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The climatic, social, economic and health phenomena that have increasingly affected our cities in recent years require the identification and implementation of adaptation actions to improve the resilience of urban systems. The three issues of the 16th volume will collect articles concerning the challenges that the complexity of the phenomena in progress imposes on cities through the adoption of mitigation measures and the commitment to transforming cities into resilient and competitive urban systems.

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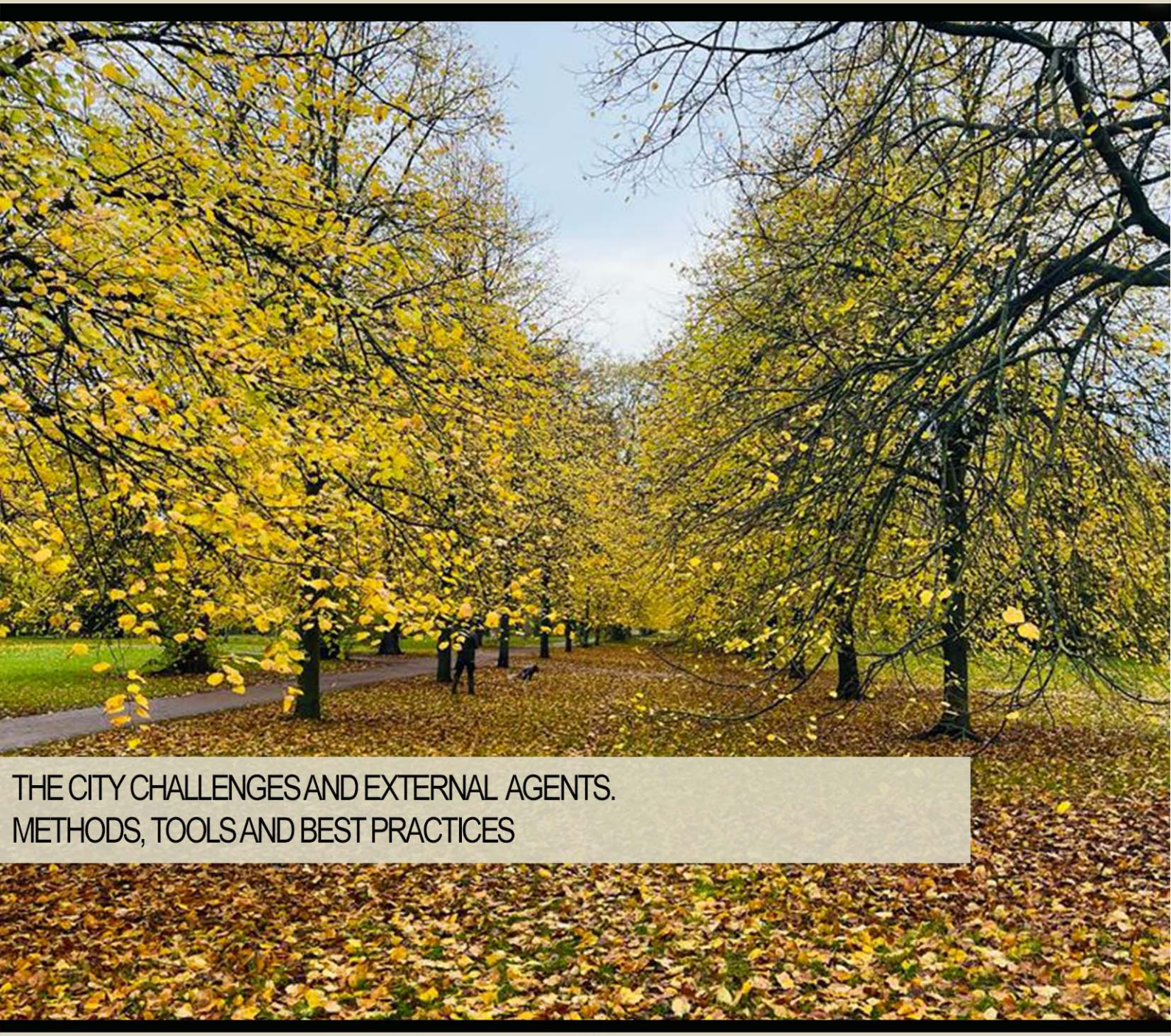

THE CITY CHALLENGES AND EXTERNAL AGENTS. METHODS, TOOLS AND BEST PRACTICES

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The cover image shows a view of Hyde Park in London (United Kingdom) during the autumn season.
The photo was taken by Enrica Papa in November 2023.

