CLIMATE-RESILIENT URBAN DESIGN

Regenerating cities through adaptive mitigation solutions

NAPOLI

SIMMCITIES_NA project
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Department of Architecture

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DiARC Dipartimento di Architettura
SIMMCITIES_NA
NYIT New York Institute of Technology
UPEM Université Paris Est Marne La Vallée
Universidad Católica de Chile
SITdA Società Italiana della Tecnologia dell'Architettura
UCCRN Urban Climate Change Research Network

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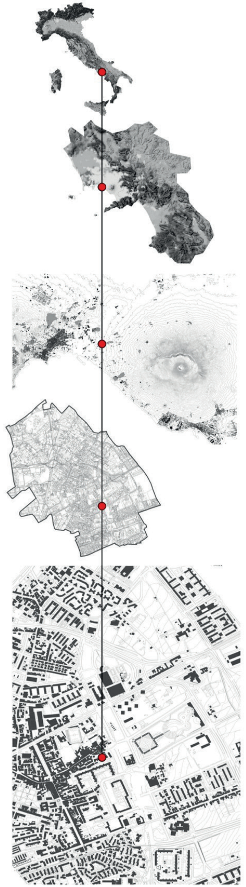
CONTENTS

Introduction

Climate change impacts are already visible today, with extreme heat and precipitation events increasingly growing in frequency and intensity worldwide. Urban climate must be a key consideration in the planning and design of contemporary cities. Climate resilient principles need thus to be integrated in the design process as a knowledge area linked to architectural disciplines. The issue of climate resilience in urban areas requires the development of innovative design methods that can handle the complexity of the information needed to guide sustainable urban regeneration and retrofitting strategies, as well as to manage the technological and environmental solutions in a multi-scale erspective. Cities represent in this sense the main field of experimentation of innovative and climateresilient design principles and methods. The International Conference and Workshop *Climate-Resilient Urban Design - Napoli* (Naples, 4-12 October 2018) has explored such concepts with the goal of developing integrated design strategies for configuring or retrofitting compact and mixed-use eco-districts that can adapt and thrive in the changing global conditions, meet carbon-reduction goals and provide new public spaces and facilities in relation to community priorities. The proposed design method, based on the principles and methodology developed by the UCCRN ARC3.2 *Urban Planning and Urban Design* working group, is process-oriented and focuses on sequential and iterative design steps implemented through a multi-disciplinary and multiscale approach.



Workshop Steps

Climate Analysis Mapping provide a critical first step in identifying urban zones subject to the greatest impacts associated with rising temperatures, increasing precipitation and extreme weather events, providing downscaled climate projections as preliminary information to orient evidence-based design uidelines. Depending on the scale of the analyses, GIS-based (UMEP, Solweig) and Parametric 3D modelling tools (Rhinoceros, Grasshopper) allow to refine morphological approaches to urban microclimate and sustainability outcomes, providing further information about occurrence and frequency of air masses exchange, thermal and air quality effects of urban climate (stress areas, insolation rates, shading conditions), buildings-open spaces energy exchange optimization.

Site surveys and Public Space Evaluation allow to couple urban climate considerations with insights about needs and expectations of local communities, whose priorities in terms of urban regeneration and building/open spaces retrofitting are often more related to a general improvement of housing and public services, to increase neighbourhood liveability, sustainable mobility and social inclusion. Existing issues such as mono-functional residential areas, interchange parking lots, playgrounds for children, green areas, pedestrian routes and cycling paths can be conveniently integrated in the design proposals to balance climate and community resilience instances.

Planning and Design Intervention phase is grounded on a critical review of the collected information to identify the relevant synergies and trade-offs in relation to the planned initiatives in the areas, as envisaged by local authorities in the mid- to long-term. Zoning regulations and building codes frame the boundaries of the design and technical options to be assessed, and the most appropriate strategies targeted for future development. Recurring design topics include: technological and energy retrofitting of buildings (envelope and HVAC systems) to achieve NZEB targets; reduction of urban heat islands through reflecting surfaces and building / urban greening solutions; optimization of urban ventilation via air exchange and wind corridors through variation of building density and mass; regulation of surface run-off through sustainable urban drainage systems.

Post-Intervention Evaluation is intended as a sequence of activities aimed at assessing the benefits of the proposed solutions in terms of microclimatic, energy and environmental performance, as well as of compliance with community priorities. The evaluation of design solutions is carried out through GIS-based parametric 3D modelling tools that can simulate climate, energy and environmental behaviour at building and neighbourhood scale.

East Naples Case Study

The eastern area of Naples was the most extended district included in the Special Plan for Housing (Piano Straordinario di Edilizia Residenziale, PSER)

launched following the 1980 earthquake. The plan of Ponticelli zone (Piano di Zona di Ponticelli) has provided 3,700 houses of the 13,000 planned by the Special Plan. The design of the new urban blocks, which accommodate more than 18,000 people, has been driven by the choice of adopting specific building typologies and prefabricated building echnologies with the aim of accelerating the construction process in order to satisfy the immediate need of the population and to offer a political response to the urgent situation. The metamorphosis of this area generated by the new building stock was more shocking then the earthquake event itself: from an agricultural landscape and economy already compromised by the near industrial area of San Giovanni a Teduccio, the built and the natural environment shifted to a metropolitan dimension changing the relation between the center and the peripheral belt of the city in a definitive way. The socio-cultural "shock" of the local residents following the massive transfer of people from the heavily damaged popular districts of Napoli city centre has resulted in a mutual segregation of the two communities which is still unresolved.
After almost 40 years Ponticelli represents an emblematic sample of the Neapolitan emergency and redevelopment process that occurred after the earthquake of 1980. In this neighborhood the post-disasterthreefold strategy – temporary houses, new residential complexes, recovery and retrofitting of damaged buildings – still co-exist and define the nature of the district. Several criticalities arise by a complex interaction between the urban morpholo-

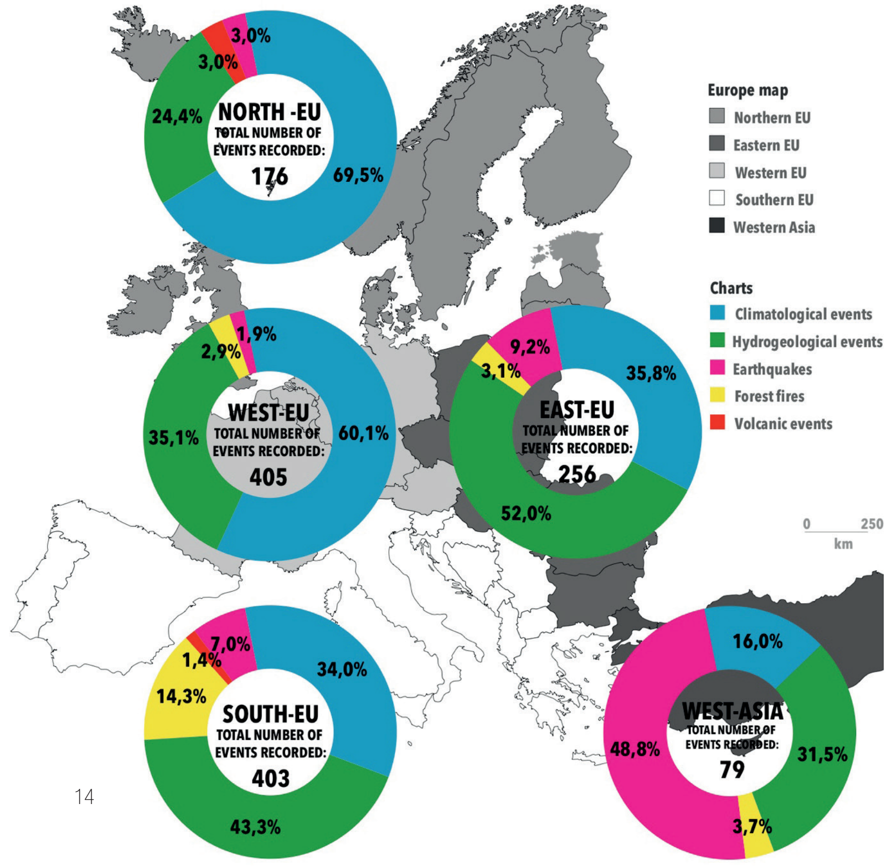
gies, housing typologies and the use of private and public spaces stressing the social dynamics and the failures of the post-earthquake interventions.
Currently the main issues characterizing the area, to be intended as direct and indirect consequences of the PSER program, can be summarized as follow:
- Temporary houses became permanent houses (Parco Galeazzo)
- Lack of infrastructures and public services caused by the non-completion of the networks and public activities planned (as in the official Programs and Plans)
- Urban fragmentation (social and spatial) with segregation dynamics between PSER urban blocks and private residential complex
- Structural and technological decay of the social housing stock provoked by the lack of maintenance, the variation of the intended uses and by the public ownership of the buildings
- Exacerbation of emerging environmental risks in particular the climate change related hazards (heat waves and pluvial floods) and the healthy risk (polluted sites) intensified by the transformation model of the area. The district shifted from an agricultural wet-land structured around productive and housing unit of Casali (historical typology of housing unit and farm) to an extended residential zone with a high percentage of sealed soils, lack of vegetation and disuse of historical drainage systems.
In the perspective of a resilience approach to the urban settlement as a

complex system, the study of Ponticelli as an area spatially, socially and culturally scarred by the post-earthquake projects could be conceived both to interpret the multiple failures (architectonic, social and political) of the post-disastermeasures and to configure a transition toward a more sustainable and resilient settlement.
The case study will focus on design answer to three key challenges:
- understanding the issues of urban warming / extreme weather events and their impact in dense cities;
- addressing climate-resilient solutions tailored according specific needs in existing districts;
- identifying climate mitigation strategies that yield concurrent adaptive benefits;
- proposing design approaches driven by community resilience principles able to enhance the ongoing initiatives from local associations and residents.

Workshop teams
Four design teams focused on complementary aspects needed to guide the urban regeneration process in a climate-resilient perspective:
DES1 - Climate Resilient Urban Planning
DES2 - Climate Resilient Urban Design
TECH - Adaptive Mitigation Solutions for Buildings and Open Spaces
COM - Creative Communication and Dissemination with Local Community

DES1 and DES2 teams will appoint 2 members each to allow the proper exchange of information with TECH
and COM teams during the implementation of the Workshop Steps implementation.
TECH will focus on identifying and communicating the benefits of adaptive mitigation technical solutions suitable for Napoli area and other sites characterized by similar climate conditions and climate change patterns. The solutions will be classified in relation to four climate-resilient design principles: Efficiency of urban systems; Form and layout; Heat-resistant construction materials; Vegetative cover.
COM will focus on community outreach and knowledge exchange,!enhancing a creative interaction with no-expert actors and inhabitants to provide input to the design implementation and promote awareness on the interlinks between climate resilience and quality of urban environments.

The initiative is funded through a joint partnership of the academic institutions involved. The initiative is part of the PRA research project SIMMCITIES_NA - Scenario Impact Modelling Methodology for Climate change Induced hazards Tools for Integrated End-users Strategic planning and design_Napoli (2017-2018), funded by University of Naples Federico II. Co-Proponents: Mario Losasso, Mattia Leone, Sergio Russo Ermolli. Scientific Representative: Mattia Leone.



