edilportale TOUR 2016

Efficienza energetica e comfort abitativo
Tecnologie non invasive e sicurezza
Sostenibilità economica e ambientale

in collaborazione con VELUX tecnova group Innovative Green Building Solutions alubel tra la terra e il cielo

Verona, 08 giugno 2016

BOLZANO SMART CITY

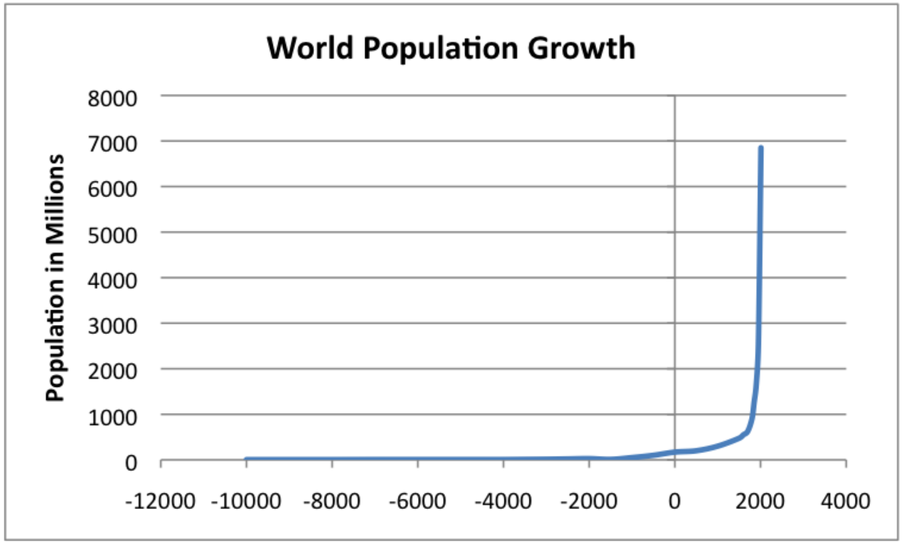
Petra Scudo

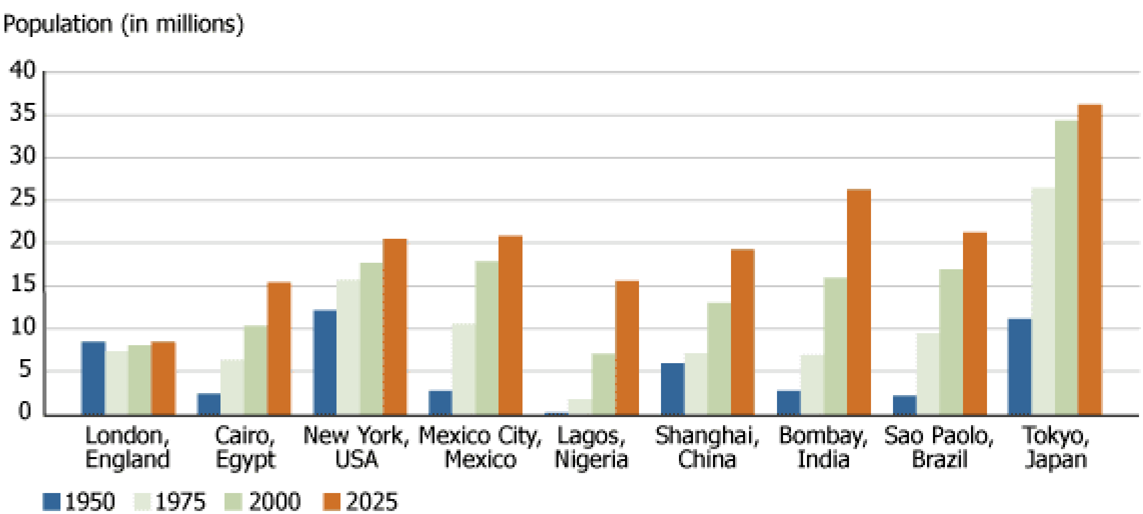
OUTLINE:

- WORLD URBANIZATION TRENDS
- CITY EVOLUTION
- CITIES AS COMPLEX SYSTEMS
- SMART CITY PLANNING
- SINFONIA: BOLZANO SMART CITY

edilportale TOUR 2016

WORLD URBANIZATION TRENDS





1950: 30% World population in cities
2008: 50% World population in cities
TODAY: 54% World population in cities
North America: 82%; South America: 80%; EU: 73%
BY 2100: 80% World population in cities

50% in medium/small cities (< 500000 inh)
12,5% in the 28 mega-cities (>10 Mln inh)

TOKYO 38 Mln
DEHLI 25 Mln
SHANGAI 23 Mln
MEXICO CITY; **MUMBAI**
SAO PAULO 21 Mln

EURAC research

EVOLUTION OF CITIES

First cities: tight, bound, compact
Last 200 years: first walls went off, then suburbs came, finally national transportation
London first reached 1 Mln inh

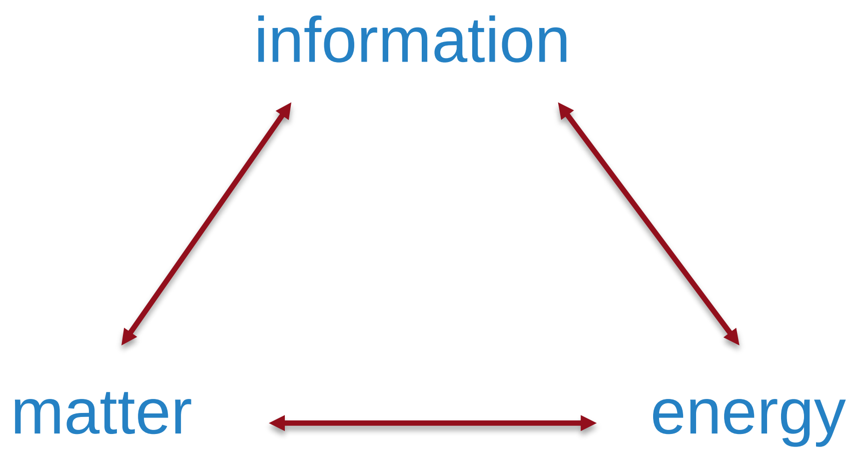
Today's cities: more people living in cities, more connections, faster information flow. Cities as connected graphs, hyperlinks in space/time

Future cities: *when all the world is a city.. WILL WE STILL SPEAK OF CITIES?*
Defining **density** and **connectivity**

EURAC research

URBANIZATION: COMPLEXITY

CITIES ARE **COMPLEX ADAPTIVE SYSTEMS**:
- Heterogeneity of people
- Circular causality feedbacks
- Everything is interconnected
- Cities develop in open-ended ways
- Human developmwent is about INFORMATION
- Evolution of information



FACTS ABOUT CITIES:

- When a city doubles in size, per capita **ECONOMIC PRODUCTIVITY INCREASES BY 15%**
- Cities rely on INFRASTRUCTURES
- Cities are SOCIAL NETWORKS

- There is a set of scaling relations for average social spatial infrastructural properties common **to all CITIES**

- A city is a **dynamical system**: It needs to evolve around you and you around the city
- Cities are general purpouse **social reactors**

- URBAN PLANNING STRATEGIES:
  average **global properties** of cities set by a few **key parameters**

Building a SMART CITY

A slew of initiatives are taking place islandwide, the goal of which is to sharpen the Government's response to city issues and hence improve people's day-to-day lives.

