

Article

Cities under Pressure: Strategies and Tools to Face Climate Change and Pandemic

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Abstract: This paper investigates the problems and stresses of the contemporary city, mainly due to natural and health factors, related to climate change and the pandemic COVID19. Besides highlighting the characteristics of climate change and the ongoing pandemic, this study focuses on the analysis of the main effects and consequences that these phenomena have produced on the city and the vulnerabilities of the urban system. To understand how these events have impacted the urban environment, directly and indirectly, this research undertakes to define some specific indicators capable of comparing the phenomena and assessing their repercussions. The Methodology is based on the following focal points: on the analysis of the urban shocks that have affected the cities in the last decade, on the comparison between contemporary survey data and those relating to historical trends, on the definition of the main urban sectors particularly affected by the onset of urban shocks, and on the definition of strategies, actions, and tools deemed to be effective in the implementation of a post-pandemic and climate-proof city. These results were achieved through complementary urban design and tools capable of creating a post-pandemic and climate-proof adaptive city, within a cross-disciplinary approach.

Keywords: resilience; smart cities; pandemic; urban mobility; COVID-19; risk; climate change

1. Introduction. Climate Change and Urban Pressures

Nowadays, the shocks, stresses, and pressures cities are forced to face have noticeably increased; these include floods, earthquakes, hurricanes, fires, volcanic eruptions, pandemics, chemical spills and explosions, terrorism, power outages, financial crises, cyber-attacks, and conflicts. Natural risk factors are well known with the increasing danger to climate change, the interdependence of phenomena, and globalization. Anthropogenic factors increase the danger and generate new risk factors—ethnic conflicts, wars, terrorist attacks, epidemics and pandemics, etc.

The outbreak of the COVID-19 pandemic, as well as the continuous and increasingly frequent effects of climate change, have had a deep impact on cities all over the world. This situation unmistakably demonstrates the uncertainties and perplexities of urban governance, both in terms of time and effectiveness. Noticeably, the urban systems where we live are characterised by a low level of resilience and, therefore, require synergistic actions for the enhancement and effectiveness of responses to stimuli and urban adaptation and mitigation. There is a growing awareness that these responses must be marked by a great technical and scientific competence, the result of a continuous synergy among different disciplines contributing to an increase in the resilience of a territory, rather than the result of a holistic and monodisciplinary vision. The main aim of this paper, the outcome of a research

path that began a few years ago and is still in the midst of its activity, is to demonstrate that some disciplines selected here (Urban Planning, Transport Engineering, and Geotechnics), can be advocates of a technical-scientific reflection. Undoubtedly, this will lead to the development of intervention tools capable of mitigating territorial vulnerability, by increasing the effectiveness of responses to stimuli and environmental adaptation and mitigation. The final result is the arrangement of actions, strategies, and tools that can contribute to the achievement of a resilient and climate-proof city, with a view to a post-pandemic reconsideration of spaces and infrastructures.

The multidimensional impact of the pandemic has led to isolation measures, such as the closure of public places and schools with the collapse of tourism and related incomes in cities. It has aggravated the deep social and economic inequalities, causing a wave of racism and xenophobia and the proliferation of domestic violence. The repercussions of these phenomena have an uneven effect on vulnerable populations, who often live in densely populated or informal areas, with precarious employment and poor financial resilience, combined with the difficulty of accessing distance education, healthcare, and other essential services. Therefore, the pandemic has left an indelible mark on the prospects of cities and this made us rethink the development of cities in different dimensions, such as the social, cultural, economic, and environmental ones.

Climate change is slowly modifying the life of human beings and various animal and plant species, leading to a reduction in coasts, a shortening of the lifespan of some species, besides damaging agriculture and causing impacts on health. The large number of people living together, coupled with a vibrant economic and cultural life, make cities particularly vulnerable to disasters. Cities have shown their ability to adapt to the changing global situation. Several cities have responded with agility and resilience to the pandemic problem by implementing relevant solutions at the local level. On the other hand, adaptations to climate change have been slower. The key challenges that cities have faced and the innovative solutions that have emerged, including the ways to develop and promote improved resilient and sustainable tourism, represent a starting point for the definition of more sustainable and fair urban living environments, as well as a better informed policy in the next months.

