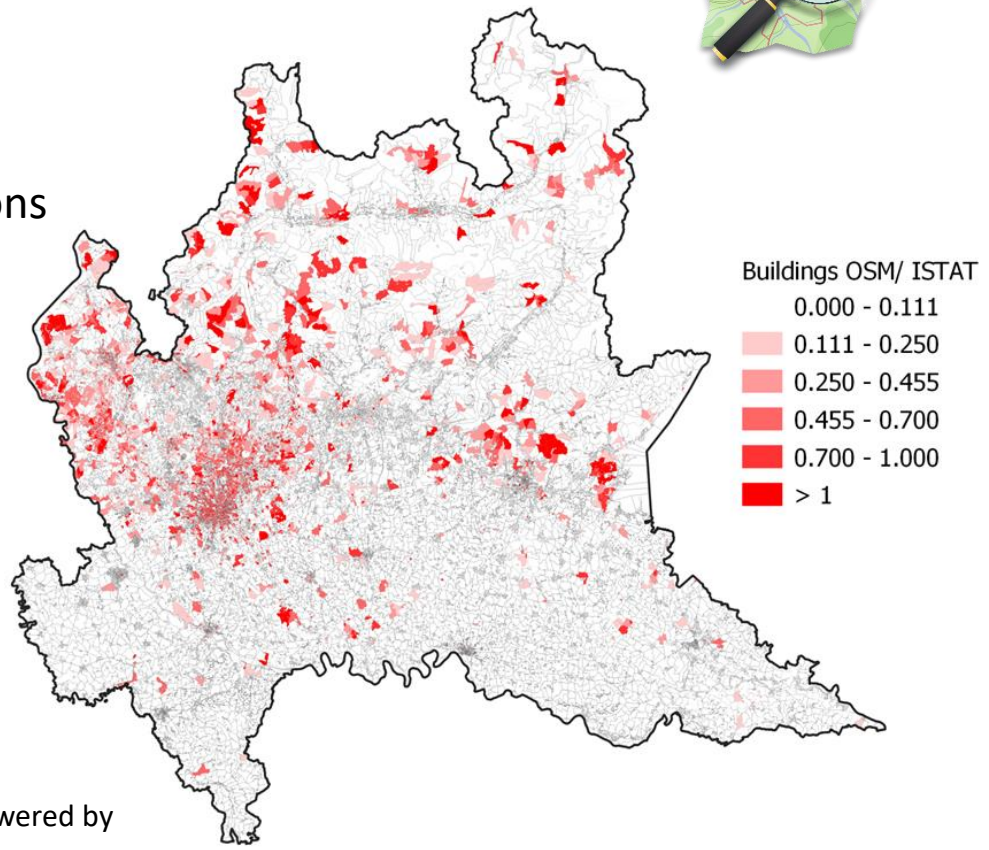
census areas have irregular shapes with different dimensions. In dense areas they are smaller (few building blocks) and coincide with roads

Areas in which OSM and ISTAT data were consistent were considered for elaborations (about 2100 census areas)