TOWN PLANNING

What: A modelling system to simulate a city's built environment and its impact on the natural environment, people, resources and costs

Who: HDB, Electricite de France, Veolia

Uses: Among other things, show how different land uses affect amenities and transport networks; how to design new housing blocks to get ideal wind flow; where best to build cycling paths

Status: Research collaboration / prototype stage

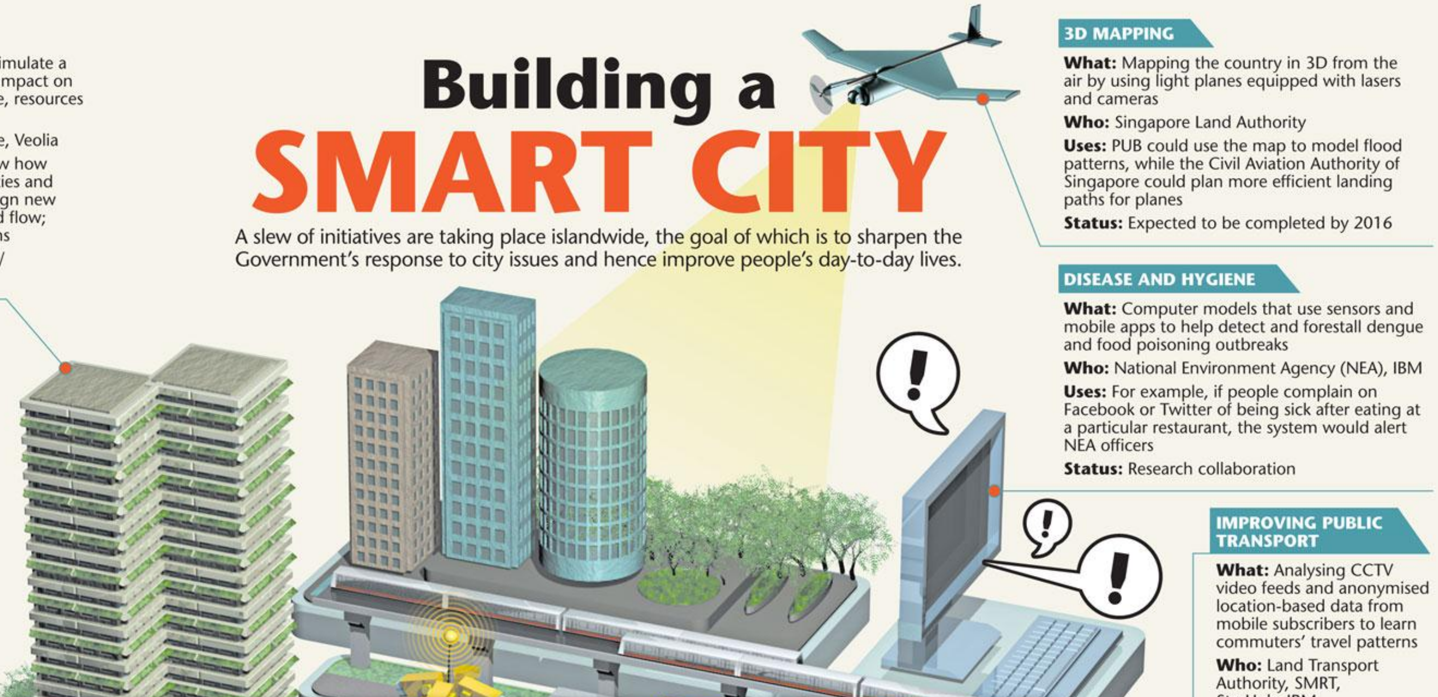
WATER QUALITY AND LEAKS

What: A network of wireless sensors that monitors water quality and detects leaks in real time

Who: PUB, Singapore-MIT Alliance for Research and Technology, Visenti

Uses: Allows PUB to repair leaks faster and reduce water loss

Status: About 300 sensors installed by end-2015



3D MAPPING

What: Mapping the country in 3D from the air by using light planes equipped with lasers and cameras

Who: Singapore Land Authority

Uses: PUB could use the map to model flood patterns, while the Civil Aviation Authority of Singapore could plan more efficient landing paths for planes

Status: Expected to be completed by 2016

DISEASE AND HYGIENE

What: Computer models that use sensors and mobile apps to help detect and forestall dengue and food poisoning outbreaks

Who: National Environment Agency (NEA), IBM

Uses: For example, if people complain on Facebook or Twitter of being sick after eating at a particular restaurant, the system would alert NEA officers

Status: Research collaboration

IMPROVING PUBLIC TRANSPORT

What: Analysing CCTV video feeds and anonymised location-based data from mobile subscribers to learn commuters' travel patterns

Who: Land Transport Authority, SMRT, StarHub, IBM

Uses: Help agencies respond better to unplanned incidents on the train and bus network, such as breakdowns or emergencies

Status: Research collaboration

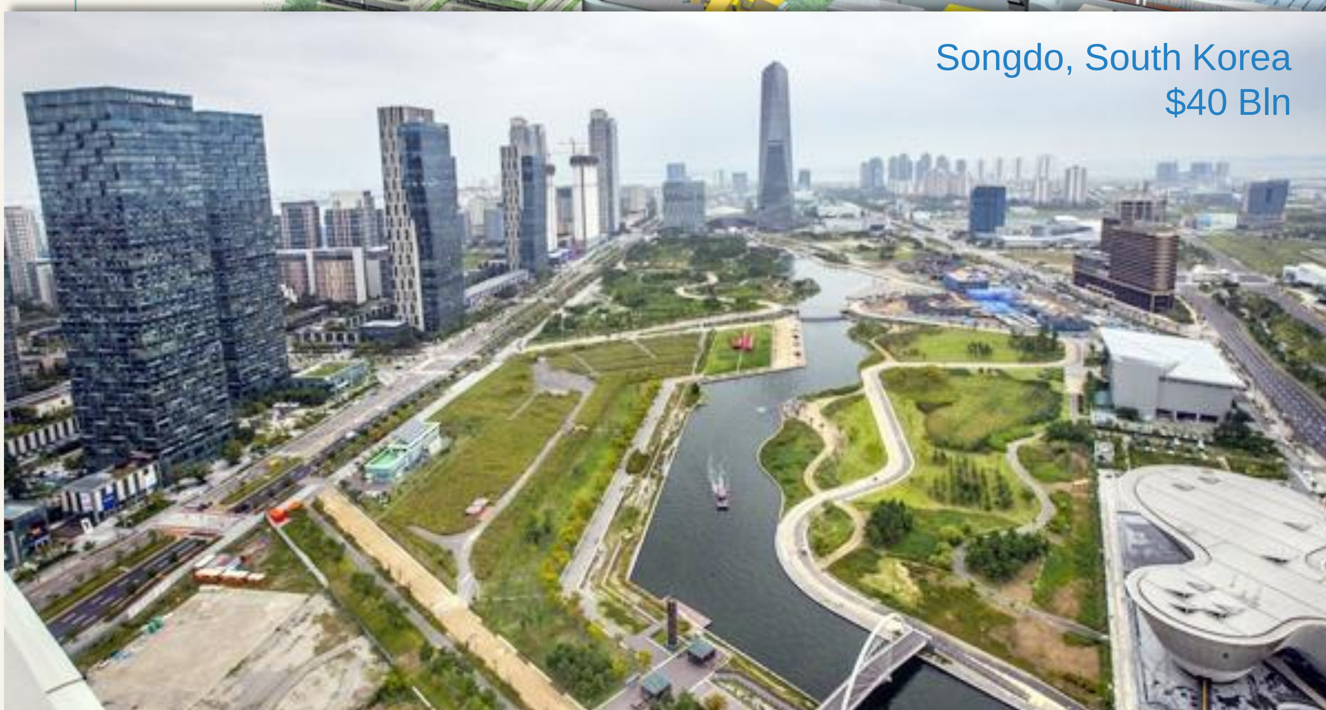
PROTECTING THE SEA

What: Eight buoys along coastline with sensors that test waters for pollutants and send real-time updates wirelessly to the NEA