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REVIEW NOTES – Urban development and NextGenerationEU

The interventions of the Italian Recovery and Resilience Plan: cities adaptation to climate change

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Abstract

Starting from the relationship between urban planning and mobility management, TeMA has gradually expanded the view of the covered topics, always following a rigorous scientific in-depth analysis. This section of the Journal, Review Notes, is the expression of a continuous updating of emerging topics concerning relationships among urban planning, mobility and environment, through a collection of short scientific papers. The Review Notes are made of five parts. Each section examines a specific aspect of the broader information storage within the main interests of TeMA Journal.

This section of the Review Notes deals with the new frontiers of urban development through the lenses of the European program NextGenerationEU.

In particular, this contribution deepens the topic of adaptation to climate change in cities, analysing the interventions proposed within the Italian National Recovery and Resilience Plan. The paper takes into account the recent PNRR strategies, projects, and initiatives aimed at coping with global warming effects in urban environments and with the increasing vulnerability of cities to climate events. Also, this paper provides an overview of the proposed projects and interventions in different Italian cities.

Keywords

Climate change; Adaptation; NextGenerationEU; Urban development.

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1. Climate change vs cities

Climate change is a long-term change in the average weather patterns that affect our planet (NASA, n.d.). Although Earth has passed through different climatic eras by virtue of its natural evolution, changes observed in its climate since the mid-20th century have been linked to human activities – particularly fossil fuel burning and the consequent increase in greenhouse gas emissions – that have caused global warming, in turn responsible for climate change. The catastrophic extreme events that the entire planet is experiencing are a demonstration of this (Lai et al., 2021). Heat waves, extreme events, storms and floods are just one example of how global warming can impact different territories, with economic and social brunt that might destablish entire countries, undermining the precarious equilibrium of anthropized territorial systems that are by nature complex, as well as vulnerable (Guida, 2021).

Cities play a key role in defining impacts as well as shaping the trajectory of climate change. Due to the increasing urbanization and the related economic, social, and environmental issues, cities have established as main targets of climate change, both for their climate vulnerability and their role in accelerating the transition towards resilient and sustainable development models (Bulkeley, 2010). The Fifth Assessment Report from the Intergovernmental Panel on Climate Change (IPCC, 2014) acknowledges that cities are drivers in leading transformative initiatives to tackle climate challenges thanks to their ability to address sectoral, demographic, spatial, and ecological issues related to climate risks (Galderisi et al., 2016; Hughes et al., 2020). Currently, more than half of the global population lives in urban areas and by 2050 it is expected that this quote will reach 67% of global population (UN, 2019). In this scenario, the physical expansion of the geographical footprints of cities constitutes a great risk, especially if urban actors do not worry about the consequences of an unbridled and uncontrolled urban development.

In cities, climate change undermines human lives, endangers housing safety, challenges transportation and essential services (Hunt & Watkiss, 2011). This is because the main effects of climate change find fertile, not to say vulnerable, ground in the urban environment. For instance, heat waves manifest themselves most heavily in cities in the form of the Urban Heat Island (UHI) phenomenon. The UHI effect is the phenomenon for which temperatures in towns and cities are generally higher than in surrounding rural or suburban areas because of higher land density, surfaces' waterproofing, concentration of activities, and lack of green areas (Gaglione & Ayiine-Etigo, 2021). UHI represents a risk for urban environment to the extent that it can exacerbate other phenomena such as air pollution and flood risk and undermine human health by exposing people living in cities – especially the most fragile such as the elderly or children – to increased and often intolerable temperatures (Heaviside et al., 2017). Wind-related disasters are more devastating in cities, especially those with infrastructure less prepared to withstand extreme events that are occurring more frequently, destroying buildings and structures, undermining biodiversity, and causing respiratory diseases in humans (He et al., 2021). Accelerated sea level rise represents a threat for sea-port cities as coastal flooding can drown coastal communities and low-lying delta cities, compromising human lives and undispensable services such as hospitals and critical services. Furthermore, floods, surges and storms, that are evolving more intense and frequent, can provoke major disruptions in cities causing damages to water networks, storage infrastructures, and transport and electricity networks, not to mention risk to properties and human lives that concern water contamination, diffusion of diseases, higher levels of mortality, as well as economic consequences (Hammond et al., 2013). It is worth dwelling on this point, namely the risk that climate change may wreak economic havoc. Rising temperatures, sea level rise, and the occurrence of extreme weather events will harm property and essential infrastructure, causing adverse effects on productivity while also negatively impacting sectors such as agriculture, forestry, fisheries, and tourism.