Number, type and distribution of disaster risks triggered by natural hazards in Europe over the last 100 years

next page

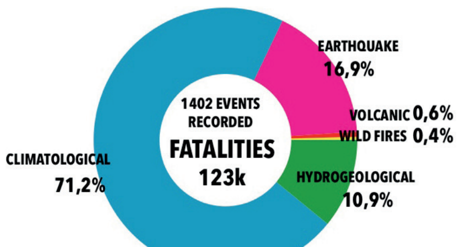
Distribution of the impacts on population of disaster risks triggered by natural hazards in Europe over the last 100 years, by type of event (source: Zuccaro et al 2018 data from EM-DAT, UNISDR, EEA).

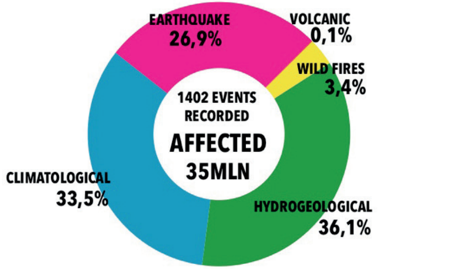
Climate-resilient urban design and SIMMCITIES_NA Research

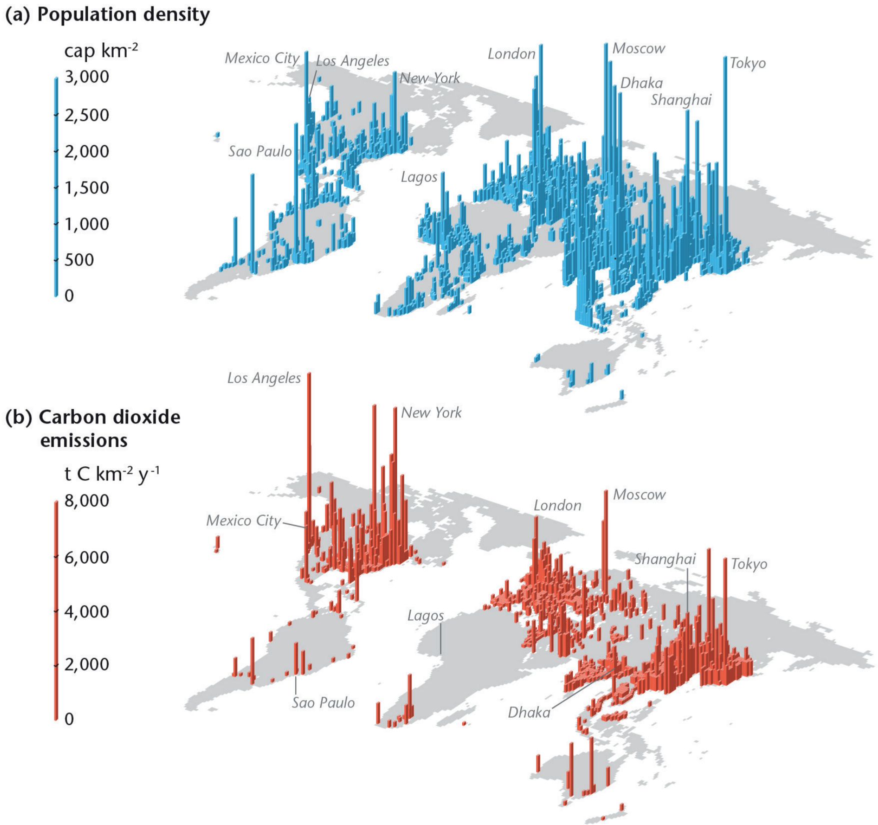
Over 80% of the physical, social and economic impacts associated with natural hazards on a global scale are linked to extreme weather events, amplified in terms of frequency and intensity by the acceleration of climate change. Economic losses, estimated at about $ 34 billion in 2017, are almost doubled compared to 2016 (Swiss-RE, 2018), bringing the total impact of natural disasters over the last twenty years to about $ 3 trillion.

Despite the increasing scale of these phenomena, it is now evident how the severity of the impacts largely depends on the widespread conditions of vulnerability of human settlements, often the result of rapid and uncontrolled urbanization that led to intense construction activity and increase of the population density in risk areas, altering ecosystem balances and microclimatic conditions, especially in urban and peri-urban areas.

In Europe, about 74% of the population live in urban centers today, with a slow but steady expansion in terms of occupied surface (+ 0.5-0.7% per year). The areas classified as peri-urban instead, grow at a rate four times faster, with a trend that if confirmed will lead to double their current extension (equal to about 48,000 km2) in 30-50 years, with irreversible consequences related to the soil consumption and increased anthropic pressure in terms of energy and resources use, pollution and





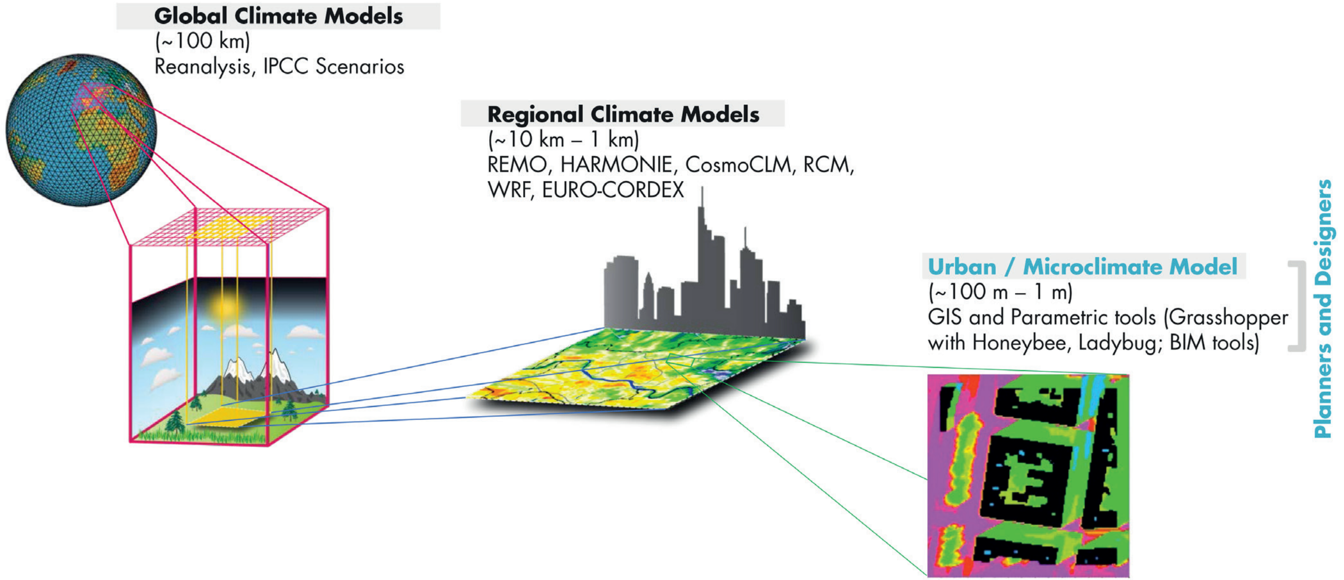


Comparison of urbanized population density and CO2 emissions on a global scale (source: Oke et al., 2018).

alteration of environmental balance (Priorr et al., 2011).
The increased anthropic pressure, the inadequate urban planning, the widespread infrastructure obsolescence, the degradation of the environmental and built heritage represent exponential growth factors of risk conditions. At the same time these represent the main areas within which to rethink the settlement models, prefiguring transition scenarios towards a progressive sustainable and resilient regeneration of urban and metropolitan contexts.
To contribute to the integration of such a perspective in current planning and design practices at urban and building scale, the Research Project SIMMCITIES_NA, carried out at the Department of Architecture of the University of Naples Federico II (2016-2018), has developed a climate-resilient design toolkit incorporating original analysis methodologies, specific process workflows and design support tools aimed at measuring the multiple benefits of applying climate-adaptive and community-driven strategies to the local scale, verifying the applicability through experimental findings in the context of urban regeneration interventions promoted by the Municipality of Naples, with particular reference to the Urban Recovery Plan of the District of Ponticelli, in the eastern suburbs of the city.
The activity of study and experimentation is enriched by the contribution of important national and international research networks, including

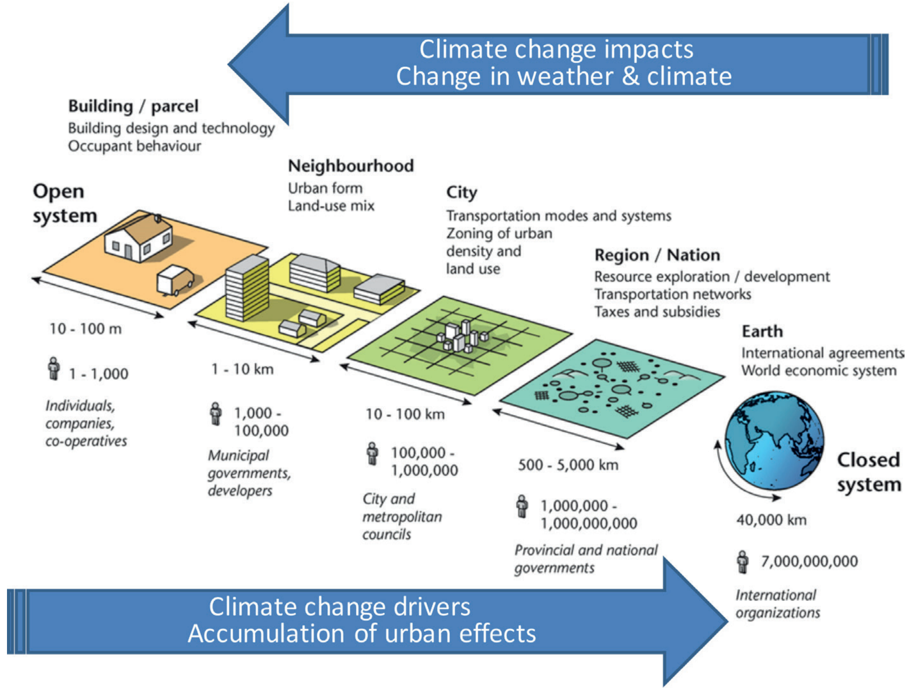
the Italian Society of Technology of Architecture (SITdA) and the Urban Climate Change Research Network (UCCRN). In particular, the activities related to the initiative promoted by SITdA with the Future Search Conference “Resilient Design” (Lucarelli et al., 2018) have allowed to incorporate significant methodological inputs related to the process dimension that characterizes the identity core of Architectural Technology and Environmental Design disciplines, while the activity carried out within the ARC3-2 Urban Planning and Design working group of the UCCRN (Rosenzweig et al., 2018) allowed to consolidate in an international multi-disciplinary and knowledge-exchange perspective the design and research methods, reaffirming the need of a coordinated global approach to the resilient regeneration of urban areas in different parts of the world, enhancing local specificities within a shared framework about scientific problem definition, intervention strategies and priorities of action.
The networking activities carried out within the SIMMCITIES_NA project found an important moment of synthesis, exchange and experimentation during the International Research Week “Environmental planning for climate adaptation. Prefiguring transition models for urban districts” (3-12 October 2018), promoted by the Department of Architecture of the University of Naples Federico II (DiARC) to address the project of adaptation and mitigation to the urban district scale, identified as scalar dimension of reference to counteract the impacts due to climate change.