Who: National Environment Agency (NEA)

Uses: Early detection of oil or chemical spills

Status: In place



edilportale TOUR 2016

Forbes

The Top 5 Smart Cities In The World

- Technologies
- Buildings
- Utilities
- Transportation & road infrastructure
- The smart city itself

edilportale® TOUR 2016

The Origins of Scaling in Cities

Luís M. A. Bettencourt

Despite the increasing importance of cities in human societies, our ability to understand them scientifically and manage them in practice has remained limited. The greatest difficulties to any scientific approach to cities have resulted from their many interdependent facets, as social, economic, infrastructural, and spatial complex systems that exist in similar but changing forms over a huge range of scales. Here, I show how all cities may evolve according to a small set of basic principles that operate locally. A theoretical framework was developed to predict the average social, spatial, and infrastructural properties of cities as a set of scaling relations that apply to all urban systems. Confirmation of these predictions was observed for thousands of cities worldwide, from many urban systems at different levels of development. Measures of urban efficiency, capturing the balance between socioeconomic outputs and infrastructural costs, were shown to be independent of city size and might be a useful means to evaluate urban planning strategies.

Cities exist, in recognizable but changing forms, over an enormous range of scales (*1*), from small towns with just a few people to the gigantic metropolis of Tokyo, with more than 35 million inhabitants. Many parallels have been suggested between cities and other complex systems, from river networks (*2*) and biological organisms (*3–6*) to insect colonies (*1*, *7*) and ecosystems (*8*). The central flaw of all these arguments is their emphasis on analogies of form rather than function, which limit their ability to help us understand and plan cities.

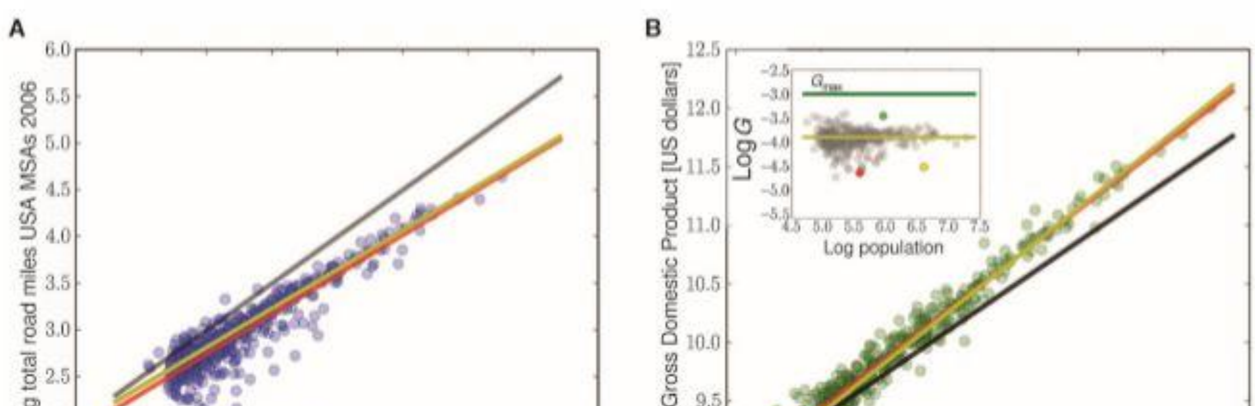
Santa Fe Institute, 1399 Hyde Park Road, Santa Fe, NM 87501, USA.
E-mail: bettencourt@santafe.edu

Recently, our increasing ability to collect and share data on many aspects of urban life has begun to supply us with better clues to the properties of cities, in terms of general statistical patterns of land use, urban infrastructure, and rates of socioeconomic activity (*6*, *9–13*). These empirical observations have been summarized across several disciplines, from geography to economics, in terms of how different urban quantities (such as the area of roads or wages paid) depend on city size, usually measured by its population, *N*.

The evidence from many empirical studies over the past 40 years points to there being no special size to cities, so that most urban properties, *Y*, vary continuously with population size and are well described mathematically on average by power-law scaling relations of the form $Y = Y_0 N^\beta$, where Y_0 and β are constants in *N*. The surprise, perhaps, is that cities of different sizes do have very different properties. Specifically, one generally observes that rates of social quantities (such as wages or new inventions) increase per capita with city size (*11*, *12*) (superlinear scaling, $\beta = 1 + \delta > 1$, with $\delta \simeq 0.15$), whereas the volume occupied by urban infrastructure per capita (roads, cables, etc.) decreases (sublinear scaling, $\beta = 1 - \delta < 1$) (Fig. 1). Thus, these data summarize familiar expectations that larger cities are not only more expensive and congested, but also more exciting and creative when compared to small towns.

These empirical results also suggest that, despite their apparent complexity, cities may actually be quite simple: Their average global properties may be set by just a few key parameters (*12*, *13*). However, the origin of these observed scaling relations and an explanation for the interdependences between spatial, infrastructural, and social facets of the city have remained a mystery.

Here, I develop a unified and quantitative framework to understand, at a theoretical level, how cities operate and how these interdependencies arise. Consider first the simplest model of a city with circumscribing land area *A* and