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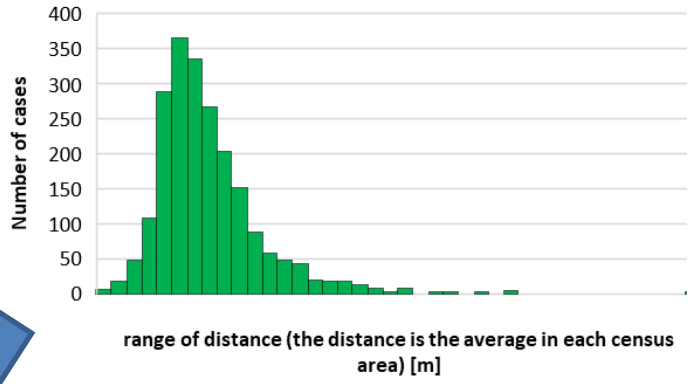
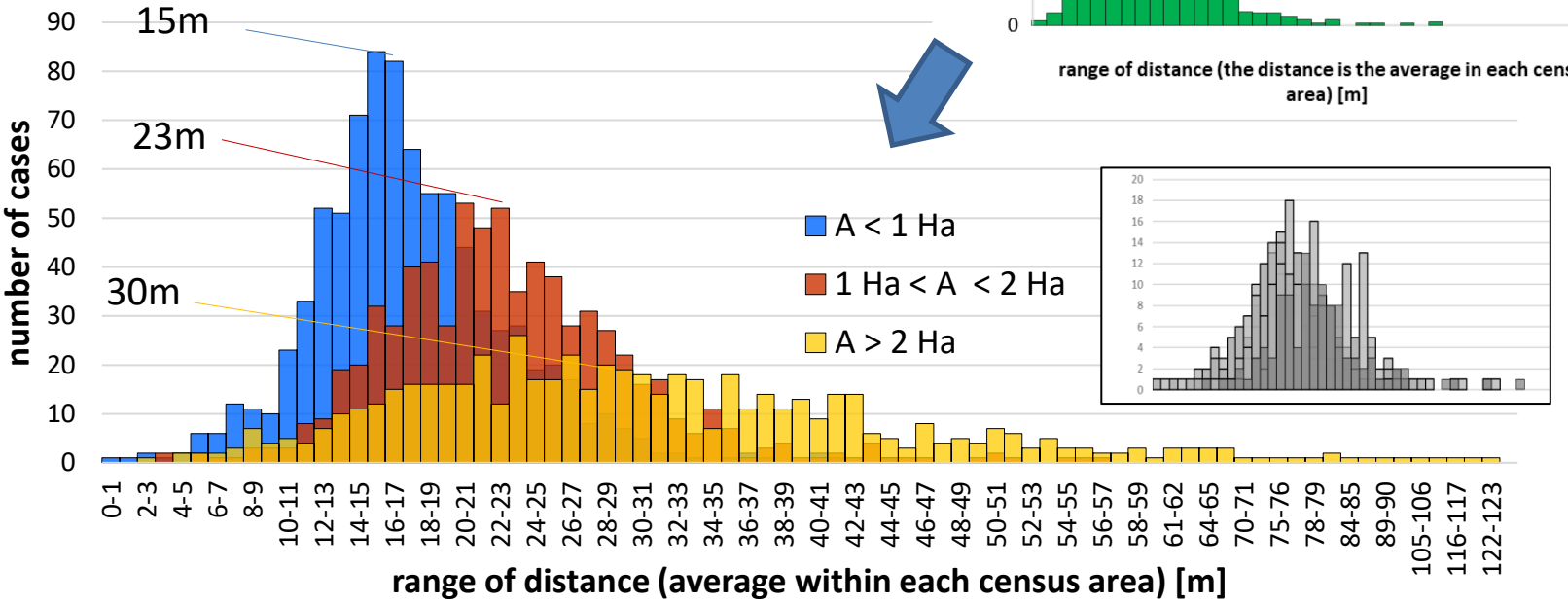
- Gaussian curves if the distribution is fragmented per surface range of the census area
- The same trends within the "A < 1 Ha" range but the population must be increased





