





Cities 
on power

Boosting energy efficiency and RES in urban context: from the plan to the project

**Giovanni Vicentini
Guglielmina Mutani**

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DEVELOPMENT FUND
The project is implemented through the CENTRAL EUROPE Programme co-financed by the ERDF

The concept **Cities** 
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Objective of the work: *finding the appropriate solutions at municipal level to boost energy efficiency and RES through the energy dossier of the building code*

- **Analysis of the geometric and typological features of the building stock**
- **Average energetic situation of the building stock**
- **Analysis of the climatic variables (ex. Degree days)**



Estimation of energy demand

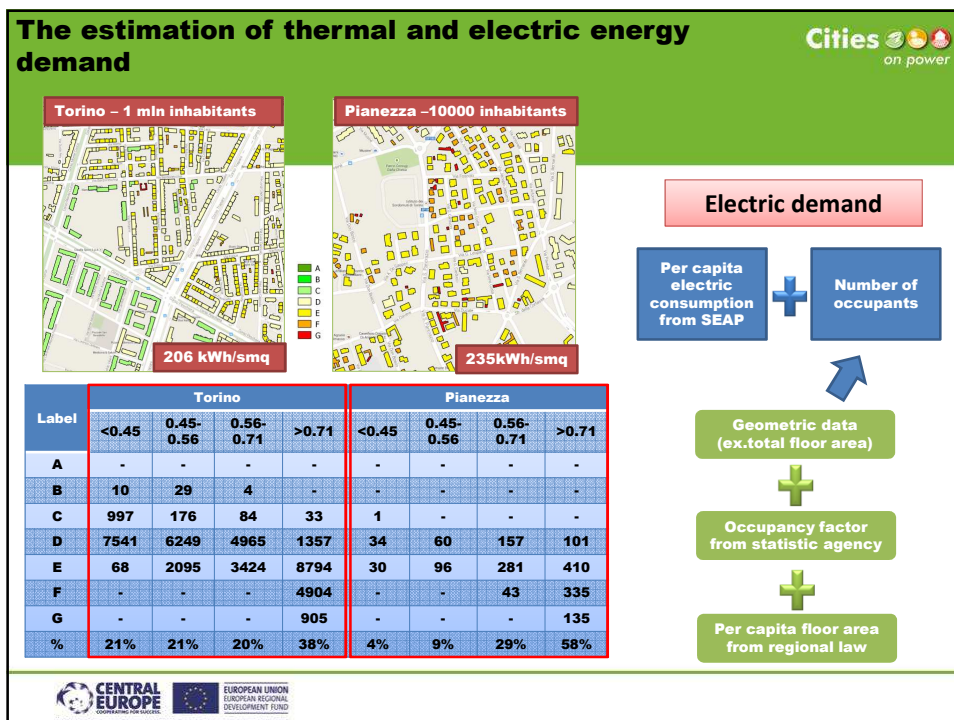
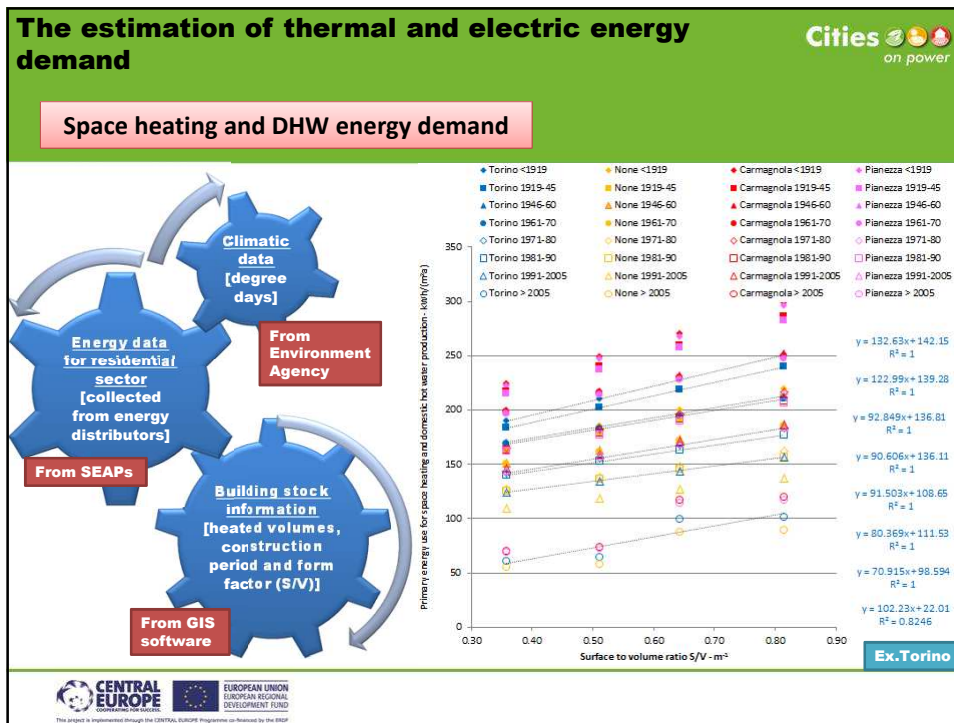
Evaluation of renovation potential