EURAC research

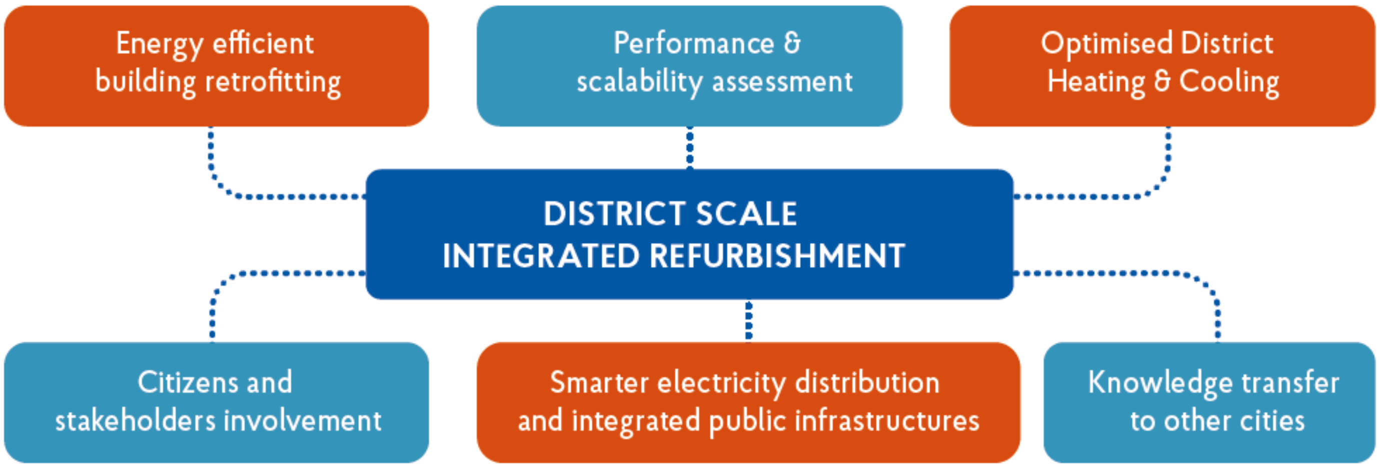
SEVENTH FRAMEWORK PROGRAMME

SINFONIA PROJECT – FP7 8.8.1 ENERGY SCC

2014-2019

“SMART INITIATIVE OF CITIES FULLY COMMITTED TO INVEST IN ADVANCED LARGE-SCALED ENERGY SOLUTIONS”

SINFONIA: STRUCTURE AND OBJECTIVES

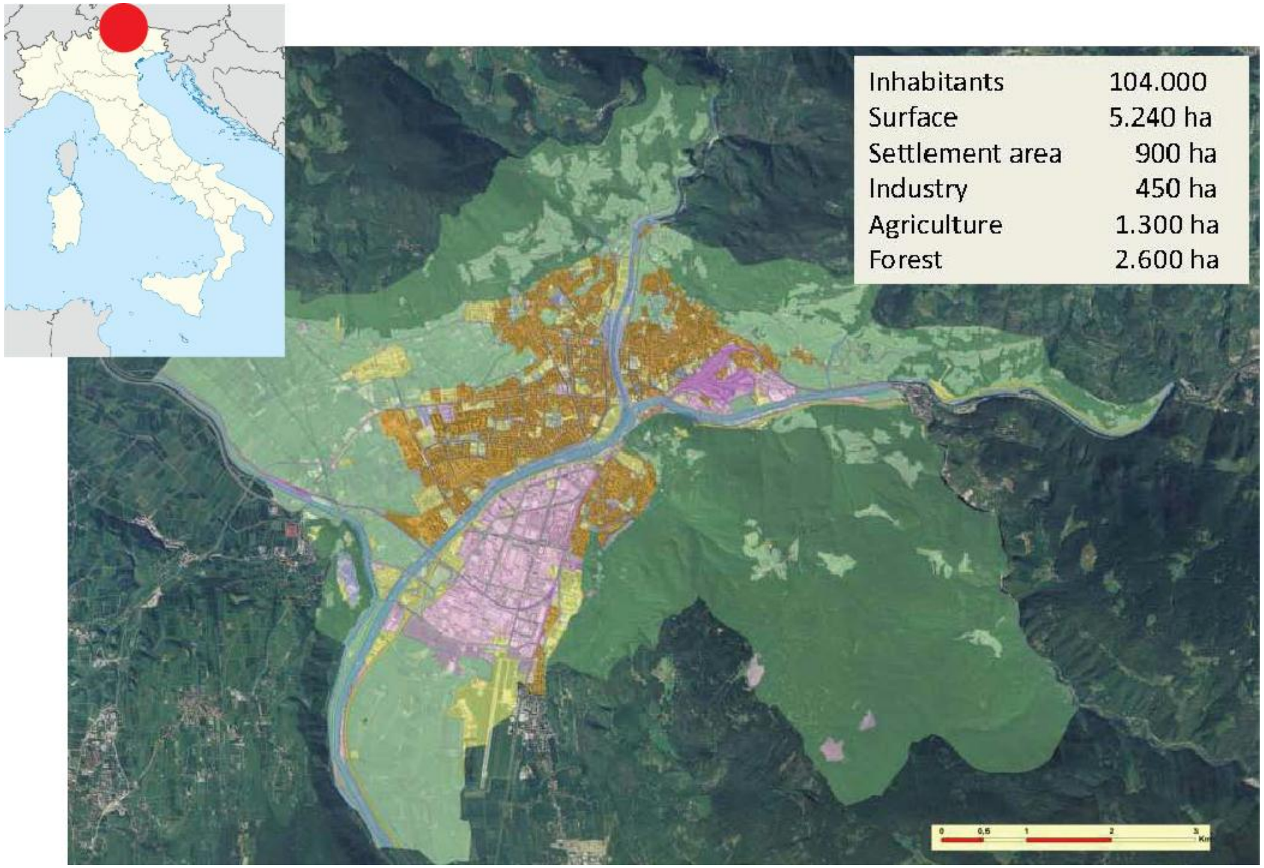


FOCUS ON **DISTRICT** LEVEL
REPLICABLE AND SCALABLE
solutions to:

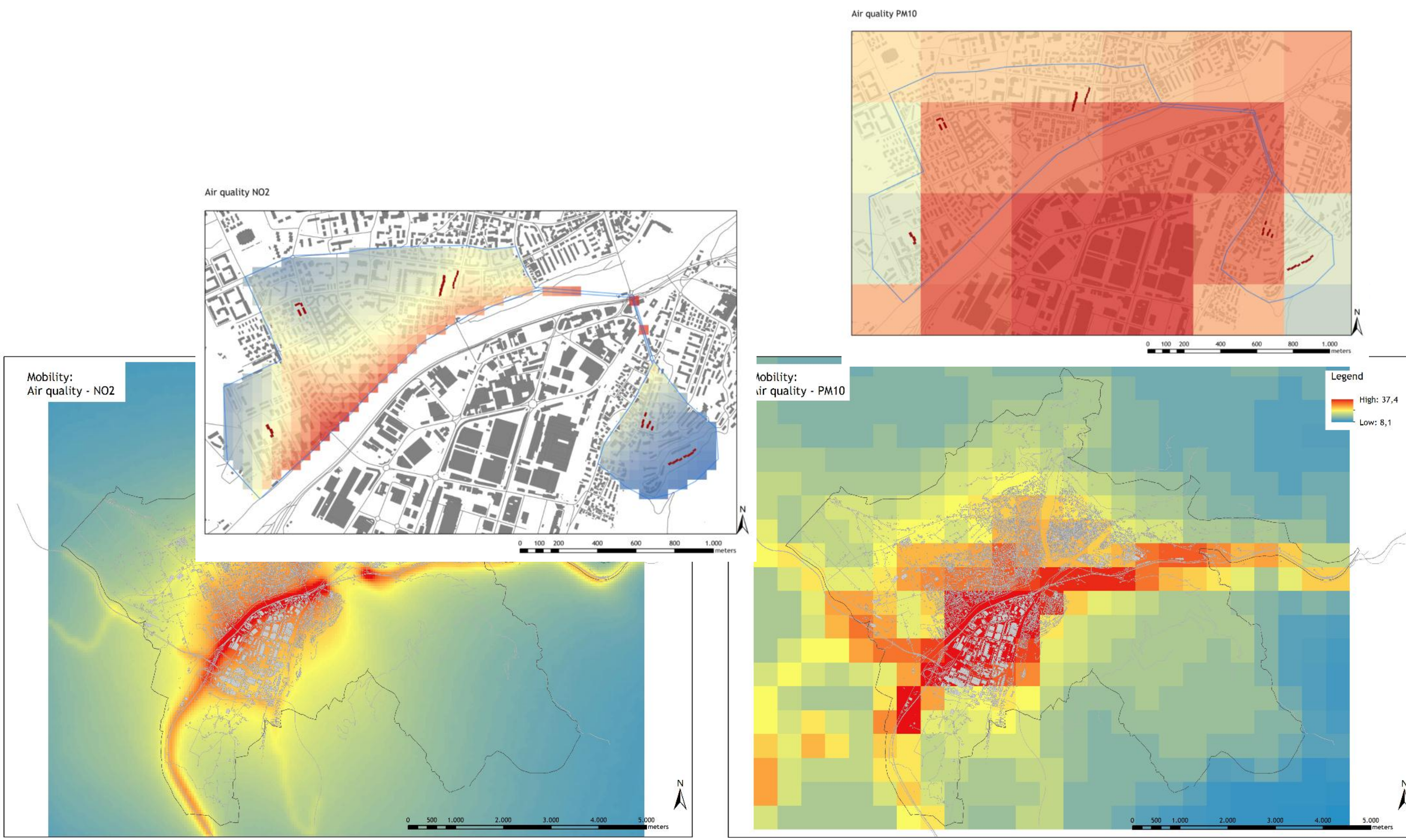
- Achieve 40 to 50% primary energy savings
- Increase the share of renewables by 20% in the district