It is very useful to highlight that the definition of Resilience is not yet clearly shared, as it often refers to different scientific and disciplinary fields. Engineering began using the term in the 19th century to represent the ability of a material to return to a previous equilibrium condition after being subjected to an effort; Ecology and Environmental Sciences have been using the concept since the 1970s when Crawford Stanley Holling [1] first used the term ecological resilience in 1973 to explain some phenomena observable in the natural environment; subsequently, other authors have defined resilience as the transition process that brings an ecosystem, subjected to external changes, to a new balance, highlighting the ability of the natural environment to regenerate and reach new state conditions [2,3].

To understand and analyse the direct and indirect effects that these phenomena have on the urban environment, specific indicators, suitable for comparing the phenomena and assessing their performance, have been defined. However, existing indicators are often not standardised, consistent, or comparable over time or across cities. The first standard of this series, ISO 37120 (Sustainable Development in Communities Indicators for city services and quality of life) has quickly become the international reference point among the indicators of sustainable cities. Subsequently, other indicators have been added to it through ISO 37123, while, in parallel, additional indicators have been defined for Smart Cities developed in ISO 37122 (Figure 1).

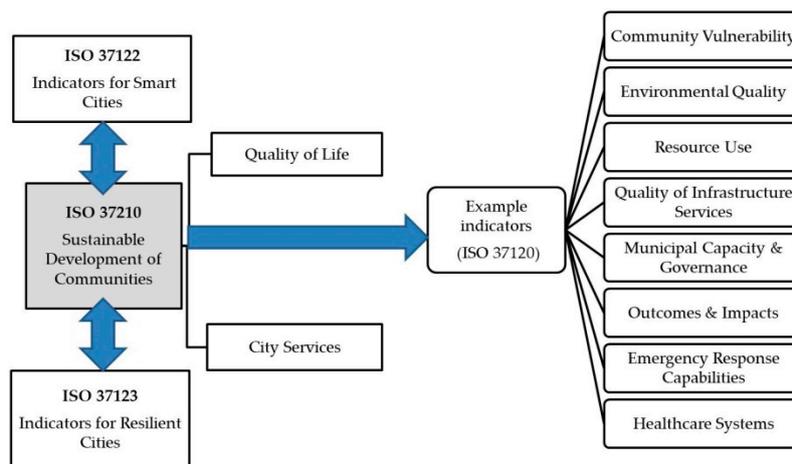


Figure 1. Urban resilience indicators. Personal elaboration.

Following the conceptual approaches and taking into account the phenomena described in the introductory part, the paper aims at outlining the main actions and design strategies that can be implemented in cities for the improvement of urban and territorial resilience. To do this, it was agreed upon to start from a few disciplinary aspects that are recognisable as basic undelayable elements in the formation of these strategies; namely, urban planning, which aims at coordinating actions and outlining them in design and strategic tools that can be implemented, transport engineering, which is mainly aimed at understanding the dynamics of mobility and connection, and, finally, geotechnics, which is mostly interested in the risks and vulnerabilities deriving from soil consumption and issues relating to soil permeability.

There are other disciplines that contribute to the formation of these strategies. A cross-disciplinary approach is fundamental when analysing and understanding both the causes of climate events and their effects on an urban and neighbourhood scale; disciplinary expertise is needed in various fields, such as Climatology, Geography, Geology, Geotechnics, Hydraulic Engineering, Transport and Mobility Engineering, Materials and Architecture Engineering, and Urban Planning [4].

All these disciplines (the list is not exhaustive) help investigate the causes and the effects of climate change and outline appropriate adaptation and mitigation strategies. This work will include specific contributions from Architecture, Urban planning, Geo-technics, and Transport Engineering, while basic concepts from Hydraulics and Climatology will be acquired as concise data, reported by specialised dossiers that have paved the way for the explanation of the phenomena described.