- **Analysis of the socio-economical variables**
- **Feasibility factor (how many buildings will be renovated?)**


- **Analysis of renewables energy supply potential**
- **Realistic objectives at municipal level (how much do the renewables will weight on?)**

Evaluation of RES potential


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The renovation of residential buildings

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To adapt the building code at local level is crucial to analyse the renovation feasibility factor



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**


Ownership factor:
dwellings owned / total dwellings
Variables: **DECISION, INTEREST**

Building factor:
small buildings (<2 dwellings)/ total buildings
Variables: **DECISION PROCESS**

Feasibility factor: estimation of the statistical inclination of citizens to renovate their own building, considering the physical condition of the object and the socio-economical variables.
 $F = F_{age} * 0,30 + F_{edu} * 0,20 + F_{employed} * 0,20 + F_{owner} * 0,15 + F_{building} * 0,15$

The renovation of residential buildings

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Feasibility factor (F)

➔

4 Statistical classes

➔

Type of interventions

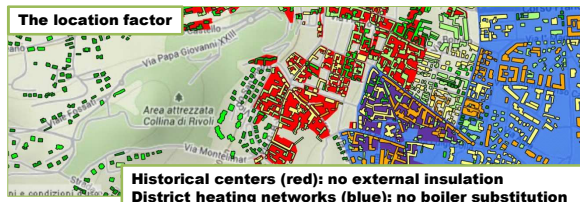
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Energy demand reduction:
a/ short term
b/ long term

Location factor (F)

⬆

The location factor



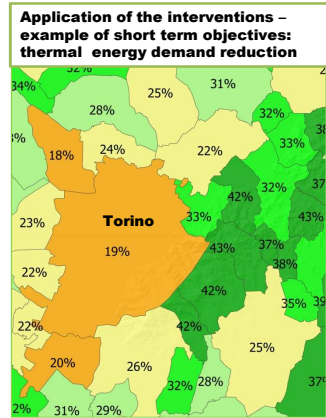
Historical centers (red): no external insulation
District heating networks (blue): no boiler substitution



Number of buildings (%)	First class	Second class	Third class	Fourth class
Province of Torino	13%	42%	39%	6%
City of Torino	20%	54%	23%	3%

Lower feasibility

Higher feasibility

Application of the interventions – example of short term objectives: thermal energy demand reduction



Satisfying energy demand with RES

Two renewables were considered in the analysis:
the solar resource and the biomass

The solar resource

Software: GRASS GIS - Tool: r.sun

Solar radiation maps

Digital Surface Model

Terrain + 3D buildings

Sky model

Turbidity factor, direct/diffuse radiation, ect

Sun model

Satisfying energy demand with RES


The biomass resource

RES potentials

Municipalities		Torino	Pecetto T.	Nichelino	Planzezza
Inhabitants 2011		874.000	3.867	48.011	14.006
Buildings (A)		35.800	1.033	2.936	2.503
Apartments (B)		440.000	1.775	20.352	7.050
Typology (B/A)		12,3	1,7	6,9	2,8
Potentials [MWh] -	PV	0,22	2,60	0,26	0,51
	ST	0,22*	0,21*	0,21*	0,18*
Per capita values	Biom	0,15	3,40	0,42	1,40
	Electric/thermal consumption from RES (max. %)	7%	60%	15%	27%

* Fixed value for the ST technology/ Residual roof space for PV

Conclusions

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Smart cities



The policies must be adapted to local needs: each group of buildings (target of the analysis) will be renovated stimulating in different ways the owners/tenants (ex. Awareness, Financial incentives or spit incentives , Grants, ect)


The smart cities need smart policies based on deeper analysis but also a real involvement of citizens and private stakeholders is essential

GIS softwares have a great potential with multi-level and territorial topics.
The open source solutions are really competitive with commercial ones

The open data are a very powerful instrument, but:

- the availability is low
- the goodness is unfrequent
- we must intercept also data coming from the private sector
- not so many data are georeferenced



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The end!

Giovanni Vicentini
Urban and energy planner
Consultant for the Province of Torino
giovanni.vicentini@gmail.com

Guglielmina Mutani
Assistant Professor at Department of Energy
Polytechnic of Torino
guglielmina.mutani@polito.it

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