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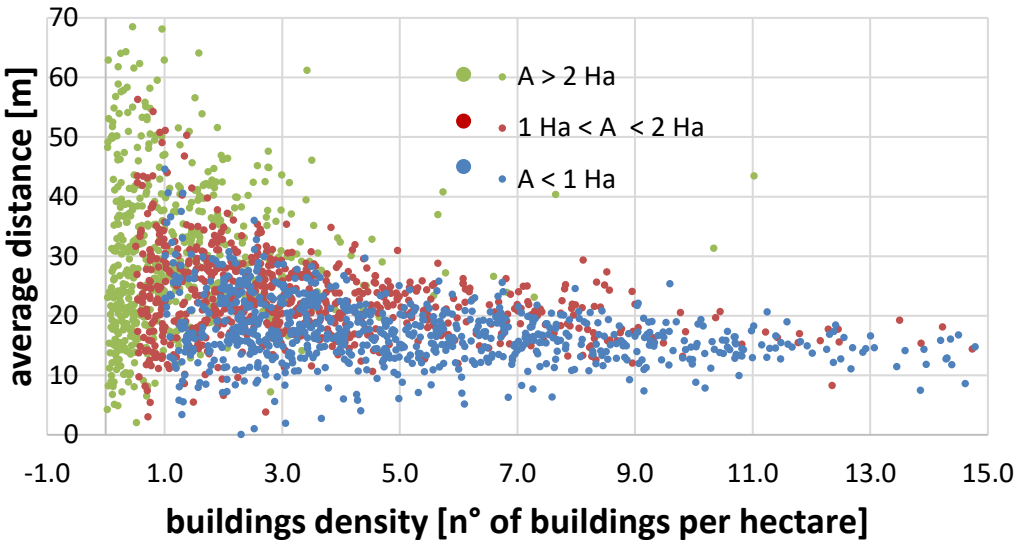
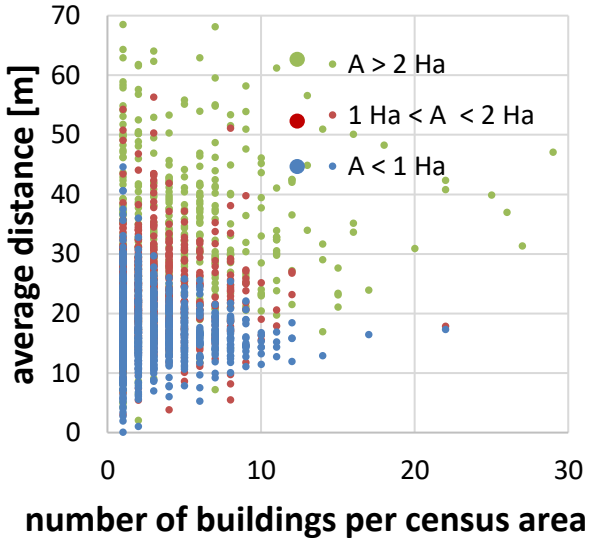
- The relation between average distance and building density (as well as for number of buildings) shows again the effect of the dimension of the census area on the spread of the measure
- Both the building density ad the number of building per census area affect the accuracy of an estimation





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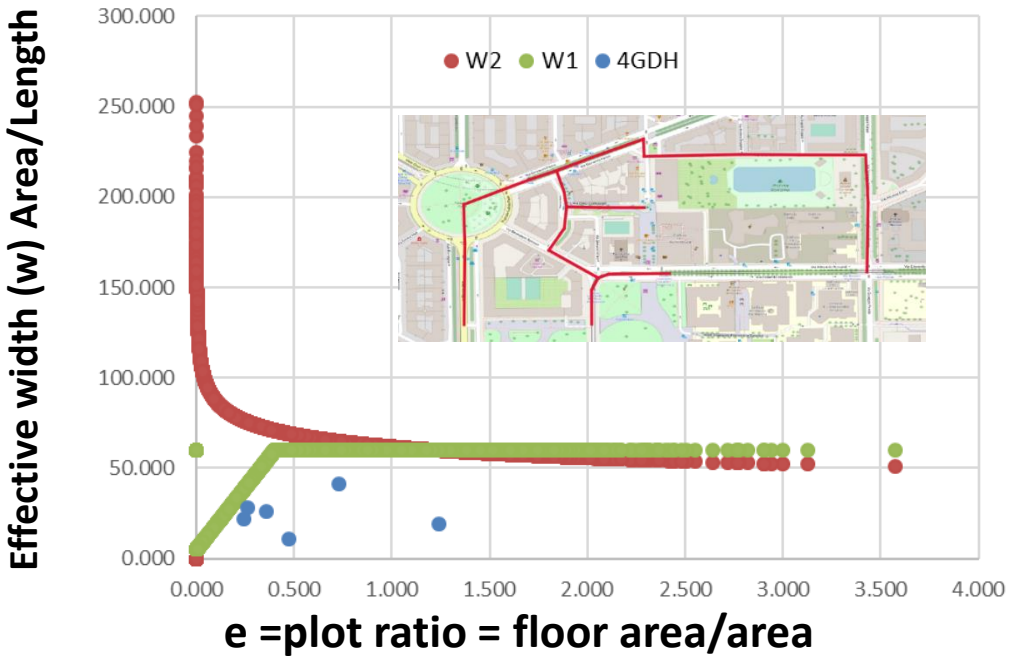
The estimation of the overall distribution network length is today mostly based on effective width (which is then used also for linear heat density) so, providing connection length in a similar form would be useful



$$w = 61{,}8 * e^{-0{,}15} \quad \left[\frac{m^2}{m}\right]$$

$$\frac{Q}{L} \quad \left[\frac{MWh_t}{m}\right] = \quad e \cdot q \cdot w$$

1. U. Persson, S. Werner *Effective width - the relative demand for district heating pipe lengths in city areas* - 12th international symposium on district heating and cooling, 5th to 7th of september, Tallin (2010), pp. 128-131
2. Persson U., Wiechers E., Moller B., Werner S., *Heat Roadmap Europe: Heat distribution costs*. Energy 176 (2019) 604-622