All these disciplines are necessary to understand the direct and indirect effects that exist among climate change, pandemics, and urban transformations.

The methodology applied is based on the following key points:

- The analysis of the urban stresses and shocks that have affected the cities in the last decade;
- The comparison between contemporary survey data and those relating to historical trends;
- The definition of the main urban issues and of the sectors that are particularly affected by the onset of urban shocks;
- The subsequent definition both of the appropriate strategies and actions needed to mitigate the vulnerability of cities, and of the elements exposed to natural and health shocks, along with the outlining of the main planning and strategic actions that can be implemented in the main urban survey systems, such as the settlement system, the mobility system, and the systems connected to the soil conditions (Figure 2).

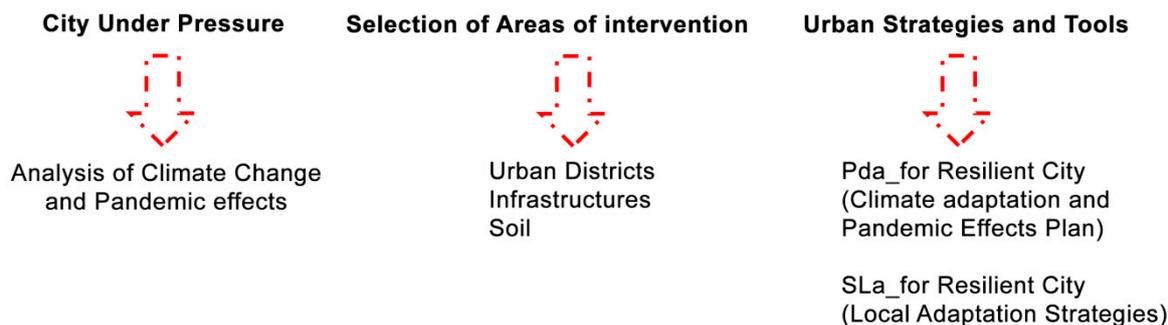


Figure 2. Conceptual scheme of the research. Personal elaboration.

The paper will focus on the analysis and research of the best design solutions to be implemented in these three sectors, which are considered to be the areas where the city can achieve the best resilience and the most effective actions to fight pandemics and urban shocks. Within the discussion, appropriate references to quantitative indicators will also be developed, enabling a better understanding of the phenomenon and better management of evaluative feedback following the project implementation.

The hypothesised indispensable and innovative tools for the management of the resilient and post-pandemic city are presented in detail in the final section of the research, in the conclusions chapter. Although, of course, this discussion requires numerous evaluative feedbacks, to verify the effectiveness of the actions in the different urban contexts where they are implemented and also to define a threshold for determining the efficacy of the project.

These evaluation procedures are part of the implementation process of the urban planning and the strategic tools introduced, which demand several check/calibration phases.

Our research team has started evaluating specific tools: Pdafor Resilient City, in the form of wide-ranging guidelines, since several phenomena, calamitous events and catastrophes, in general, know no administrative limits. The recent COVID-19 pandemic is an example of this. It is also true that there are climatic, geographical, and morphological conditions that make different realities equal, whether they are more or less contiguous.

Furthermore, it is necessary to adopt Local Adaptation Strategies, SLaforResilientCity, to contextualise the actions and limit the impacts of climate change, by reducing the vulnerability of territories and local communities. In this case, the second-level tools will be operational and will identify timely strategies, actions, impacts, repercussions, in addition to back-up measures to finance interventions. Albeit, the Adaptation Plan will not only be linked to climate change but will also have a priority objective of making the city resilient to extraordinary events, disasters, and pandemics.