- Retrofitting of > **37,000m²** of living surface
- Optimisation of the electricity grid
- Solutions for district heating and cooling

BOLZANO

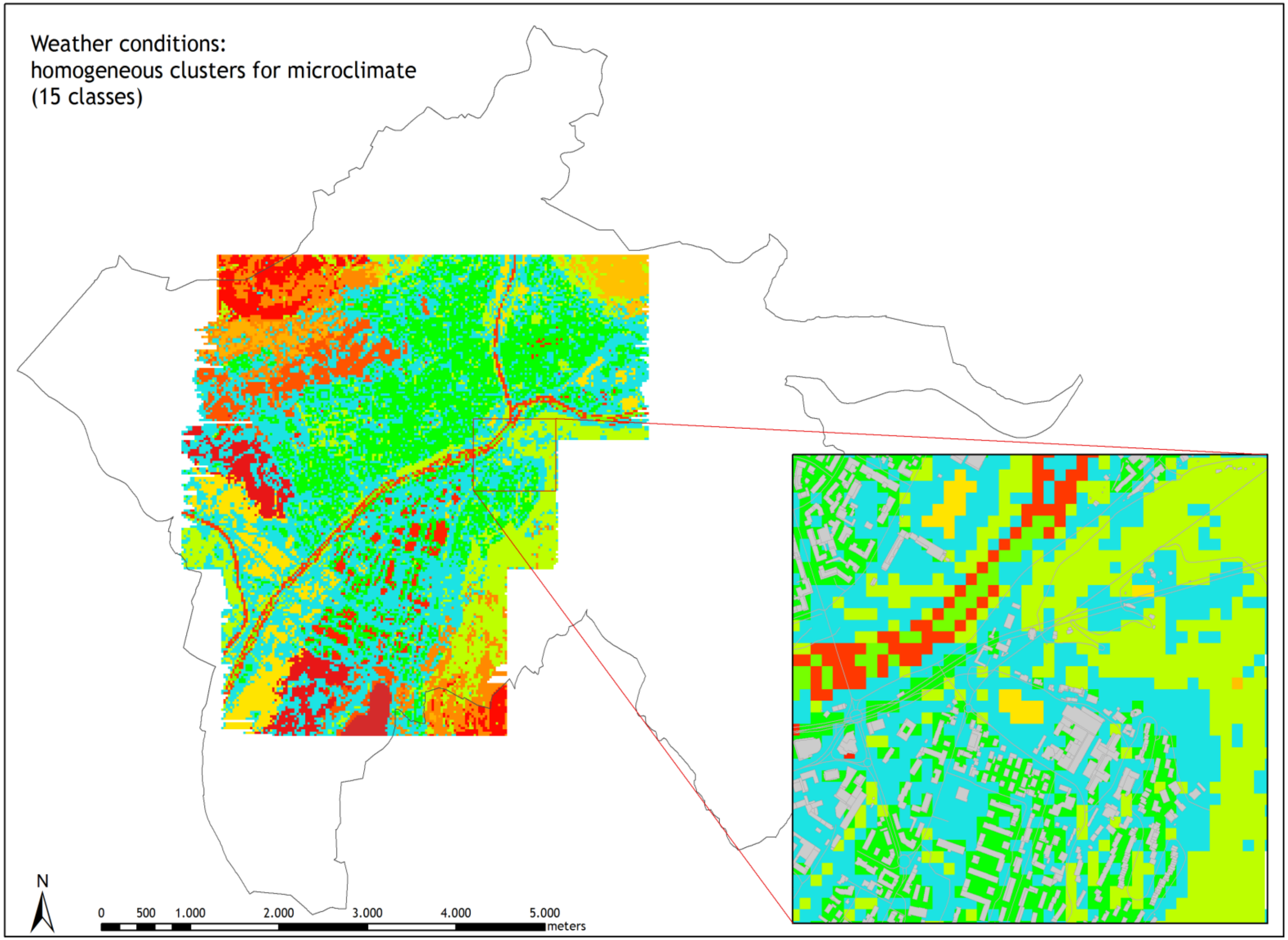

Inhabitants 104.000
Surface 5.240 ha
Settlement area 900 ha
Industry 450 ha
Agriculture 1.300 ha
Forest 2.600 ha