The local dimension of the climate challenge: variability of urban microclimates and amplification of risk conditions (source: Oke et al., 2018).



Climate change modelling across spatial scales and integration of design-friendly tools for urban microclimate analysis.

In particular, the methodological and design approaches were tested in the framework of the International Workshop "Climate-Resilient Urban Design - Regenerating cities through adaptive mitigation solutions", developed by DiARC in collaboration with the Polytechnic of Milan, New York Institute of Technology, Université Paris Est Marne La Vallée, PontificiaUniversidad Católica de Chile, University College Dublin, Atelier Ten, Needle.
The workshop saw the participation of over 60 international students and teachers, who were confronted with the theme of the resilient and climate-adaptive project, testing methodologies, design principles, computational design tools and technological and environmental solutions to be applied to the case study of the district of Ponticelli in Naples. Within this process, original methods for collaborative mapping and design with local communities have been developed, and the project proposals developed have been discussed with the local authorities in charge of the urban regeneration of the area during a final public event.



Systemic interactions between climate impacts, spatial scales, urbanization effects and levels of governance (source: G. Mills, 2018).

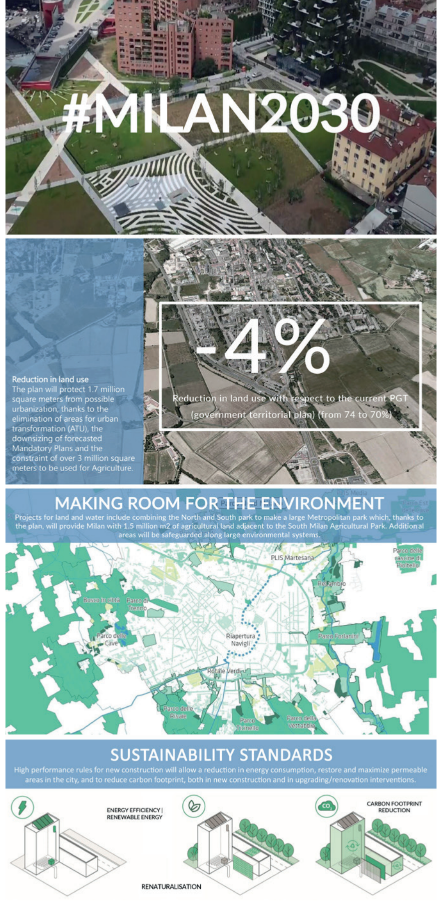
next page

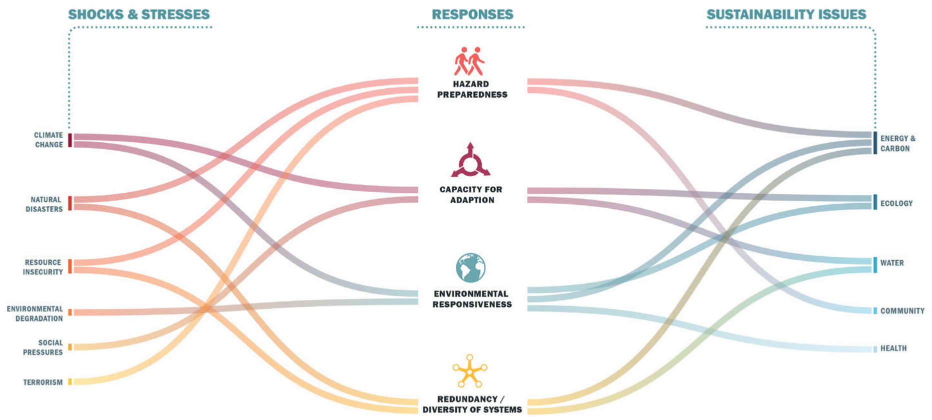
Resilient urban regeneration strategies for the Municipality of Milan. The administrative figure of the Chief Resilient Officer, introduced by joining the 100 Resilient Cities program of the Rockefeller Foundation, allows for a connection between the various programmatic actions put in place by the local government, guaranteeing consistency and complementarity between financing measures and control of the results in relation to the pre-defined objectives (source: P. Pelizzaro, Municipality of Milan).

Methodological approach and resilient design principles

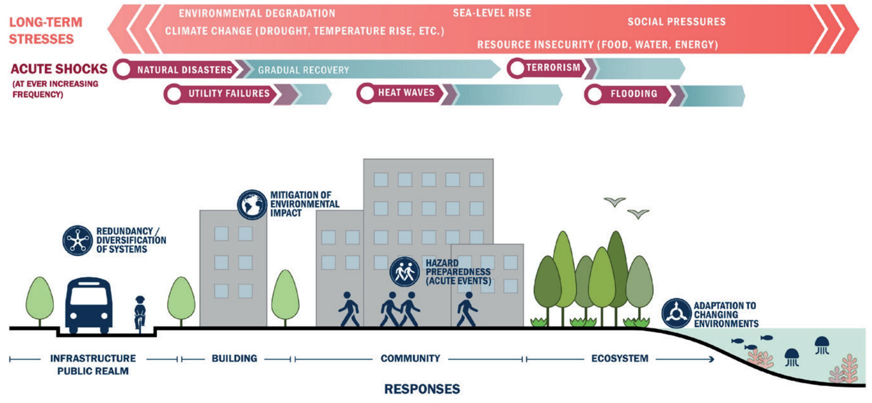
The evolution of the methodological approaches in the field of urban planning and urban design in response to the strategic objectives of the 2030 and 2050 global agendas is contributing to update sustainability and resilience concepts in the light of climate and global changes, strengthening the awareness of how GHG emissions and the adaptation of urban systems depend to a large extent on specific factors which can be controlled through design actions, such as the morphological structures and spatial-functional layouts of urban districts, the technical-constructive characteristics of buildings and infrastructures, the changes in land use and the ecosystem interactions with peri-urban areas.

Driving urban and metropolitan regeneration actions through integrated strategies for Disaster Risk Reduction, Climate Change Adaptation and Sustainable Development allows to optimize the available technical and financial resources and avoid sectoral and siloed approaches which can reduce the effectiveness of interventions. This further highlights the need to develop procedural, design and technological solutions able to simultaneously respond to the challenges related to the reduction of natural hazards, climate adaptation and energy transition, developing adaptive mitigation actions (Raven et al., 2018) and multi-risk approaches (Zuccaro and Leone, 2014). With reference to the Italian case,





next page
Synergies between complementary measures aimed at increasing resilience and environmental, social, economic regeneration of urban districts (source: Polytechnic of Milan, Urban and Landscape Regeneration Study 2017-2018, Prof. M. Leone, Design Team: B.A. Inanlou , M.C. Durak, N. Soudmand, O. Sener, Y. Liu).



Synergies between sustainability issues and natural hazards, climate and socio-economic changes in relation to the regeneration of the built environment (source: M. Esposito, Atelier Ten, 2018).

significant advantages may derive in fact from the development of integrated technological solutions capable of responding at the same time to the conditions of hydrogeological, seismic and volcanic risk, which extensively affect the territory.
Adaptive mitigation design strategies should be implemented in a multi-scale view - metropolitan region, city, district, block and building-open space system - reconfiguring the urban districts as low-carbon eco-districts designed according to local microclimate specificities.
To this aim, the SIMMCITIES_NA research project has adopted the design methods and principles developed by ARC3-2 Urban Planning and Urban Design team of the Urban Climate Change Research Network (Raven et al., 2018), to implement urban regeneration interventions in a resilient and climate-adaptive perspective tailored to the East Napoli Case Study (Leone, 2018).
The proposed methodology focuses on sequential and iterative phases that lead to the development of the project through a multi-disciplinary and multi-scale approach. These are implemented with the support of experts from different fields of study and urban stakeholders, defining an intervention model that combines knowledge-sharing and co-design actions which involve urban decision-makers and local communities, with the development of simulations based on computational design tools that allow the control of the main indicators that determine the

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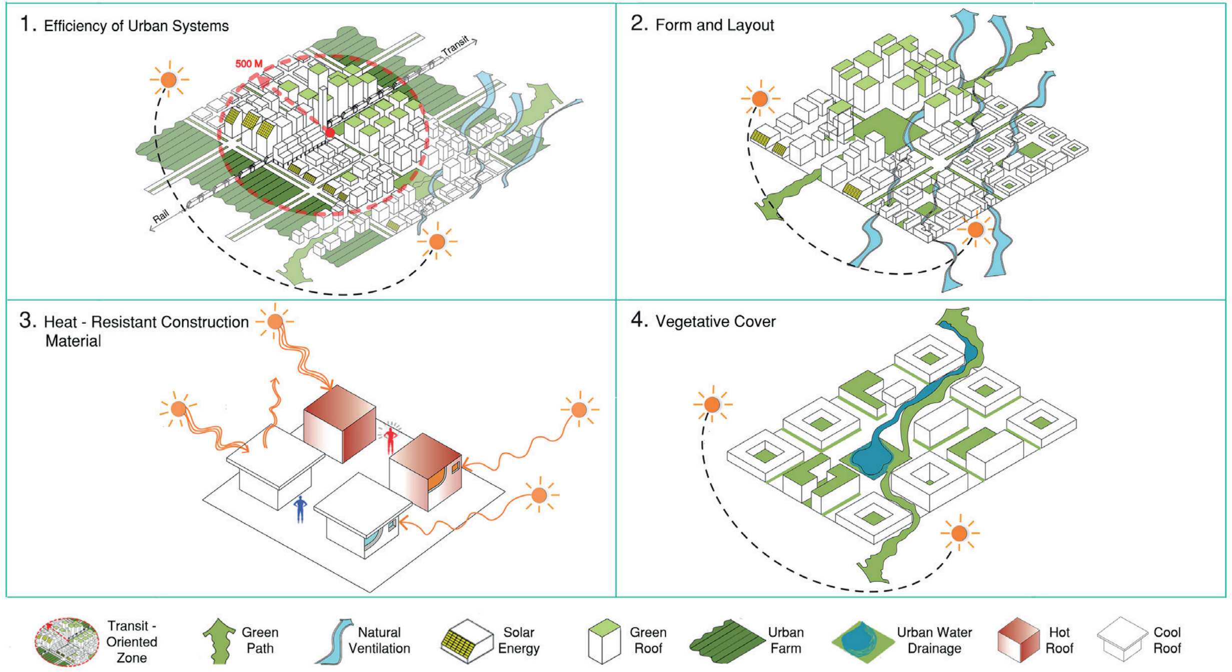
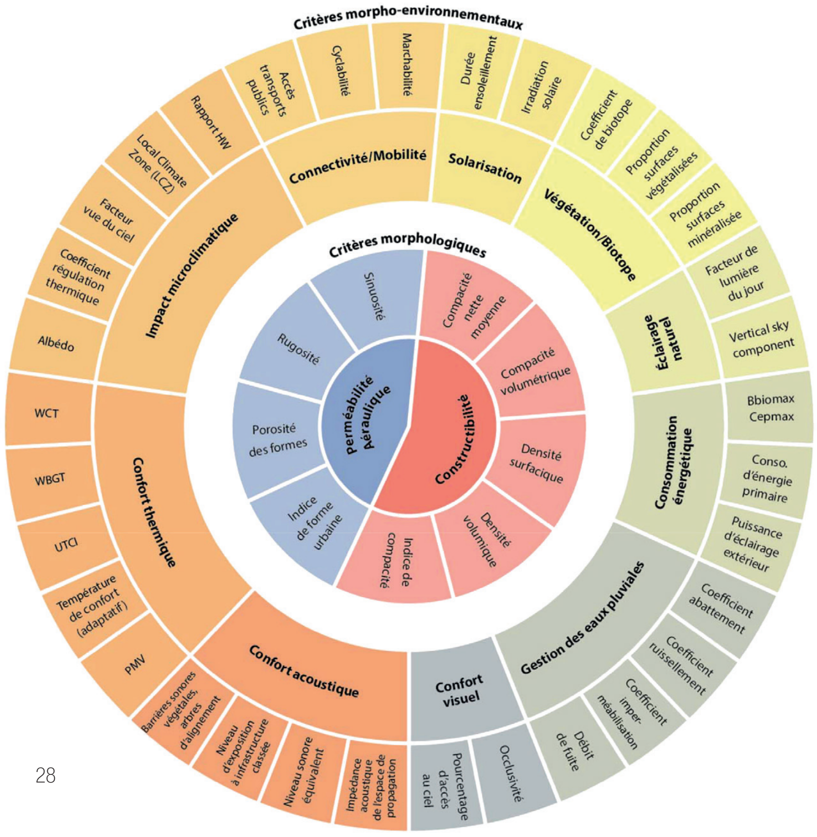
ARC3.2 Climate-Resilient Design Principles (fonte: elaborazione da Raven et al., 2018).