Hence, the proposal addressed by this work is to introduce and define the critical issues relating to climate change and the COVID-19 pandemic connected to the city-infrastructure soil system. This analysis is preparatory to understanding how cities can respond to these impulses in a resilient way, showing that some indicators have been calibrated by regulatory bodies to provide a synthetic and quantitative evaluation of this response. The intention of this study, therefore, is focused on a brief analysis of the definition of resilience and on the required tools to evaluate it. The criticalities connected to climate change and the pandemic were described considering the possible correlation between pollution and the aforementioned unresolved issues. This work gradually shows which solutions can be adopted concerning mobility and the geotechnical sectors, to reduce the risk of new impacts generated by these events.

The analytical and design process experienced by our research team is described in the following conceptual scheme (Figure 3).

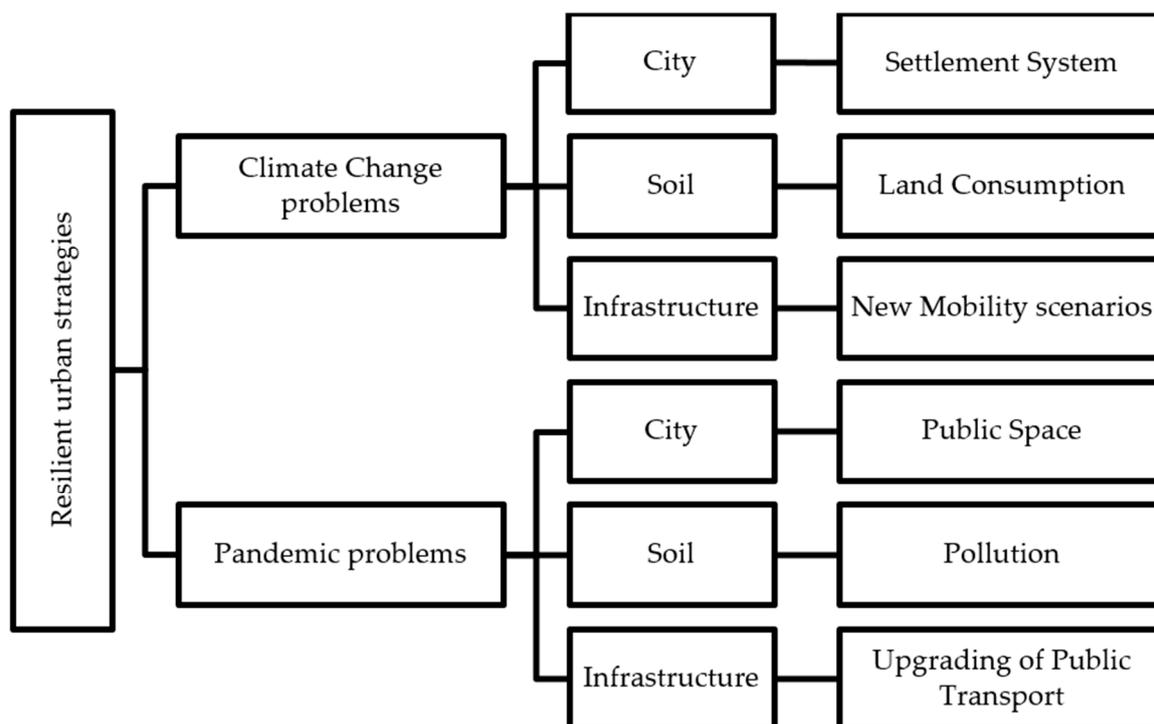


Figure 3. Main resilient urban strategies related to investigated factors. Personal elaboration.

2. Conceptual Section. Climate Change and COVID19

In 1979, the Charney report was the first document predicting the climate crisis, defining the production system based on fossil fuels as unsustainable and providing warnings about the consequences of the increase in CO₂ in the atmosphere. In 1979, the first global scientific assessment of the impact of greenhouse gas emissions on the Earth's climate was published and the anthropogenic origin of climate change was proven.