MOBILITY: AIR QUALITY

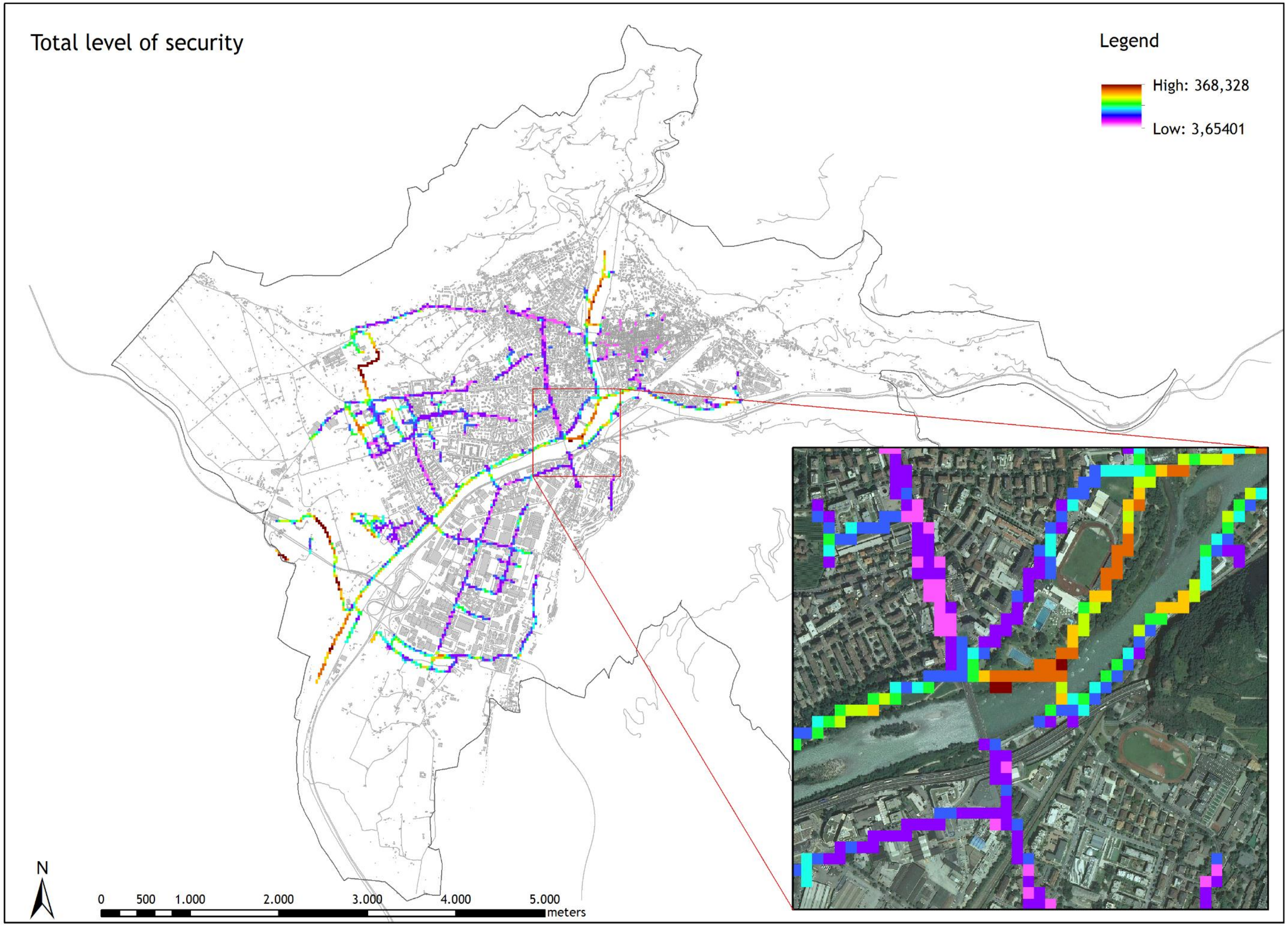


EURAC research

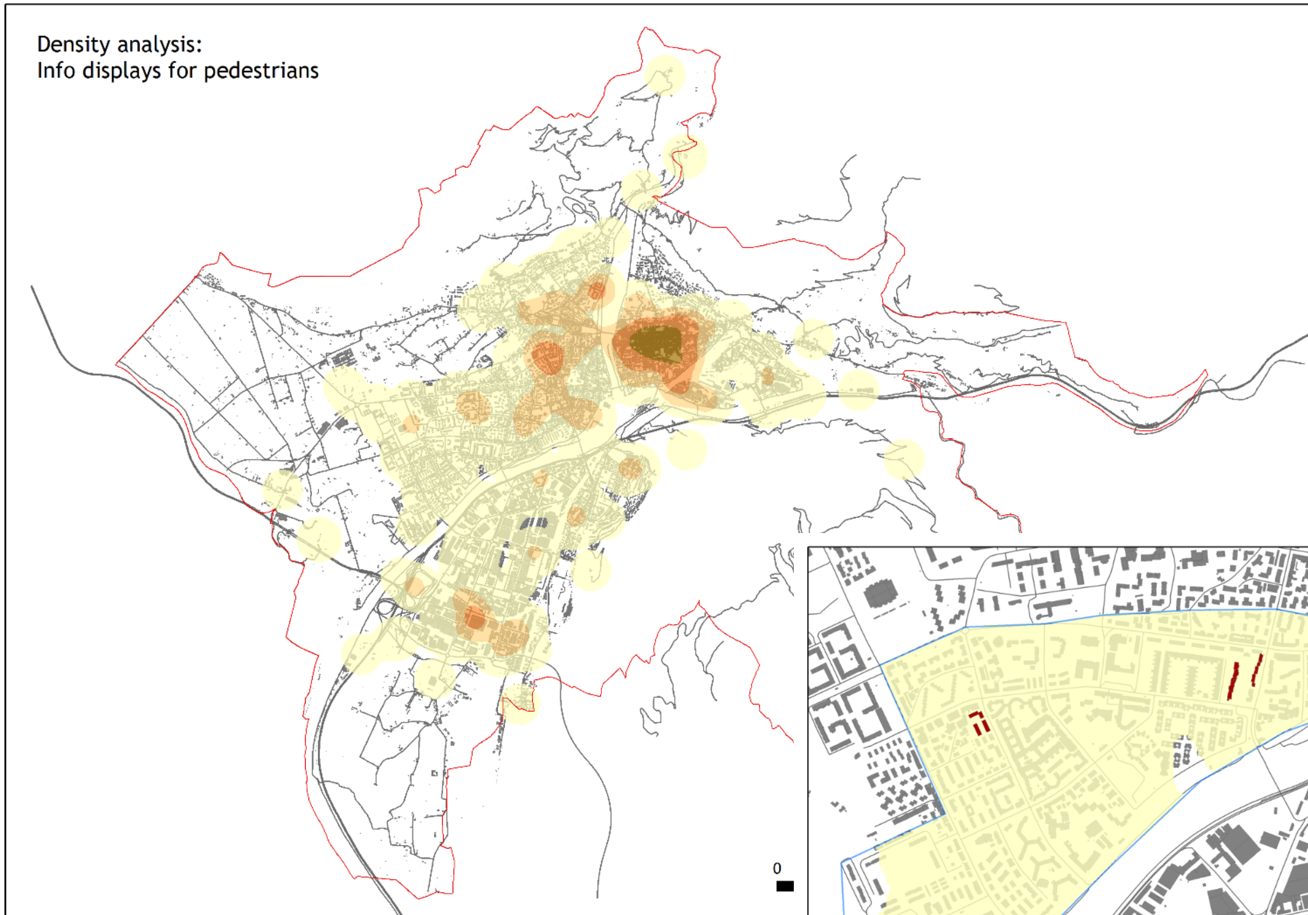
MICROCLIMATE: WEATHER CLUSTERS



SECURITY

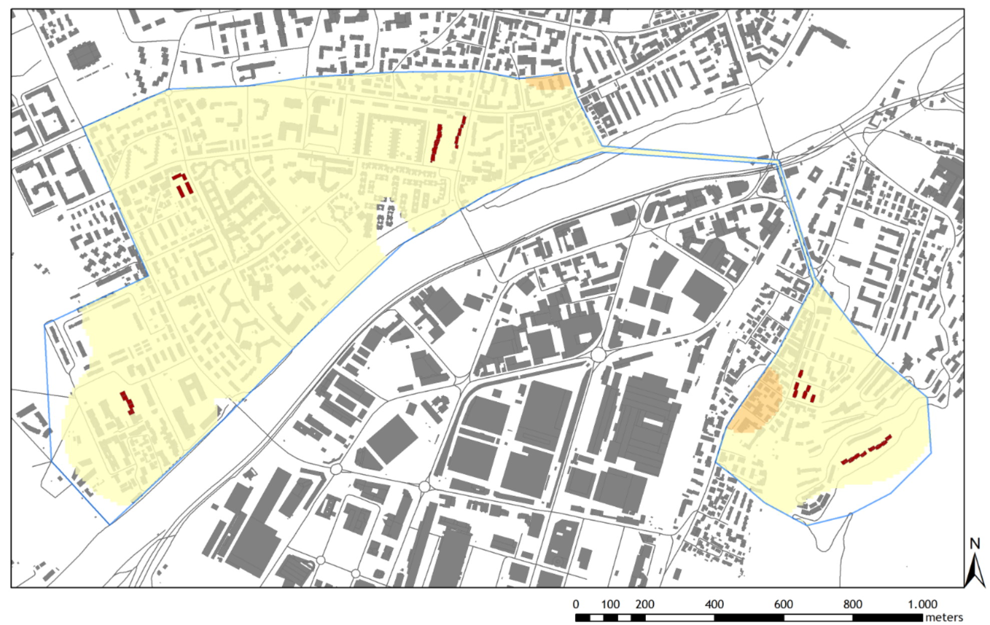

Total level of security
Legend
High: 368,328
Low: 3,65401
N
0
500
1.000
2.000
3.000
4.000
5.000
meters

INFO/SERVICES TO CITIZENS

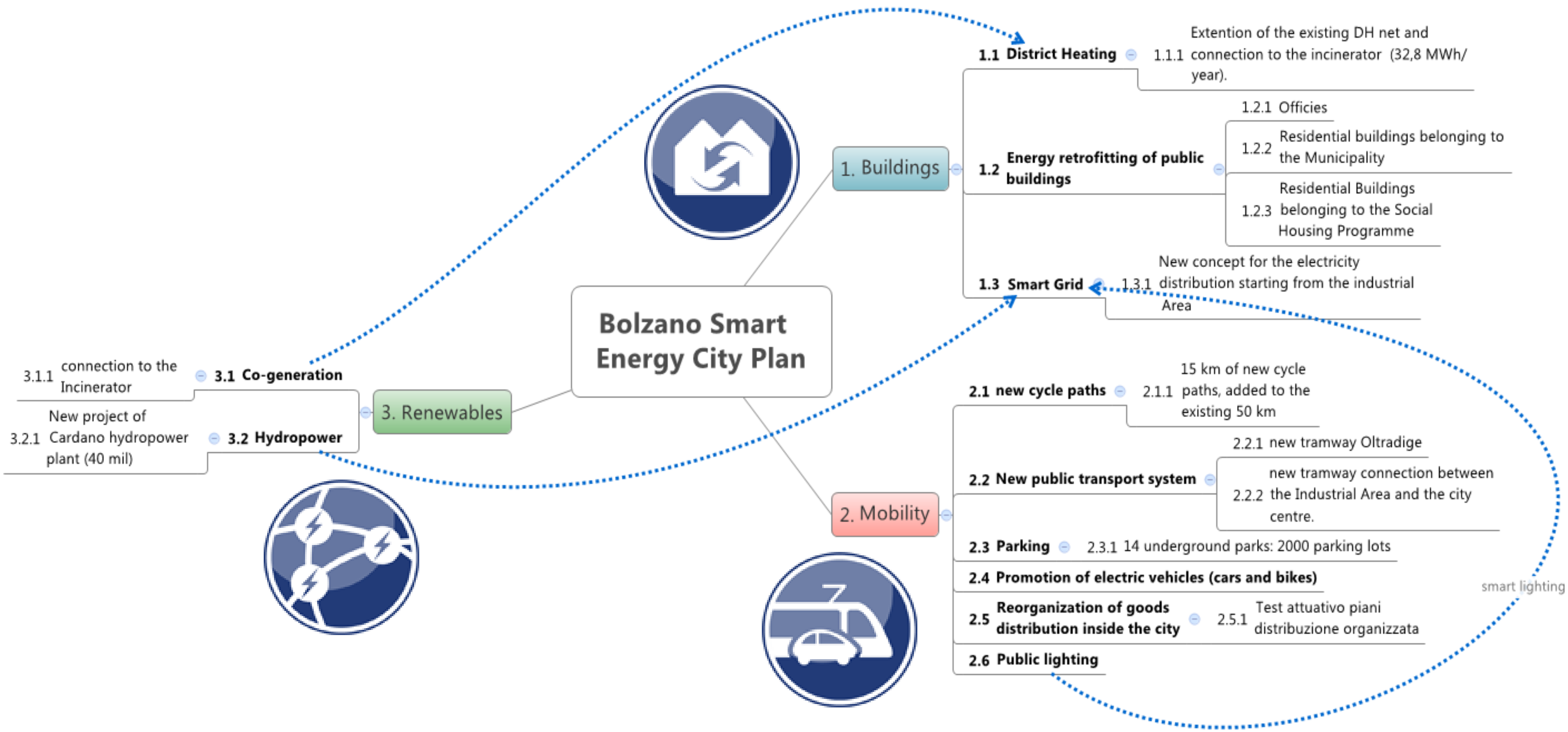


DENSITY WEIGHTED ANALYSIS OF:

- **schools** (with internal weights),
- **bars/restaurants, stores** (>= 50 workers),
- **theaters/museums, parking** (no hospital and >= 150 places),
- **stations** (bus and train),
- **principal squares**



SUSTAINABLE ENERGY PLAN



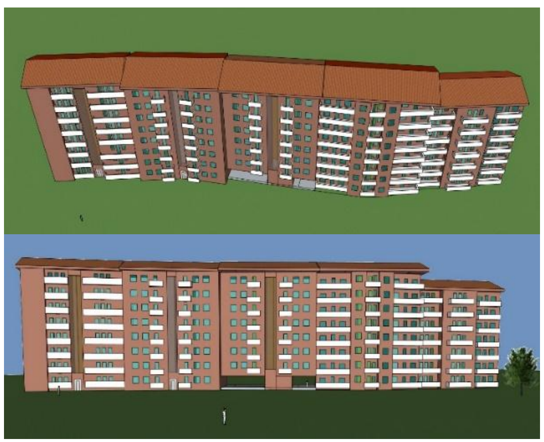
EURAC research

Sinfonia a Bolzano

Citizens living in refurbished area	15,000
Total refurbished area	37,000m²
Dwellings retrofitted	451
Estimated Energy Savings	50%