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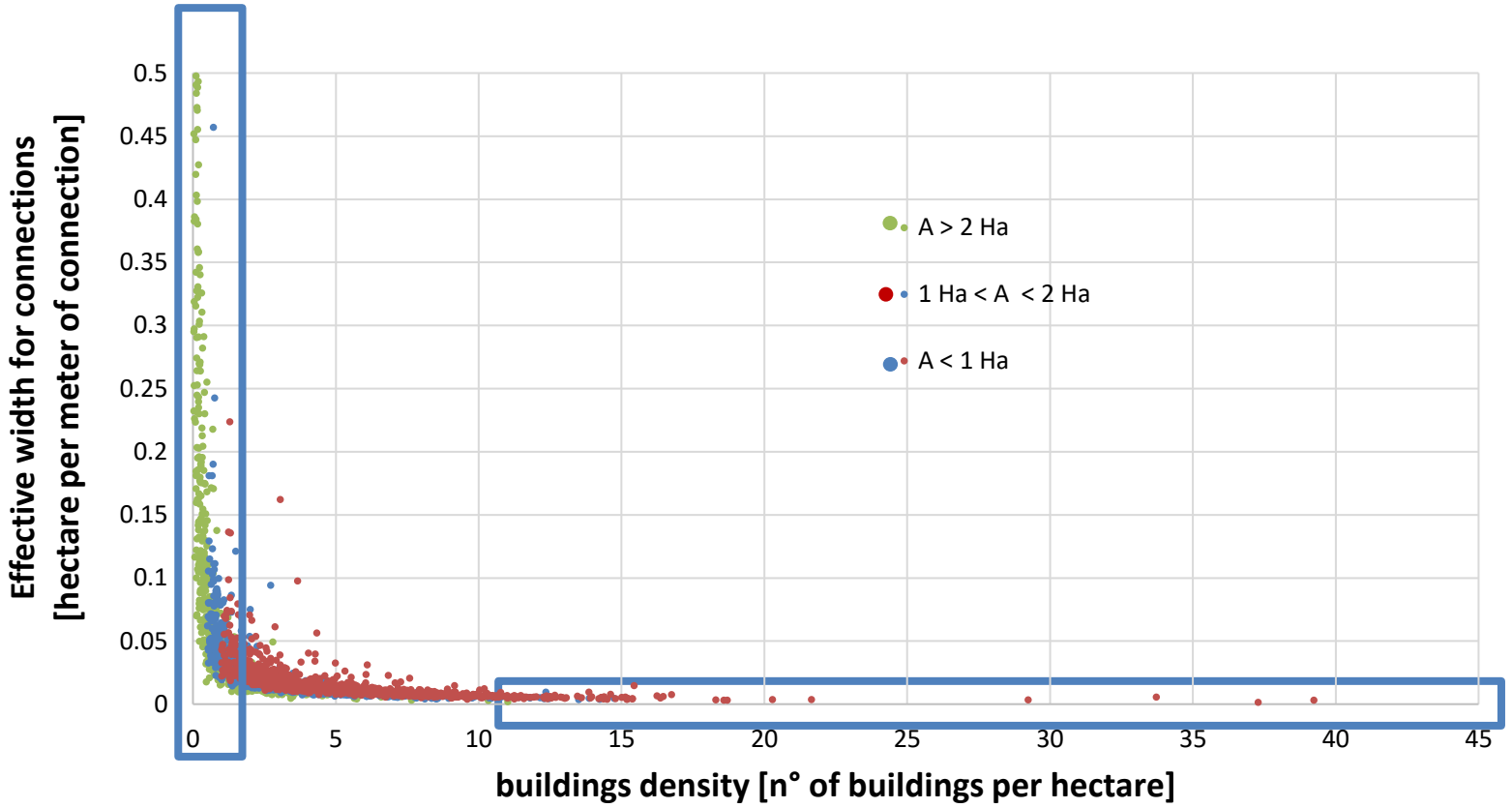