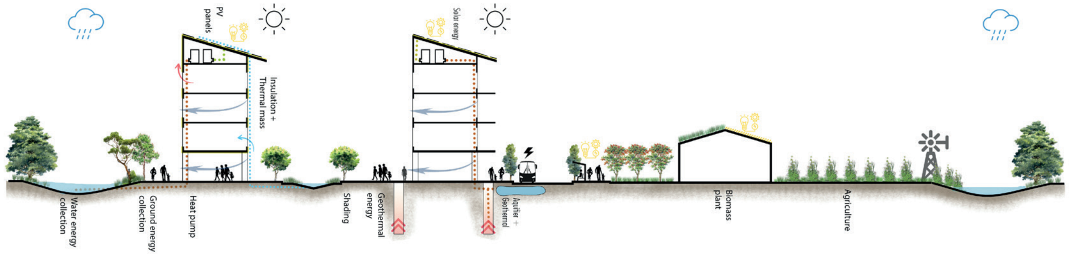




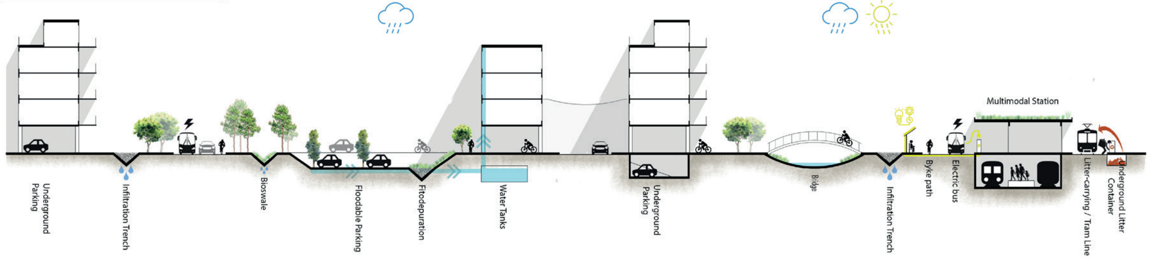
Examples of morphological, typological, functional, technological and environmental indicators for resilient design developed in the MESH project - Modeval'Urba 2015 (Modélisation et évaluation au service des acteurs des territoires et des villes de demain) project promoted by ADEME in France (source: B. Barroca, M. Pellegrino, Université Paris-Est Marne-La-Vallée, Lab'URBA)

performance response of buildings and open spaces in relation to the conditions of climatic stress. Specific insights concerned the use of designer-friendly tools for the control of the urban microclimate and the definition of climate-resilient design solutions with reference to extreme temperature and precipitation events.
The adoption of ARC3-2 principles and methods has allowed to harmonize the types of outputs from the analysis phases and the main performance indicators for the evaluation of design alternatives, making them replicable and comparable. In this way it is possible to connect (with the necessary differences in terms of the level of detail of the information managed) large-scale planning scenarios and neighborhood scale actions, avoiding that a sum of interventions on parts and urban elements is incongruent with strategic the objectives defined at the metropolitan and territorial level, and improving the coordination between top-down implementation models carried out by institutional actors and bottom-up solutions promoted by local communities. The climate and microclimate analysis provides a first fundamental step in identifying the urban areas most affected by extreme events and seasonal variations, providing local climate projections as preliminary project information. Historical data from weather stations and the results of regional climate models (RCMs) are processed through IT tools and provide the set of information needed to assess the potential impacts of extreme weather events.

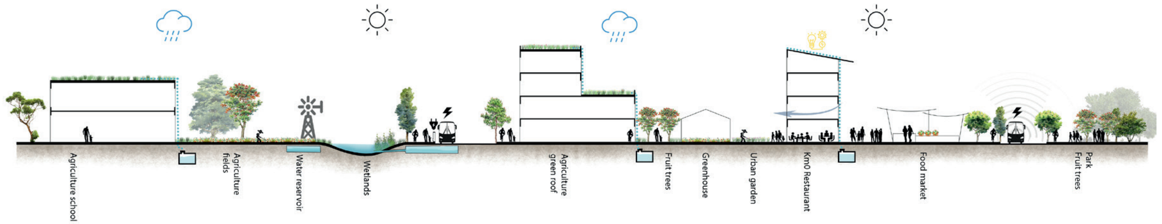
Energy



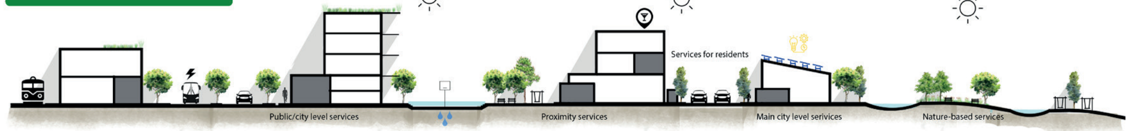
Connectivity



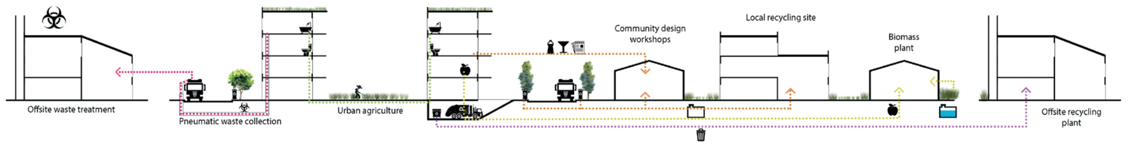
Agricolture

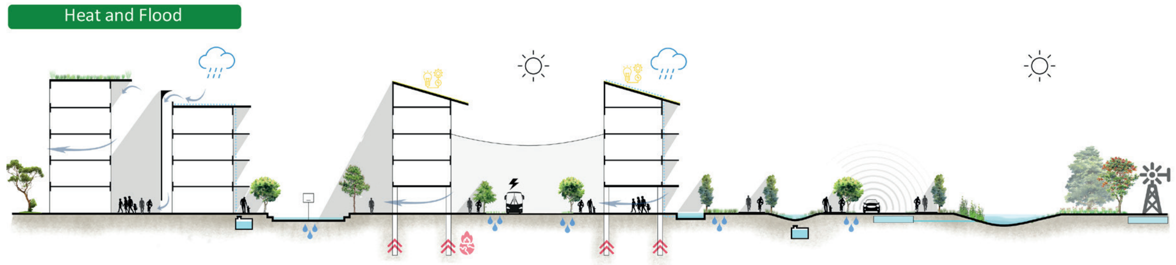


Social Services



Waste Management





Conceptualization of the adaptive mitigation approach in the design of the building-open spaces system: reduction of the buildings' energy needs, production of energy from renewable sources, design of the green / blue infrastructure to respond to thermal and water stresses induced by climate change (source: SIMMCITIES_NA, International Workshop Climate-Resilient Urban Design).

previous pages

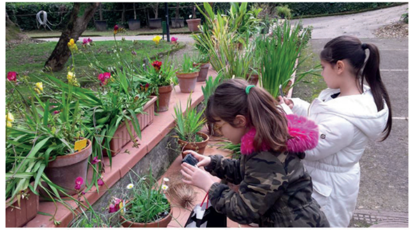
Tematization of the adaptive mitigation approach in the project of buildings and open spaces with reference to the urban regeneration priorities identified in the case study of Ponticelli (Naples): Energy, Mobility, Waste Management, Urban agriculture, Public / social services (source: SIMMCITIES_NA, International Workshop Climate-Resilient Urban Design).

next page

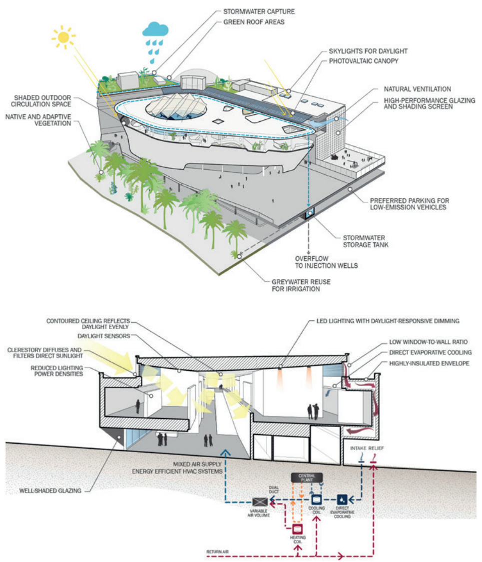
Active involvement of local communities and urban creativity as a model of social inclusion in the redevelopment of buildings and open spaces in Ponticelli, Naples (source: L. Borriello, Inward - Observatory on Urban Creativity).

The tools used and spatial resolution are adapted to the scale of intervention: GIS systems are used for district-level analysis, providing as output urban heat hotspots and flood zones, while parametric 3D modeling tools (Rhynoceros + Grasshopper) allow to to define the main factors that influence the urban microclimate, so to evaluate and compare alternative solutions.