The term Resilience began being applied to cities in 2012 in the USA, when Hurricane Sandy devastated the US East Coast, Jamaica, Cuba, and the Bahamas. Within Materials Engineering, this term has been used to describe the ability of a material to absorb a shock without breaking. The Latins employed the term to indicate “a backward leap without rupture”, while, in Urban Planning and Design, it refers to a series of necessary and useful actions and strategies adopted to manage climate change, allowing cities to adapt and mitigate its effects and systemic vulnerability. In Italy, there is no legislation on resilient planning, although several applications can be found in Architecture, particularly in Urban Planning. The municipal Urban Planning tool that best represents the effectiveness of this term is the Milan 2030 Territory Government Plan (PGT), approved in April 2019, which introduced the Climate Reduction Index (based on the Berlin planning model) and some effective resilient planning actions, such as targeted interventions on roofs, building facades, and urban parks. Furthermore, the Municipality of Milan boasts a Project Management Department on the resilient city, whose Chief Resilient Officer is Dr. Piero Pelizzaro. This structure has been set as part of the Rockefeller Foundation “100 Resilient Cities” project, with 89 member cities worldwide and a Municipal Department on environmental transition, whose powers have been held, so far, by the current mayor Giuseppe Sala. Milano 2030 is a resilient PGT, as it is reducing the land consumption index, compared to the previous PGT. 1.7 million square metres of land that will be no longer buildable and 3.5 million square metres will be set aside for new agricultural areas, 20 new city parks are in the pipeline, as well as the ForestaMI project, aiming at planting 3 million new trees by 2030. It also involves the requirement for new buildings, to make them carbon neutral, with a reduction of the soil footprint by 10%, in the case of demolition and reconstruction work. Furthermore, it implies the diminution of the building index for areas less accessible to public transport, with the ambitious,

but not utopian, objective of renaturalising 4% of the surface area currently occupied by buildings. There is also a focus on mobility and infrastructure, with the need to build 35 km of cycle paths and to expand the Zones 30 (Z30) and public spaces, while adopting tactical urban planning in the transformation of vehicular spaces into walkability spaces.

A new line of research, which has been developed since March 2020, identifies a direct correlation between pollution and climate-altering substances, with the spread of pathogenic events and the onset of pandemics. On 9 April 2020, the meteorologist Luca Mercalli reported about this matter on a webinar promoted by the Planning Climate Change Lab of the IUAV in Venice, entitled “Pandemics and climate crisis”, centred on the relationship between the two crises (the environmental and health ones), sometimes caused by very similar factors. A study accomplished in March 2020 directly links the issue of air pollution to the spread of pathogens. Fine dust as a vehicle for spreading pathogens has become a strongly debated topic within the scientific community, following the current transmission of the COVID-19 pandemic. In a document recently released by the Italian Society of Environmental Medicine, “Report on the effect of air particulate pollution and virus spread in the population [5]”, some cases of virus spread are listed in relation to air particulate concentrations (2010 avian influenza, 2016 RSV, 2017–2020 measles). According to this study, the atmospheric particulate acts as a transport vector for a number of biological contaminants, including viruses (Figure 4).