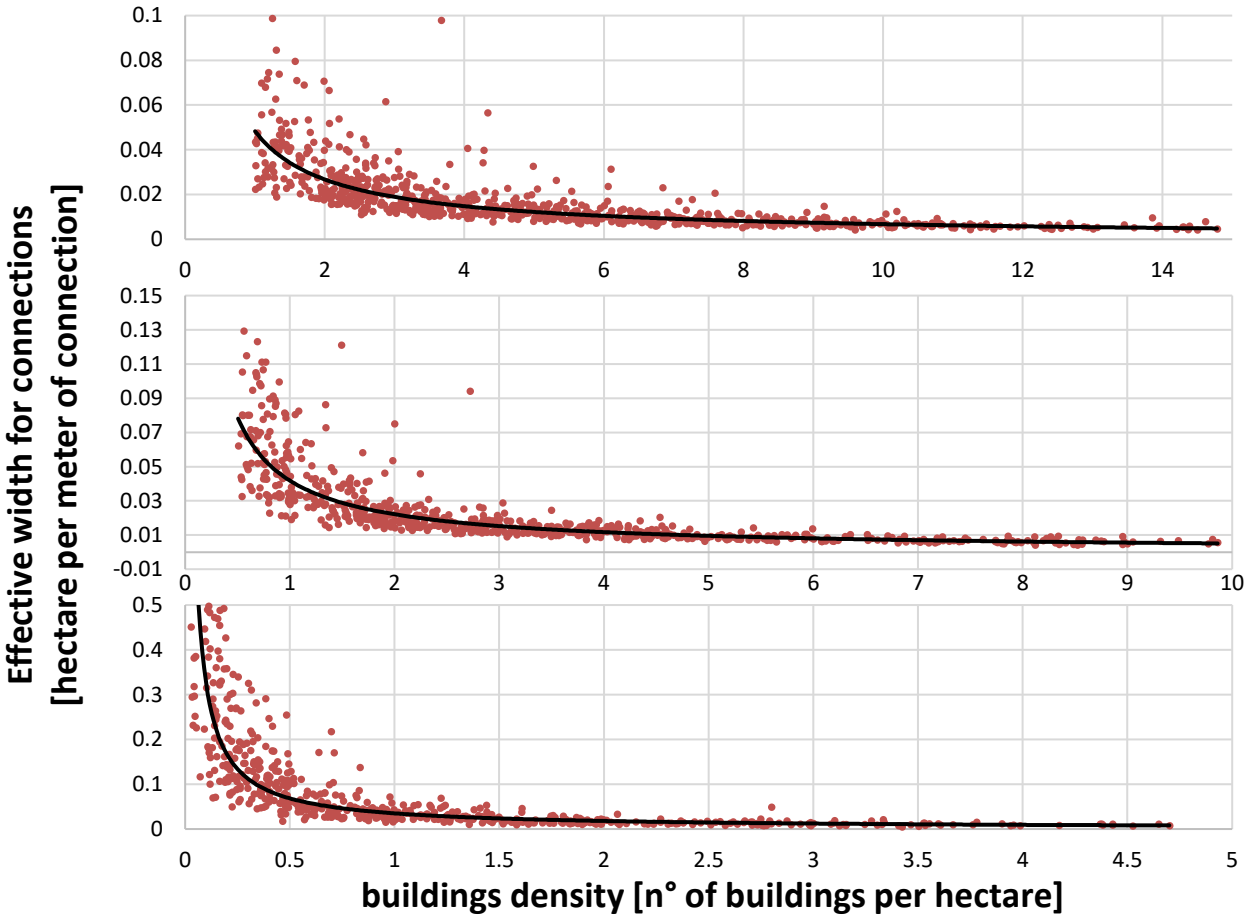

Area < 1 ha

$y = 0.0484x^{-0.856}$

$R^2 = 0.7629$

1 ha < Area < 2 ha

$y = 0.0419x^{-0.918}$

$R^2 = 0.8354$

Area > 2 ha

$y = 0.0348x^{-0.972}$

$R^2 = 0.8306$

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CONCLUSIONS

- Effective width accounting for connections (→ cost estimation)
- It can take into account different penetration (→4GDH)
- Based on open tool and data (→ replicable)

Next steps

- Increase the statistical population, also outside Lombardy and Italy – any external contribution is welcome
- Extend the analysis on the buildings of the tertiary sector
- Integrate the effective width curve and validate the final curve

Thank you for your attention

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