According to the U.N. Office for Disaster Risk Reduction (UNDRR), natural disasters caused economic losses of up to $2,908 billion worldwide between 1998 and 2017. And estimates suggest that the global economic costs to cities, from rising seas and inland flooding, could amount to $1 trillion by mid-century (C40 et al.,

2018). According to Nordhaus & Moffat (2017) the impact of climate damages would amount to a permanent reduction of global GDP by 2%, concentrated in the poorer regions of the world. In short, the net damage costs of climate change are likely to be significant and to increase over time (Ciccarelli & Marotta, 2021).
In this scenario, cities are recognized as salient environments in the fight against climate change, as demonstrated by the political importance achieved in contemporary global agreements like the United Nations Framework Convention on Climate Change (UNFCCC) Paris Agreement (2015), the Sustainable Development Goals (SDGs), and Habitat III's New Urban Agenda (2016). That is why many national and international institutions, as well as local policymakers, are advocating for increasing climate resilience in urban environments by implementing synergically mitigation, adaptation and sustainable development strategies (Adger, 2011; Pede et al., 2022).
Several studies have demonstrated that making cities more resilient may effectively reduce adverse environmental, social, and economic conditions associated with climate change, improving citizens' quality of life, cities' attractiveness, and territorial competitiveness (Granberg & Nyberg, 2017; Sgambati et al., 2022). Furthermore, strategies aiming at increasing climate resilience can contribute to creating healthier and safer living environments, guaranteeing climate justice. To this end, innovative and adaptable strategies and measures are needed.

1.1 Adaptation or mitigation?

Given the current trends, climate change may well continue to adversely affect ecosystems, water resources, food production, human settlements resulting in great risks for our ecosystems as well as economic and financial system.
To respond to this challenge, in 2015 196 Parties at the UN Climate Change Conference (COP21) signed up to the Paris Agreement, with the primary goal to keep the average global temperature rise this century below 2°C above pre-industrial levels. In the same year, the United Nations adopted the 2030 Agenda for Sustainable Development comprising 17 Sustainable Development Goals (SDGs) (UN, 2015) to achieve by 2030. These ambitious targets are the result of research conducted by the Intergovernmental Panel on Climate Change (IPCC, 2014) to meet the commitment to stay within a global average temperature rise of between 1.5°C and 2°C compared to the pre-industrial era. The upper end of this range is considered a limit not to be exceeded to avoid potentially destructive impacts.
All the measures embedded within these two documents, are are associated with the reduction of the human footprint on earth and aim to act on the causes of global warming, by "mitigating" climate change effects. Mitigation strategies focus on reducing fossil-based CO_2 emissions, decarbonizing economies, storage and reutilization of resources, and use of alternative energy (Fawzy et al., 2020). Reducing emissions requires the reshaping of development models in diverse sectors and it is an issue that regards both local and global realities.
Yet, although the scientific community agrees that global warming has an anthropogenic matrix – being caused by the release of greenhouse gases into the atmosphere from fossil fuel use, deforestation, and intensive agricultural and industrial activities – mitigation is not the only panacea. Spatial governance tools must inevitably be geared towards adapting urban systems to the phenomena that global warming entails, increasing their ability to respond effectively. Considering the growing economic, social and urban vulnerability of cities, the rapid depletion of resources, the increasing number of disastrous natural events and the progressive environmental degradation of urban centres, adopting adaptation-based planning strategies may be one of the solutions (Balletto et al., 2022).
Adaptation to climate change can be defined as "as an adjustment in ecological, social or economic systems in response to observed or expected changes in climatic stimuli and their effects and impacts in order to alleviate adverse impacts of change or take advantage of new opportunities" (Adger et al., 2005). Hence,