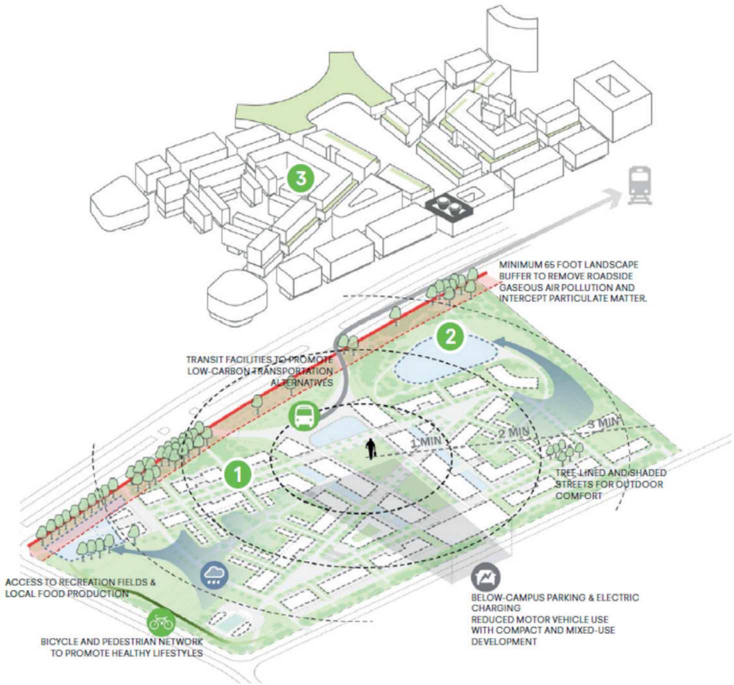
Collaborative and participatory activities to assess the quality of urban spaces allow to combine climate-related considerations with insights on the needs and expectations of local communities, such as the general increase in the quality of housing and public services, the livability of the neighborhood, sustainable mobility options and social inclusion models. Recurring problems such as mono-functional residential areas, lack of intermodal parking areas, equipped green areas, pedestrian and cycle paths can be conveniently integrated into the project proposals to balance climate and community resilience instances. The stakeholders engagement methods are based on well-established tools such as structured interviews, focus groups and workshops that include innovative approaches, such as gamification and learning by doing, involving residents, local administrations, neighborhood and category associations, so to develop a shared reading of the main critical aspects of the urban system in relation to environmental, functional-spatial and socio-economic aspects. The synthesis of the results outlines a picture



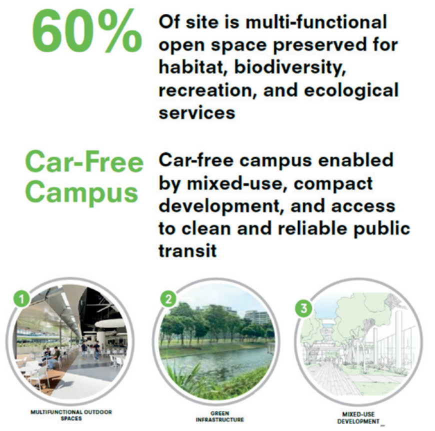
of shared needs and possible divergence elements between categories of stakeholders to be opportunely integrated into the project.
The planning and design phase is based on a critical review of the information collected to identify synergies and tradeoffs that can be implemented in relation to the planning initiatives envisaged by the local authorities. The urban plans and building regulations define the limits within which to develop the most appropriate technical-design strategies and solutions to achieve the set of objectives. The design approach involves the development of masterplans oriented to the organization of new functional-spatial layouts in relation to the environmental quality of the building-open spaces system and in-depth analysis of the building's scale and open spaces, aimed at specifying design solutions and technology capable of improving the performance response in relation to climate vulnerability indicators. The reorganization of the green-blue infrastructures is balanced in relation to the endowment of public facilities, proposing new morphological structures deriving from the reorganization of the available volumes according to the opportunities offered by the urban plans.
The post-intervention evaluation is intended as a sequence of activities to evaluate the benefits of the proposed solutions in terms of microclimatic, energy and environmental performance, as well as compliance with community priorities. The evaluations concern the comparison

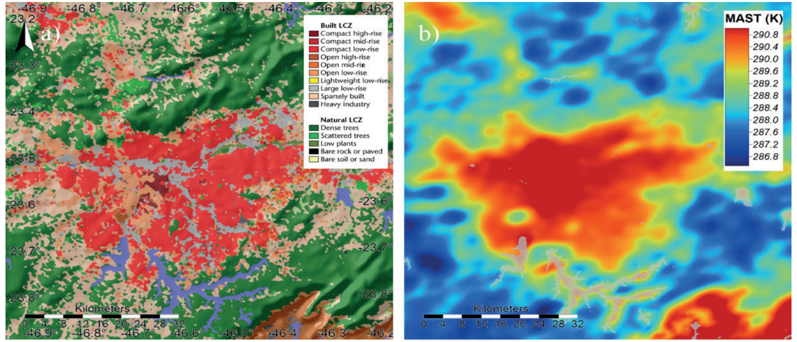


Energy efficiency and emission reduction: integration of active and passive solutions in the project of almost zero-energy buildings (source: M. Esposito, Atelier Ten, 2018).



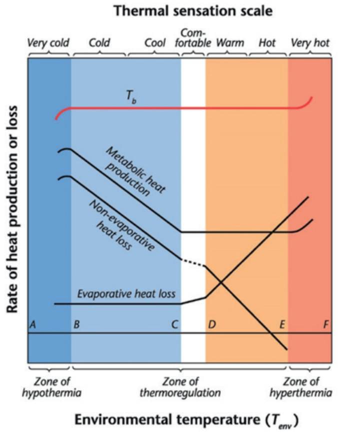
Energy efficiency and emission reductions: sustainable mobility strategies for pedestrian and cycle paths, public transport and electric vehicles in relation to the organization of functional-spatial layouts and the green/blue infrastructure at district scale (source: M. Esposito, Atelier Ten, 2018).

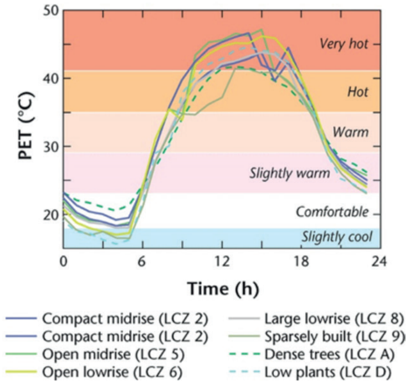




Shape and layout: Beijing urban heat island, relationship between urban morphology according to LCZ classification (Stewart & Oke, 2012) and surface temperatures (source: G. Mills, 2018).

Relationship between urban morphology according to the LCZ classification (Stewart & Oke, 2012) and perceived thermal comfort according to the Physiologically Equivalent Temperature - PET indicator (source: G. Mills, 2018).





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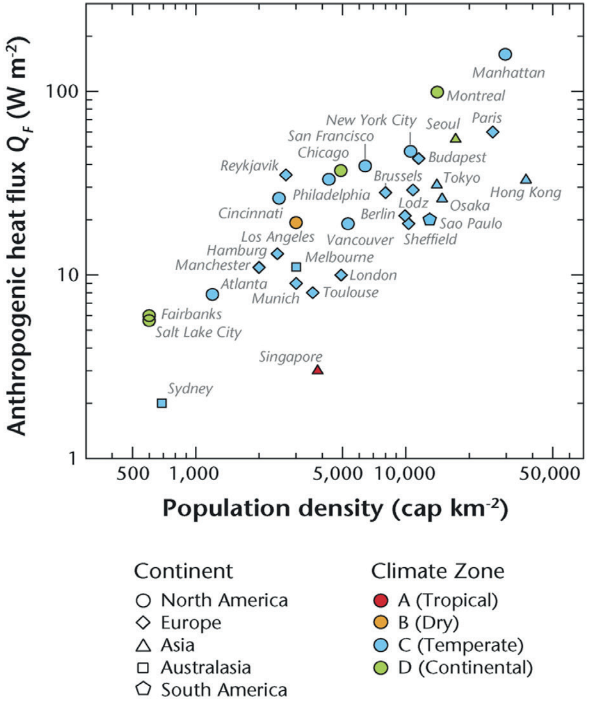
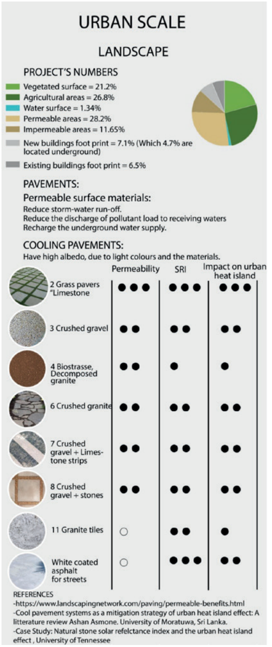
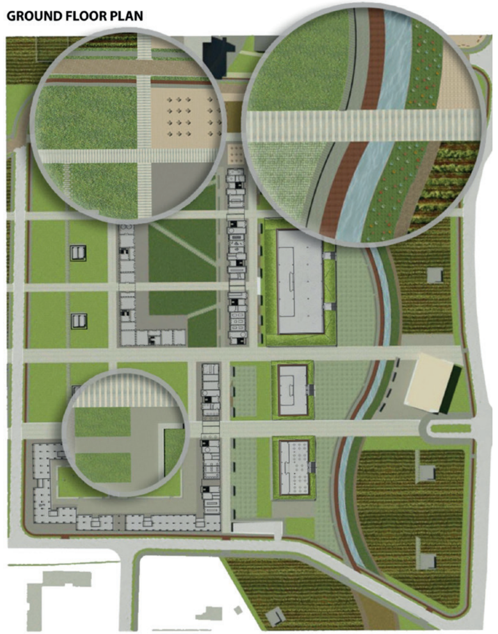
Form and layout: relationship between population density in different climatic zones and Anthropogenic Heat Flux (AHF) linked to energy and transport uses (source: G. Mills, 2018).







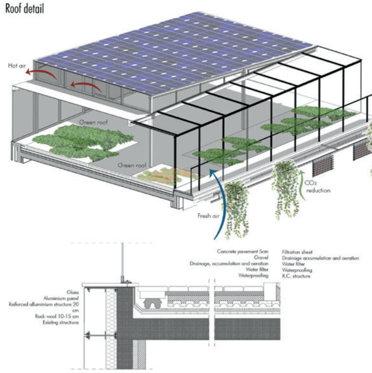
Building materials and construction technologies: parameterization of key indicators for the control of surface superheat (SRI - Solar Reflective Index) and of permeability for different types of flooring and land use in the design of open spaces (source: Polytechnic of Milan, Urban and Landscape Regeneration Studio 2017-2018, Prof. M. Leone, Design Team: R. Avitabile, R. Gurkan, M. Ibrahim, G. Panzetti, Q. Wang, X. Wu).

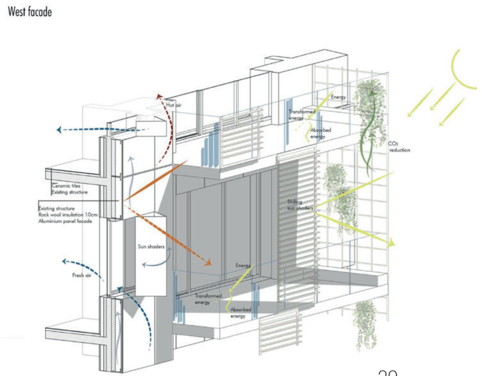
next page

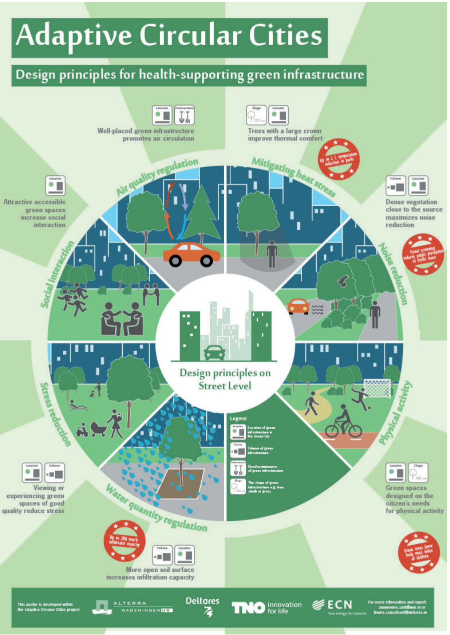
Building materials and construction technologies: adaptive mitigation technological solutions for building envelope retrofitting (source: Polytechnic of Milan, Urban and Landscape Regeneration Studio 2017-2018, Prof. M. Leone, Design Team: Z. Bokshi, D. Dormus, K. Mavraj, F. Mercandelli, H. You).