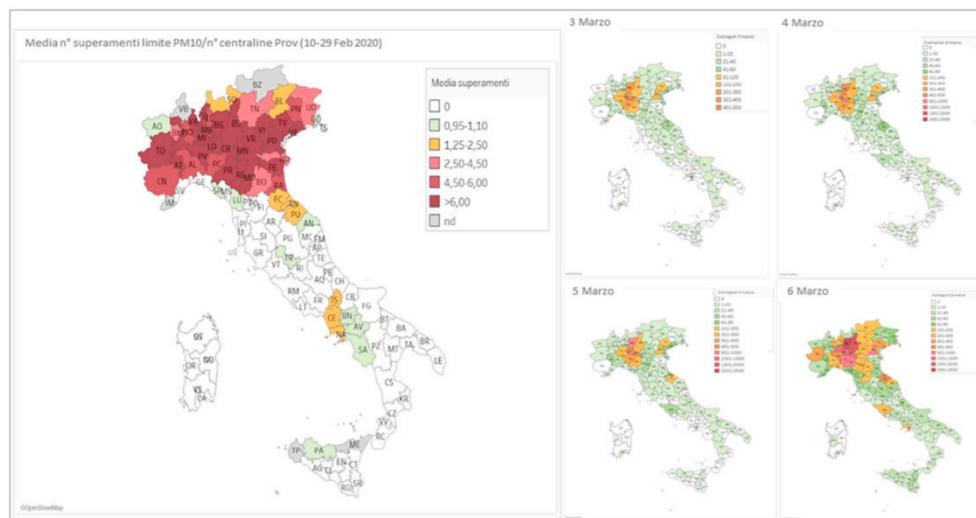


Figure 4. Exceeding PM10n. Limit control units and number of contagions in each Italian province [5].

The report presents a preliminary analysis regarding the possible correlation between the PM10 daily concentration data, collected by ARPA (Regional Environmental Protection Agencies) and the number of cases infected by COVID-19 in Italy, published on the Civil Protection website.

The analysis seems to indicate a direct relationship between the number of cases of COVID-19 and the PM10 pollution status of the Italian provinces. In particular, the concentration of the major outbreaks has been recorded in the regions of northern Italy, where, considering the period 10–29 February, high concentrations (above the PM10 limit) may have worked as a boost to the virulent spread of the epidemic, especially in the Po Valley, unlike what has been observed in other Italian regions.

To better comprehend the issue of Climate Change and Pandemic Matters, along with their repercussions on an urban scale, it is necessary to start from the definitions regarding the geological era, up to the most recent disciplinary innovations combining the traditional scientific terms with the words that have currently entered the common multidisciplinary lexicon, such as “resilience” and “climate adaptation”, as well as the word “Anthropocene” (presently photographing and simplifying the discussions relating to climate change and its anthropological derivation).

Holocene is the most recent geological era, where we locate ourselves, while Anthropocene is a term coined back in the 80's, by the biologist Stoermer, which was adopted in 2000 by the Nobel Prize for Chemistry Paul Crutzen in his book "Welcome to the Anthropocene" [6].

The term indicates the current geological age when human beings and their activities are charged with the responsibility of territorial, structural, and climatic changes.

Definitions like "Sons of Anthropocene" are increasingly widespread, to the same extent as political, technical, and even religious warnings about the need for a change in development.

The main consequences of climate change are:

- The creation of heatwaves;
- Long periods of drought;
- The melting of glaciers;
- Sea level rise;
- Floods and extreme weather events (fierce storms).

Regarding the sea level rise, a study, conducted by the Enea Laboratory of Climate Modelling and Impacts in 2007 [7], demonstrates that the sea level has increased by 20 cm in the last century and, since this uprise is inextricably linked to the climb in temperature, if the $T^{\circ}\text{C}$ does not exceed 2°C , the sea rise will not surpass 50 cm. On the other hand, in the worst-case scenario, if the $T^{\circ}\text{C}$ reaches $+5^{\circ}\text{C}$ in 2015, the sea level will grow by about 3.5 cm per year. Consequently, by 2100, 33 areas belonging to the Italian coastline will be submerged, such as Venice (whose sea level will ascend by 1.5 m), Versilia, the Orbetello Lagoon in Tuscany, the Po Delta, 50% of the beaches in Marche and 60% of those in Abruzzo, the Gulf of Cagliari and Oristano in Sardinia, the "Piana" of Catania and the Salt Pans of Trapani in Sicily.

It has been estimated that, by 2015, the "perennial" glaciers below 4000 m altitude will melt, for instance, most of the ones located on the Alpine mountain chain.

Although these effects are evident within our urban systems, some scepticism persists in understanding climate change and, above all, in defining it as the main cause of extreme events. This perplexity involves about 72% of the population and 3% of scientists, proclaiming to be sceptical about global warming and climate change. This share of doubt is getting thinner and thinner as we are confronted with more and more extreme events in those areas where they never occurred before or, to a lesser extent, when analysing the return times of the events that have been more frequent in recent years.