differently from mitigation, adaptation tries to intervene on the consequences of climate change rather than the causes, assuming the irreversibility of the climatic transformations our planet is experiencing.
To date, much more importance has been given to mitigation strategies, but the irreversibility of climate change along with its increasingly pronounced impacts on territories, are highlighting the necessity to focus on adaptation more than mitigation, or, at least, on integrated strategies able to combine the two lines of action (Guida, 2022). Therefore, tackling effectively climate change requires the development of new patterns and processes of engagement, finance, and collaboration, among different contexts and administrative levels that give priority to adaptation measures. The implementation of adaptation and adjustment actions to persistent risks in complex and stratified urban context must be aimed not only at protecting the exposed systems but also at creating added value and raising the competitive level (Sgambati & Carvalho, 2023). Moreover, to demonstrate their effectiveness, climate change adaptation solutions are necessarily embedded in and produced by multilevel governance contexts.

2. Climate adaptation in cities between the NGEU program and the Italian PNRR

The European Union has devolved a lot of resources to cope with climate change issues over the past decades. One of the main results achieved, in terms of mitigation, was the 30% drop in EU emissions in 2020 compared with 1990 levels — well beyond the 2020 target to reduce emissions by 20%. In the wake of these achievements, Europe has set itself the ambitious goal of carbon neutrality by 2050. The European Green Deal outlines a comprehensive plan to ensure the European Union achieves climate neutrality with the objective of tackling climate change while also growing economically and safe-guarding the well-being of individuals.
However the 2020 Covid-19 emergency and the recent energy supply crisis are challenging Euroepan countries roadmap and this puts at risk not only the strategies developed so far to combat climate change, but also the security of the countries involved, especially those that are more fragile or have fewer means to deal with the climate challenge. In 2021, the European Commission adopted the Next Generation EU, a program that, in the attempt to relaunch the competitiveness of member states by acting on multiple levels, aims to straighten out the course towards climate neutrality (EC, 2021). By investing €750 billion, this financial instrument has been designed to boost a 'sustainable, even, inclusive and equitable recovery' in the post-covid era, aiming at, *inter alia*, stimulating environmental-friendly technology, greener ways of transport and built heritage efficiency, and renewing the goal of climate neutrality. Among the "pillars" of the Next Generation EU program, there is that of the green transition which, within its objectives, aims to climate change adaptation.
In the case of Italy, one of the main objectives of the National Recovery and Resilience Plan (NRRP) (Governo Italiano, 2021) – financed by the abovementioned NextgenerationEU program – is to promote sustainable and resilient development of territories. The NRRP allocates 71.7 billion (37.5% of the total) to the ecological transition, slightly exceeding the EU minimum (37%), the lowest level after Latvia. These resources are distributed over 108 measures (OpenPNRR, 2023). However, mitigation got the most resources at the expense of adaptation.
The largest share is allocated to infrastructure for sustainable mobility (mostly rails and means of transport), which accounts for 40% of the total. Also important (with 31% of the resources) are efficiency measures (i.e. those that lead to less energy and water consumption), which mainly consist of spending on improving buildings (the "110% Superbonus" is one of the measures proposed) and electricity and water networks. Investments in renewable energy account for 14% of the total. Just the rest 15% of the total budget is made up of preventive works (i.e. 'adaptation' borrowing the term from the classic dichotomy between tools to reduce global warming and to adapt to it) (la Repubblica, 2022; Openpolis, 2023).
The plan's green measures can be grouped into four categories: Transport and other green infrastructure, efficiency, renewable energy, environmental prevention works. This last category includes various

interventions aimed at flood risk adaptation, prevention and management. These interventions include awareness-raising, civil protection, disaster management systems and infrastructure, and ecosystem-based approaches. Investments in research and innovation focusing on the low-carbon economy, resilience and adaptation to climate change also fall into this category. Almost all measures in this category are oriented towards climate change adaptation.