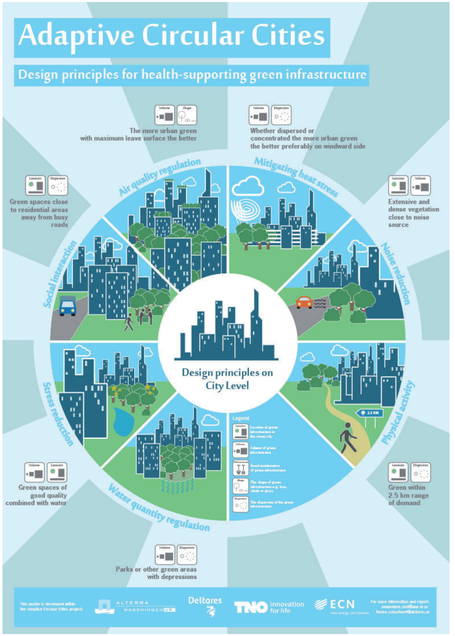
between the proposed solutions and the current conditions through buildings and neighborhood scale simulations, as well as community workshops aimed at gathering direct feedback from residents and local stakeholders.

The outcomes of the testing activities carried out within the SIMMCITIES_NA project represent a tool provided to decision makers and local communities aimed at promoting the integration of specific climate-resileint process / design strategies and technical solutions in the context of the local urban regeneration initiatives in progress. The elaboration of a portfolio of metadesign solutions, regardless of the formal outcomes and the specific functional-spatial configurations suggested, is configured as a repertoire of good practices aimed at combining the reduction of climatic risks with the increase of architectural quality and liveability and urban spaces, also in relation to specific socio-economic problems and opportunities for social inclusion.





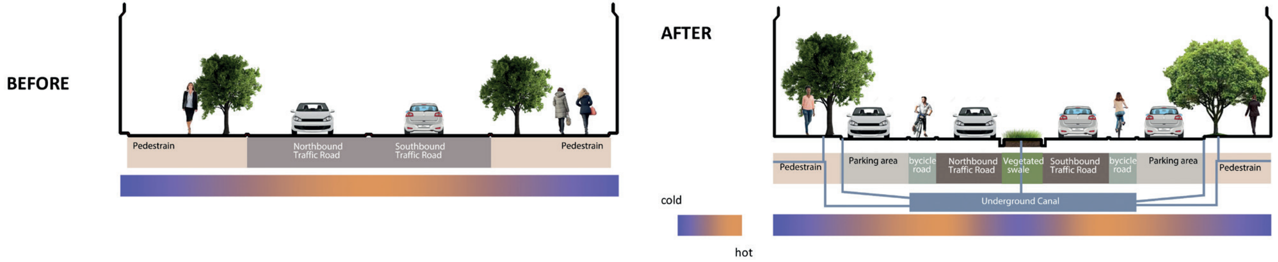


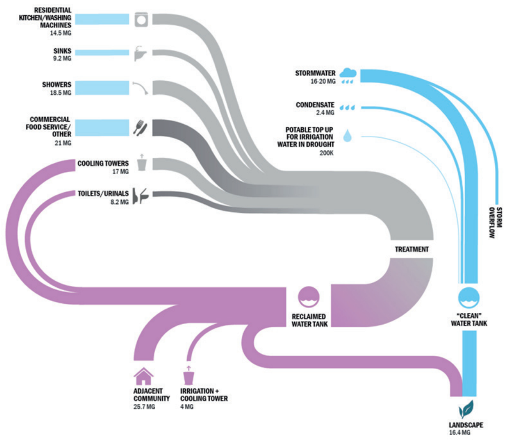


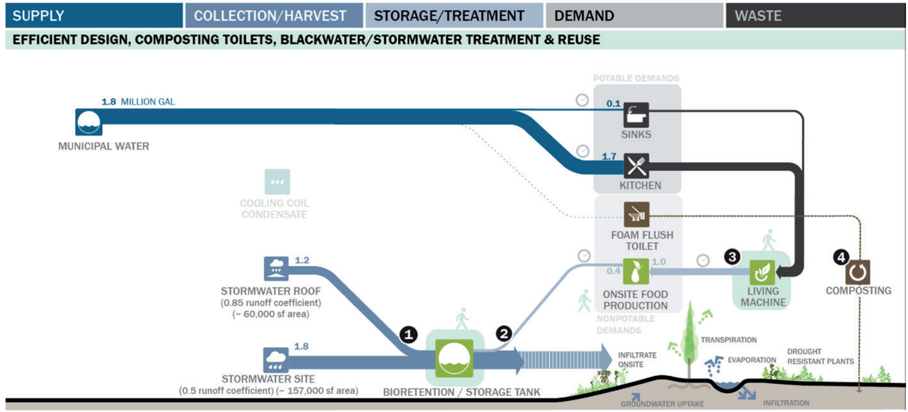
Green and blue infrastructures: categorization of ecosystem services proposed by the UK National Ecosystem Service Assessment (source: West England Nature Partnership).

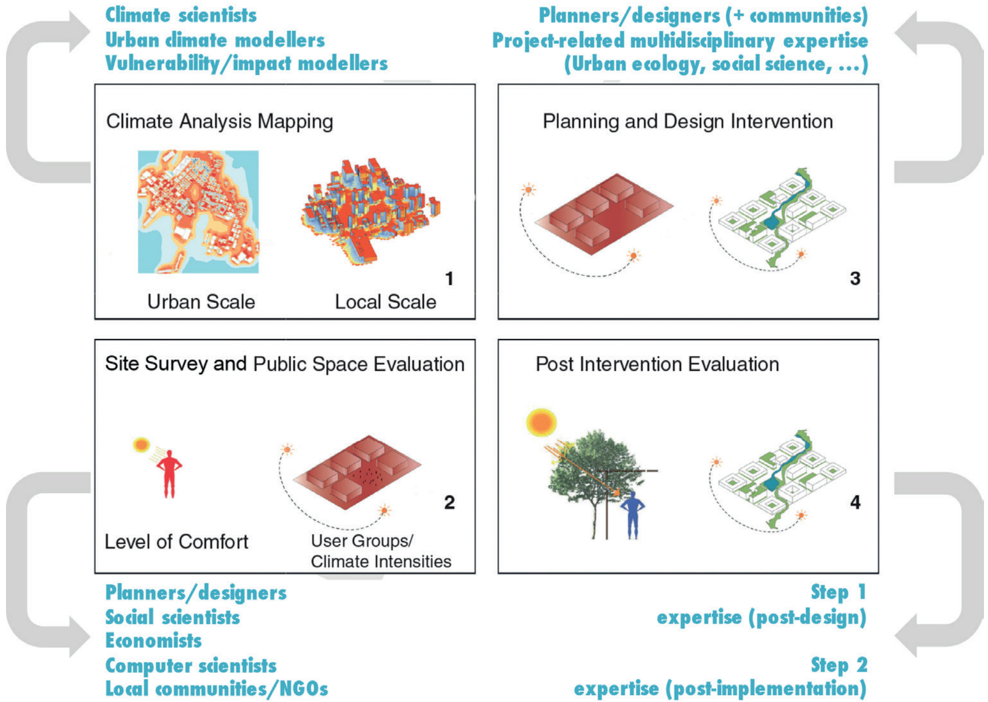
next page
Green and blue infrastructures: reorganization of oversized roadways in the case study of Ponticelli (Naples) to improve shading and surface drainage conditions (source: SIMMCITIES_NA, International Workshop Climate-Resilient Urban Design).

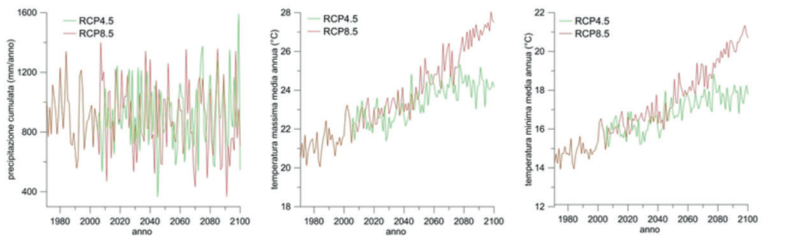
Green and blue infrastructures: design principles for decentralized water management (source: M. Esposito, Atelier Ten, 2018).







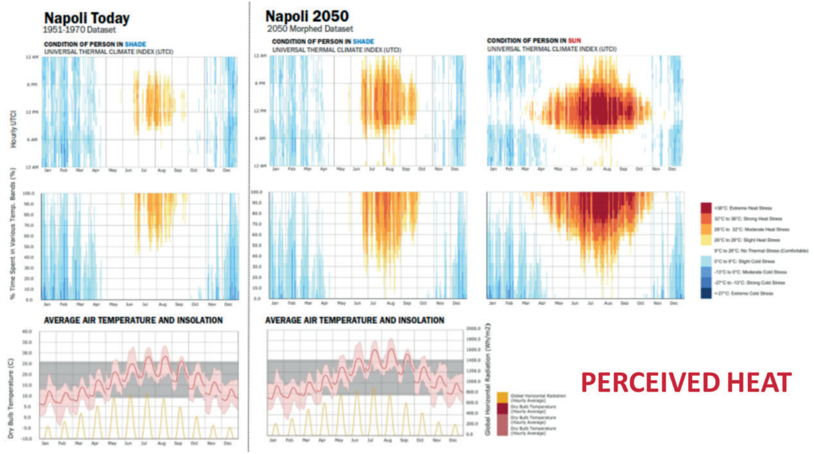




EXTREME EVENTS (2015-2018)
Rain: 600-700 mm/hr (duration 20-30min)
Heat wave: Tmax >33°C (duration 12 days, peak 38°C, deltaT avg night-day ≈10°C)

EXTREME EVENTS (2050-2080)
Rain: 600-700 mm/hr (duration 20-30min) → more frequent
Heat wave: Tmax >36°C (duration 30 days, peak 42°C, deltaT avg night-day ≈5°C)

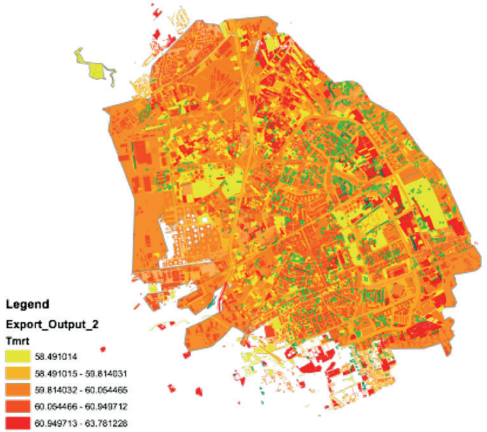
	2020s	2050s	2080s
Temperature	+ 1.0°C to + 1.6°C	+ 1.8°C to + 2.9°C	+ 2.5°C to + 4.2°C
Precipitation	- 5% to + 1%	- 10% to - 1%	- 15% to - 4%



in this and in next page
Climate and microclimate analysis: downscaling processes from Regional Climate Models (RCM), to local historic data analysis, to urban microclimate simulation (source: CMCC, NASA-GISS, SIMMCITIES_NA, International Workshop Climate-Resilient Urban Design).

previous page
Design process phases, roles and fields of expertise involved (source: elaboration from Raven et al., 2018).