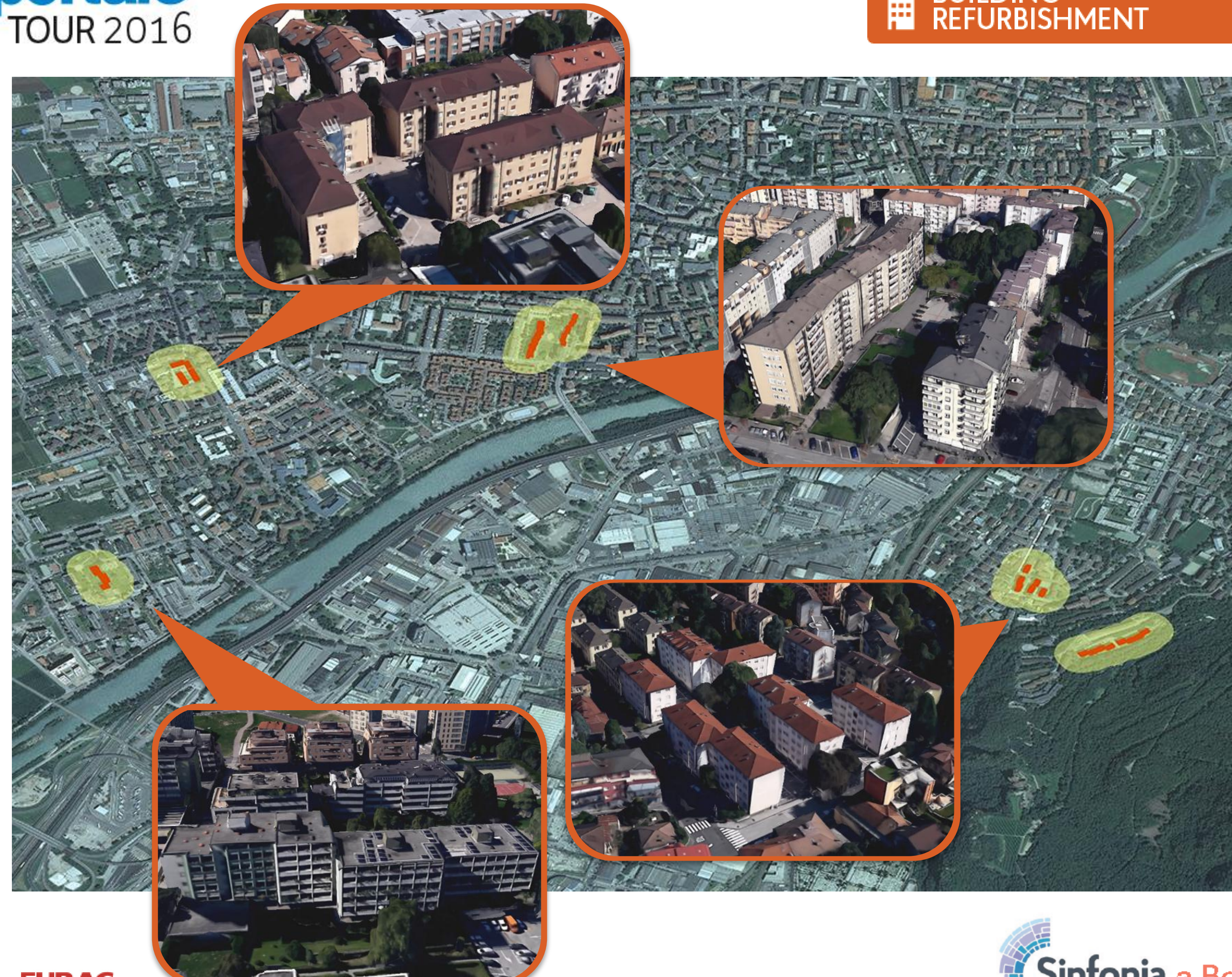
SOCIAL HOUSING BUILDINGS OF 1950-70TIES

- Building envelope insulation;
- Integration of renewable energy sources for electricity, heating and domestic hot water;
- PV panels;
- Additional storeys using innovative timber construction technologies.



edilportale TOUR 2016

BUILDING REFURBISHMENT



Sinfonia a Bolzano

EURAC research

VIA ASLAGO
AREA ARCHITETTI


VIA PARMA
M7 ARCHITECTURE

PASSEGGIATA DEI CASTANI

STUDIO MELLANO&ARCH+MORE

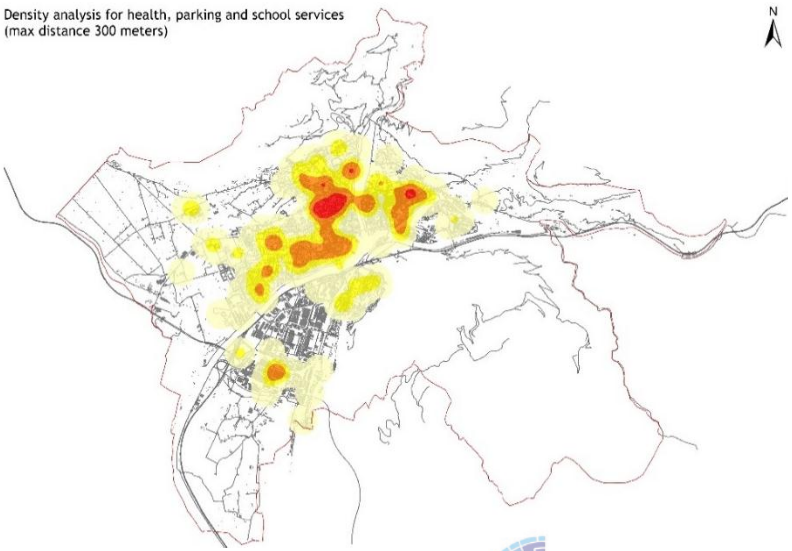
edilportale TOUR 2016

ELECTRICITY GRID

Smart points	150
Different services	6
Citizens involved	50,000

URBAN SERVICE-ORIENTED SENSIBLE GRID (USOS-GRID)

- Recharge points for vehicles and bicycles;
- Meteorological stations for local climate condition monitoring;
- Smart retrofitting of the public lighting system.



EURAC research

Sinfonia a Bolzano

Expected reduction of

CO2eq up to **30%**

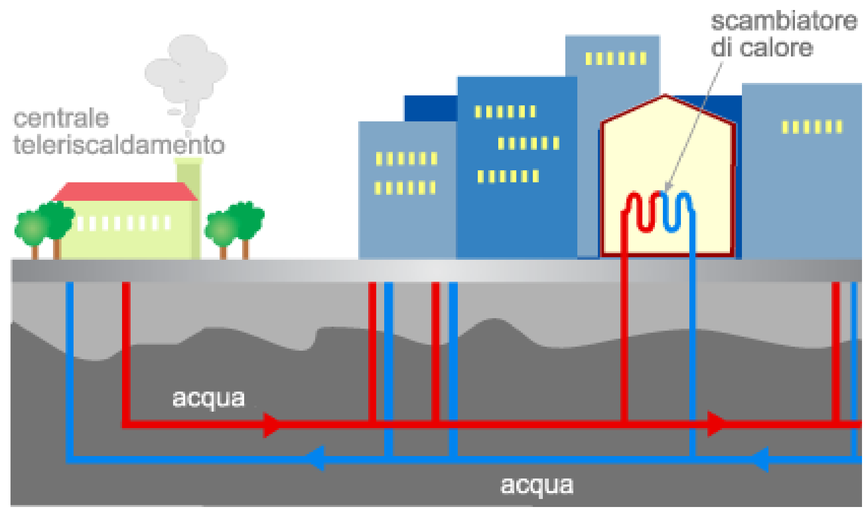
NOx up to **60%**

THE DISTRICT & COOLING NETWORK EXTENDED AND OPTIMISED

- Real time monitoring and forecasting of peak loads and energy demand;
- Hybrid hydrogen/methane backup system;
- Feasibility study for recovery of wasted energy in the local industrial park.







WWW.SINFONIA-SMARTCITIES.EU