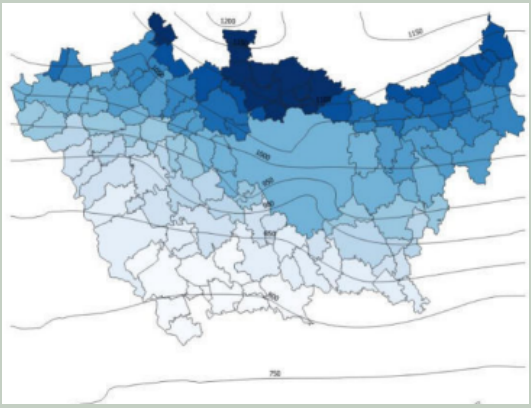
Sector	% of resources within the PNRR
Sustainable mobility	40%
Efficiency measures	31%
Renewable energy	14%
Adaptation	15%

Tab.1 The NRRP resources for ecological transition and sustainabl development articulated per sectors of investment (Source: la Repubblica, 2022)

Currently, the Italian Government is discussing the need to cut funds to meet reporting deadlines with the European Union. Unfortunately, an important piece of €16 billion has been trashed, a cut that also includes the €1.28 billion allocated to municipalities for flood risk management. Yet, through these measures and investments, the NRRP aims to foster the construction of climate-neutral and resilient cities, where people can feel safe. That is why it is worth contouring focusing on climate adaptation, also proposing measures at the urban and local scales that should be integrated in broader strategies at the national scale

Although climate adaptation measures are disseminated among the proposed strategies for ecological transition, Italy lacks cases that address the issue of adaptation in an integrated manner. The only significant case is the "Sponge City" Plan presented by the City of Milan, a plan focusing on climate adaptation in the Milan metropolitan area and involving several municipalities, that look at the problem of climate adaptation in a systemic way, also focusing on related social and economic issues. In the following table, this case is further discussed.

City of Milan – "Sponge city" Plan



Some of the funds of the NRRP have been dedicated to the development of Integrated Urban Plans at the metropolitan level, offering major Italian cities the opportunity to invest in the transformation and improvement of their territory. The Metropolitan City of Milan together with its municipalities will carry out interventions amounting to over 277 million euro, aimed at making the territory more resilient and regenerating the urban fabric. Here, the Integrated Urban Plans are intended to reduce situations of social decay promote urban regeneration (recovery, renovation and re-functionalisation) support projects linked to smart cities (transport and energy consumption), and, for what concerns the focus of this study, tackling climate change.

In particular, the Integrated Plan "Sponge City" aims at responding to the increasing sollecitations due to climate change that are testing the resistance of the city of Milan and its systems. The term "sponge city" is not a novelty: it refers to a specific urban planning sectors which, through the implementation of Nature-based solutions, i.e. based on natural principles, tries to reduce flooding risks, preserve water resources, combat droughts, and reduce water pollution.

The plan was designed with the aim of ecosystem-based land redevelopment through soil permeabilisation and stormwater management. This is achieved through a series of Nature Based interventions flanked by grey solution as well, which allow for a new management of rainwater and the functionalisation of new urban green spaces. This has an eco-functional benefit of redeveloping the territory in a climatic, environmental and hydraulic sense, reducing its vulnerability and strengthening the resilience of the territory both socially, naturally and economically. To this end, 90 interventions have been identified in 32 municipalities. These interventions regard, mainly, public spaces such as parking

areas, squares, streets and green urban areas, providing for the construction of surface disconnection works and the sustainable management of surface stormwater runoff. The plan has been projected to favouring on-site retention with delivery by infiltration, where possible, into the soil and the first layers of the subsoil. The types of sustainable urban drainage works proposed within the plan are: surface dewatering, bioretention areas, infiltrating and draining trenches, tree boxes, detention basins, wetlands, vegetated drainage channels, deep infiltration systems, subsurface retention, draining pavements, storage tanks or cisterns.
The interventions will be very widespread, so as to broaden the local and micro-local impact of the interventions. Besides, the benefits associated with such interventions can bring to a wider economic, ecosystemic, and social advantage.
In conclusion, with the definition of this Integrated Urban Plan, the Metropolitan City of Milan aims at decreasing, with an integrated approach, the vulnerability of natural and socio-economic systems and of strengthening, especially for territories characterised by high levels of sealing and high urban density, the resilience of the territory in the face of the inevitable impacts of climate change, also by fostering cooperation between public, private and citizens subjects in pursuing concrete actions

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