URBAN MICROCLIMATE

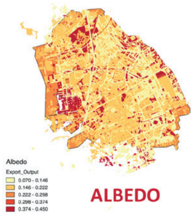


REFERENCE HEAT WAVE EVENT

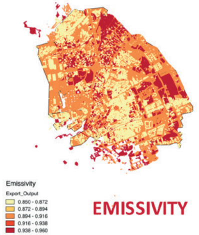
Heat wave: Tmax >36°C
(duration 30 days, peak 42°C, deltaT avg night-day ≈5°C)

MEAN RADIANT TEMPERATURE

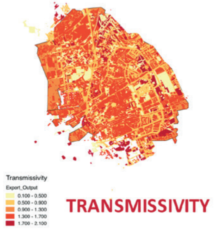
KEY PARAMETERS



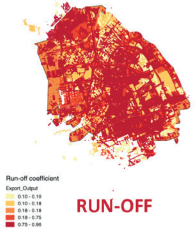
ALBEDO



EMISSIVITY

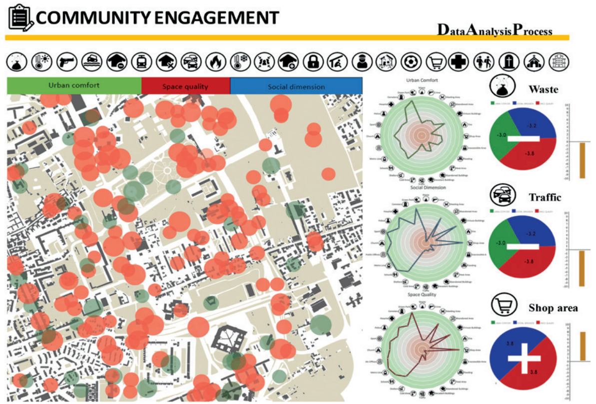


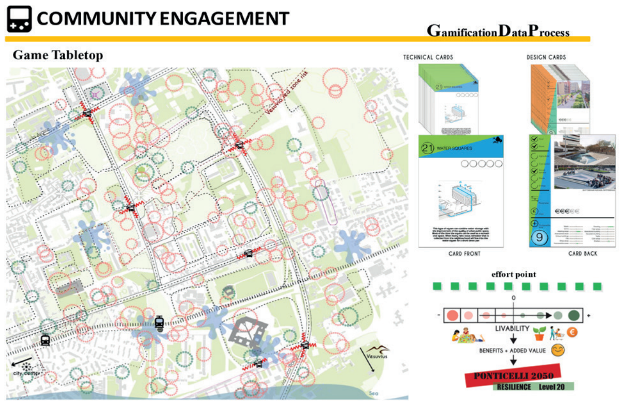
TRANSMISSIVITY

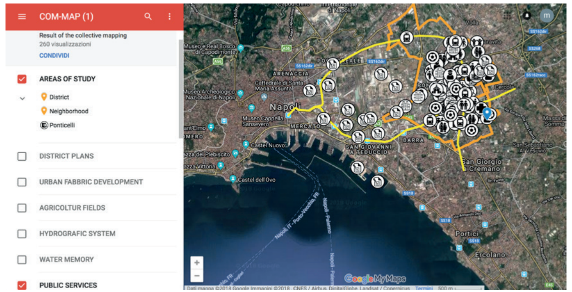


RUN-OFF

Evaluation of the quality of urban spaces: gamification-based tools for collaborative mapping developed for the Ponticelli case study (source: SIMMCITIES_NA, International Workshop Climate-Resilient Urban Design).

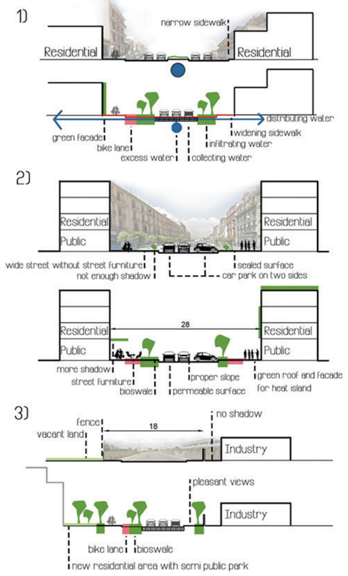






STRATEGY

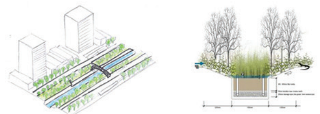
Change in living infrastructure

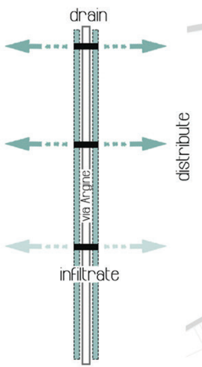


- parks
- agricultural use
- multifunctional green belt
- main spines
- proposed social facility clusters
- railway

REVITALIZE BLUE INFRASTRUCTURE

1. water as infrastucture

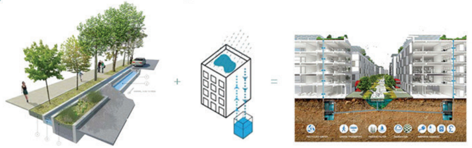




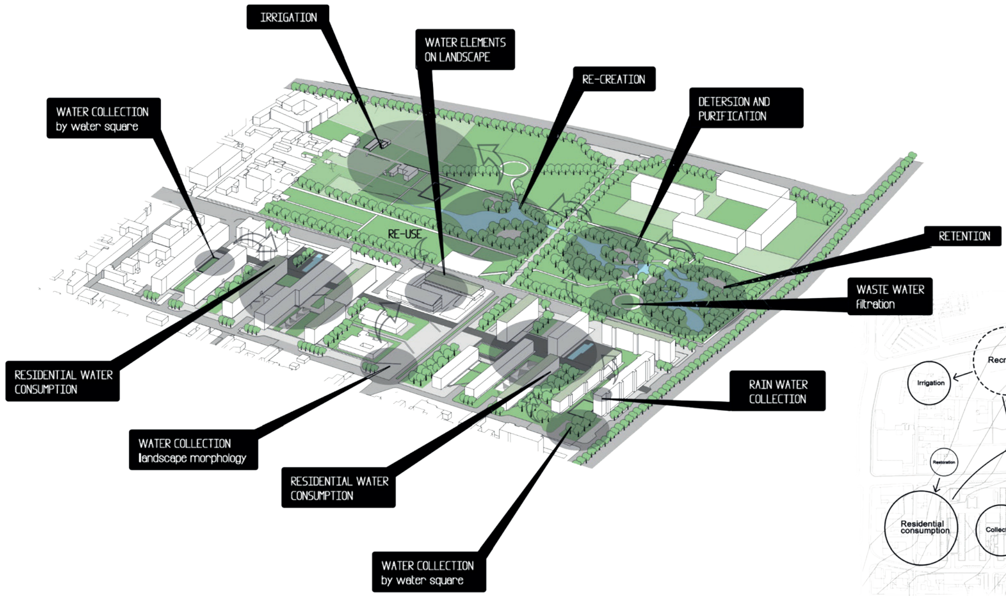
2. water + green infrastucture + public spaces

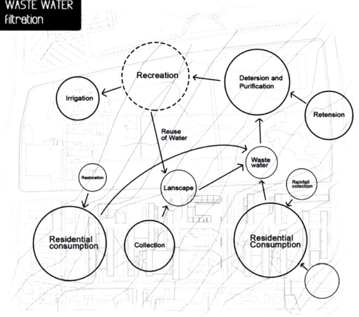
3. canals for irrigation of agricultural areas

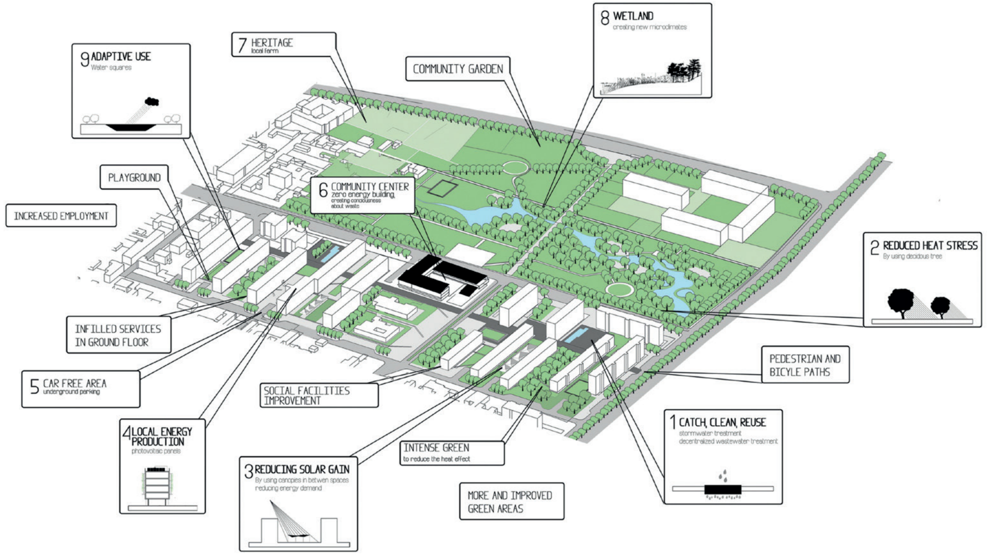
4. rain water collection building and street section



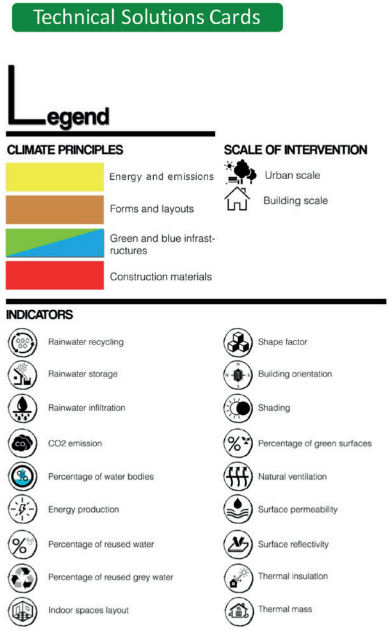
- water boulvard
- drainage + catchment
- agricultural areas
- critical heat islands
- reshaped infrastructure
- green corridor