The average temperature has increased by 1.2°C in the last century. Taking into account the last years, it can be noticed that the months of June, July, September, October, November, December 2019, and January 2020 have been the hottest in history, with average temperature differences up to $10\text{--}12^{\circ}\text{C}$ (source: Copernicus Climate Change Service, the European satellite Earth observation programme).

It is a sick and heavily polluted world. There are about 411 parts per million CO_2 in the atmosphere (Figure 5). These values had never been reached in the last million years of the world's history. Climate-altering substances (mostly CO_2 and CH_4) are due to the direct consequences of our habits and lifestyle, mainly based on the use of fossil fuels. They are also due to the so-called "isotopic signature"; according to it, the real "signature" of a contaminant derives from its particular isotopic composition, which enables us to trace its exact origin, transport routes, and distribution in the environment and population.

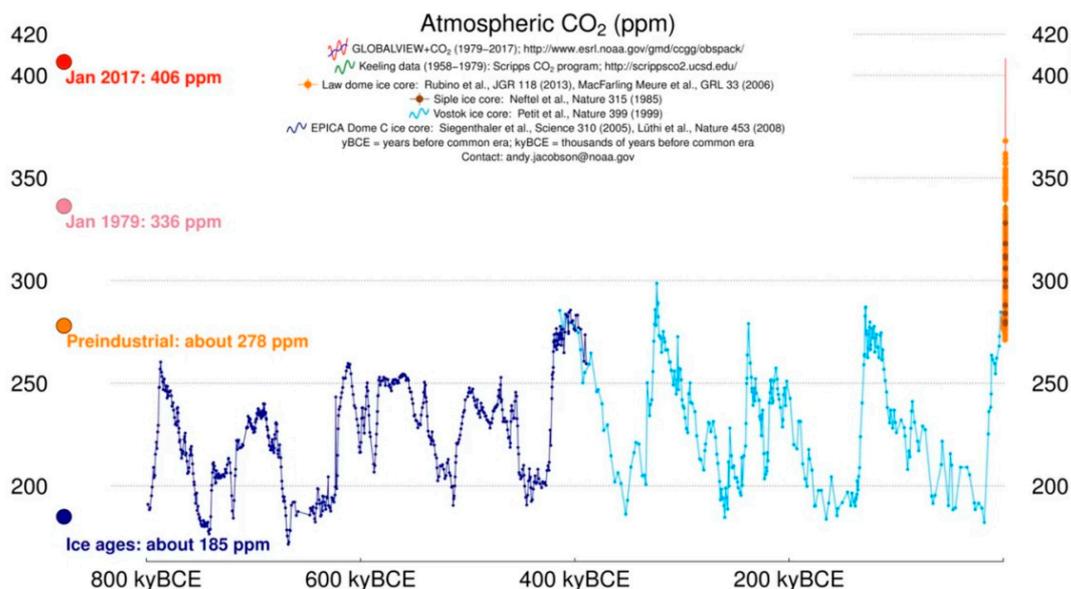


Figure 5. Atmospheric CO₂ (ppm). Source: NOAA.

Global warming has also affected the Arctic, where, in recent decades, temperatures have risen faster than the global average. Considering the sea ice acts as a shiny floating lid on the Arctic Sea, reflecting most of the sunlight entering outer space, if the ice melts, more heat is absorbed by the water. This phenomenon, in turn, warms up the atmosphere above.

In Alaska, on 4 July 2019, the temperature reached 32 °C. Likewise, record heat waves occurred throughout Europe, with temperatures exceeding 40 °C on 25 July 2019, in Belgium, Germany, Luxembourg, and the Netherlands (Figure 6). In Paris, the thermometer has registered a record temperature of 42.6 °C since the weather station was activated (in 1869) [8]. In Italy, the temperature rise is concentrated in some cities, particularly the ones affected by the presence of intensive industrial areas. According to a study published in Sole24Ore [9], the highest increase occurred in Pavia (+1.3 °C in the last century), while the lowest increase was in Cagliari (+0.67 °C). In Milan, for instance, the average temperature has augmented by 4 °C in the last 100 years (source: Fondazione Osservatorio Meteorologico Milano Duomo).