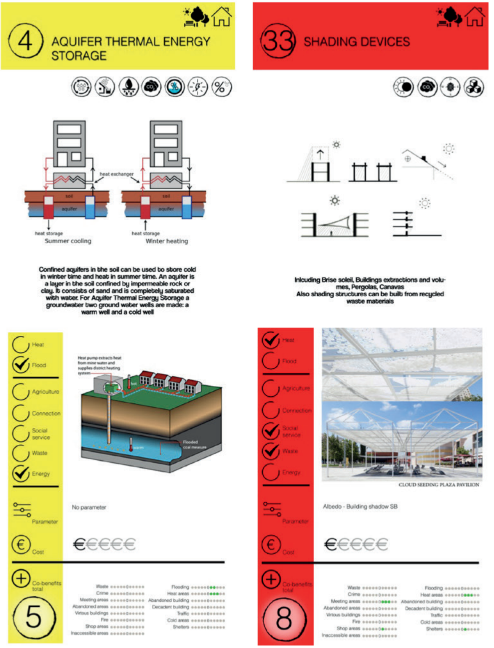






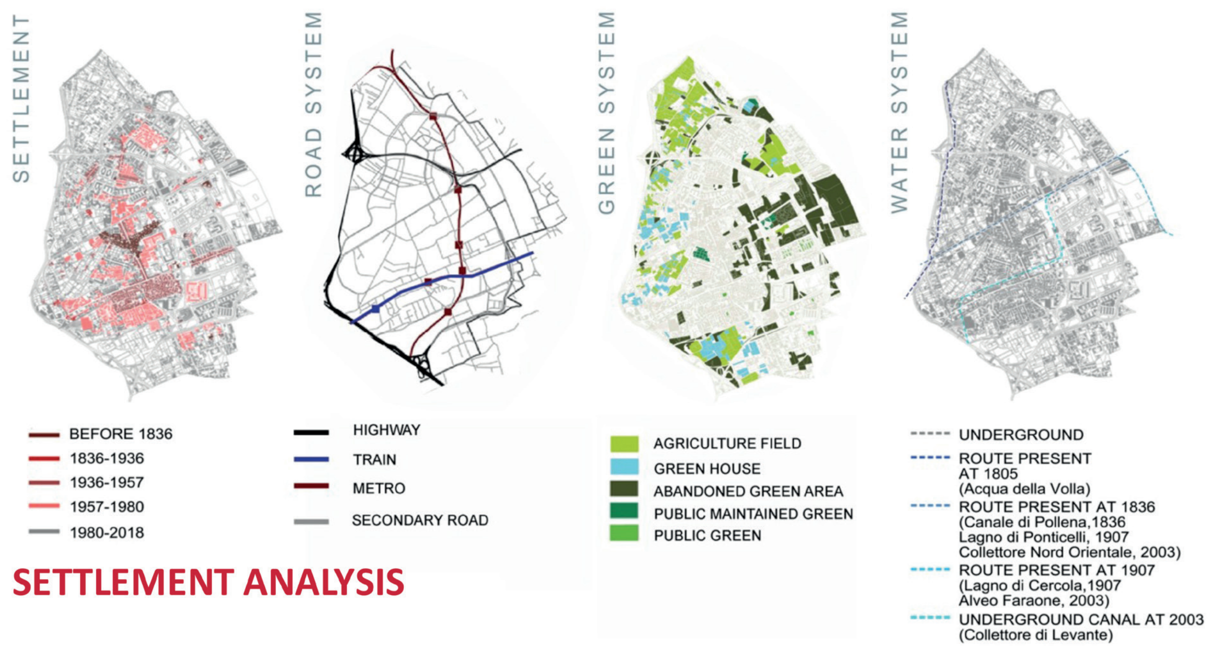
in this and in previous pages
Planning and design: concept and master plan for the reorganization of the functional-spatial layout in a residential block in Ponticelli to promote pedestrian accessibility, the inclusion of new public services and the integration of green/blue infrastructures (source: Polytechnic of Milan, Urban and Landscape Regeneration Study 2017-2018, Prof. M. Leone, Design Team: A.B. Atalay, G Carini, E. Dösemeci, I. Papila, T. Deniz, Q. Zhang).





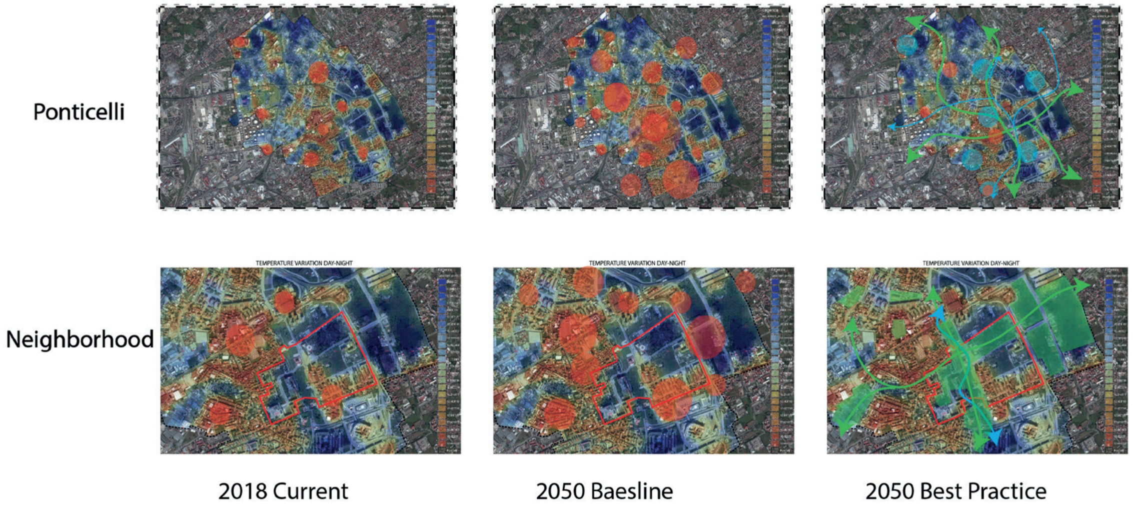
Planning and design: technical solutions for adaptive mitigation of buildings and open spaces developed in the SIMMCITIES_NA project, with identification of the main performance parameters in relation to the impact on the urban microclimate and associated social, economic and environmental co-benefits (source: SIMMCITIES_NA, International Workshop Climate-Resilient Urban Design).

Planning and design: urban agriculture as a strategy for climate adaptation and activation of circular economy in the Ponticelli district (source: SIMMCITIES_NA, International Workshop Climate-Resilient Urban Design).

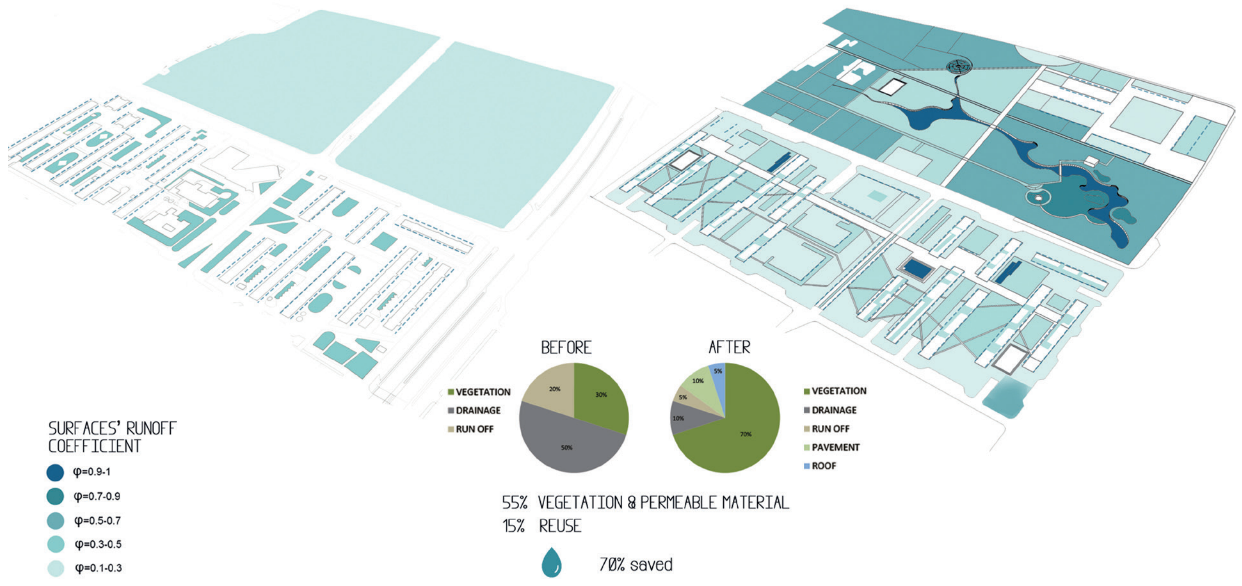


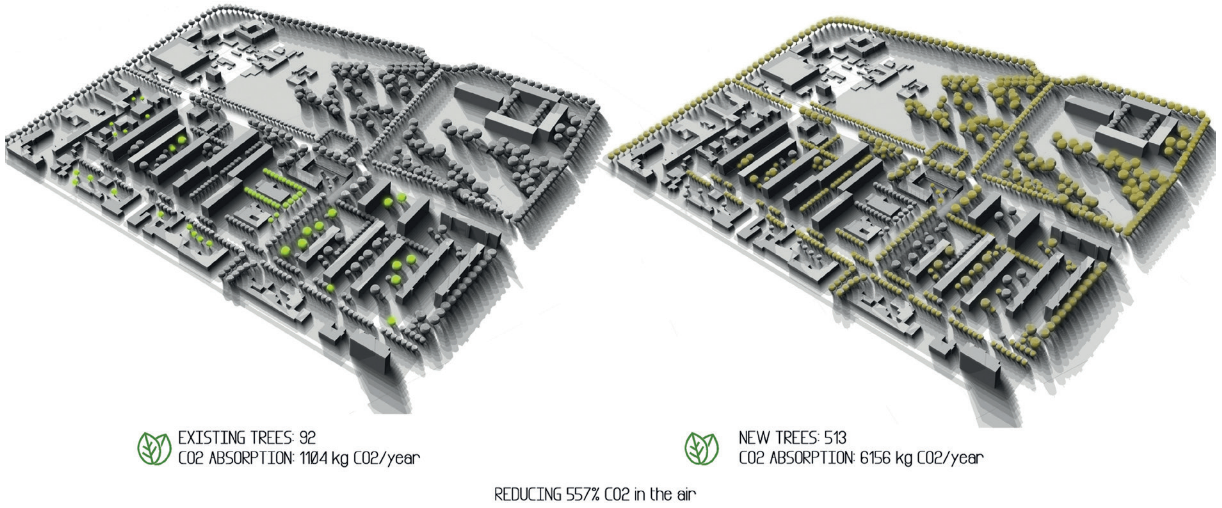
SETTLEMENT ANALYSIS

SCENARIO COMPARISON



Post-intervention evaluation: comparison between the current conditions and multiscale design scenarios for the Ponticelli case study (source: SIMMCITIES_NA, International Workshop Climate-Resilient Urban Design).





Post-intervention evaluation: comparison of CO_2 emission values for the presence of new trees.

previous page

Post-intervention evaluation: comparison of surface permeability values (source: Polytechnic of Milan, Urban and Landscape Regeneration Studio 2017-2018, prof. M. Leone, Design Team: A.B. Atalay, G. Carini, E. Dösemeci, I. Papila, T. Deniz, Q. Zhang).

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Workshop Videos and Web Tools

International Workshop - Climate Resilient Urban Design

https://youtu.be/E5iCH6PvzkA

Creative Communication and Dissemination with Local Community

https://youtu.be/y0AGU1ZrUlk

Collaborative mapping tool

https://www.google.com/maps/d/u/0/viewer?mid=1KVELhy6wVgnD818VcRcVI8-JeTb9YXX5&ll=40.86045083416662%2C14.330356384594097&z=15