Drought, i.e., “the decrease of water available in a particular period within a particular area [10]”, has remarkably intensified in recent years. Especially in Italy, in 2020, the driest spring, as well as the most negative spring anomaly occurring in the last 60 years, has been characterised by scant rainfall, with severe repercussions on the flow rate of lakes and rivers. Since the beginning of 2020, in Italy, the anomaly has registered −44% rainfall, i.e., 23.4 million cubic metres less water fallen to the ground, a volume equal to the basin of Como Lake (Source: Ansa, 16 April 2020). In Australia, in 2019, terrible fires caused the destruction of approximately 20% of the forests; the burnt zones surface area was equal to one-third of the Italian peninsula and the fires were provoked by a long period of drought, with 40% less rainfall to the ground. This event had been predicted in 2013, by a Dossier entitled “Be prepared: climate change and the Australian bushfire treats [11]”.

Even though longer and longer periods of drought are going to be faced, floods are equally increasing, mainly due to the rise of the peak intensity of rainfall. More and more often intense downpours, concentrated in very short and circumscribed time lapses, take place. In most cases, these events exceed the intensity of storms (30 mm/h), pouring 100, 200, 300 mm water in few hours, causing huge problems and sadly, sometimes, even fatal consequences. This is confirmed by a number of similar examples on a global basis, such as the floods in Beijing in 2012 (200 mm in a few hours) and Mumbai in 2017 (300 mm in two days). Likewise, in Rome in 2018 (50 mm/30 min), in Sicily in 2018, 2019, and 2020 (from 52 mm/h to 90 mm/h in Palermo on 15 July 2020), and in Calabria in 2018 (70 mm in 2 h). A similar event happened in the Varese province on 7 June 2020. Within a period

of eight hours, the amount of rainfall recorded was equivalent to that normally seen in a month, 1/10 of what is expected in a year. Moreover, the maximum peak reached 163 mm, overloading brooks, streams, and rivers, which devastated the banks of roads and several residential areas, causing floods and landslips.

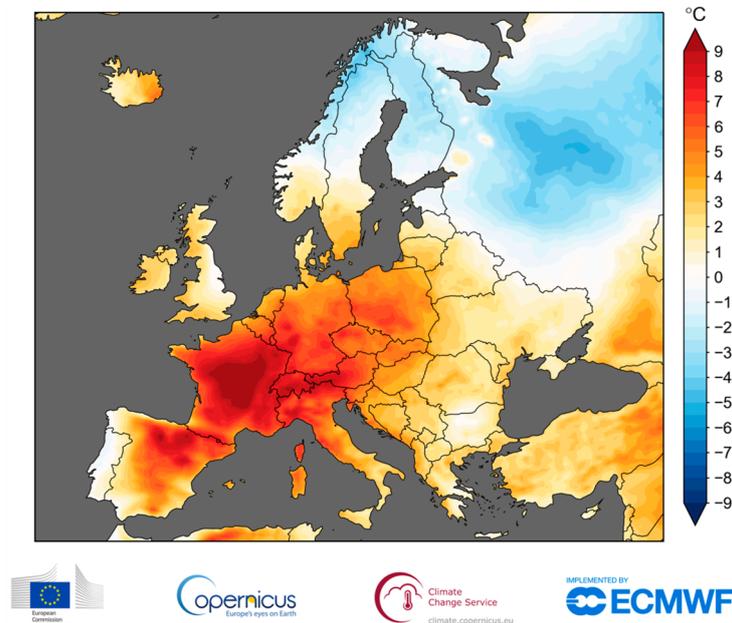


Figure 6. Average 2m temperature anomaly for 25–29 June 2019, Climate Change Service (C3S).

Peak intensity is directly related to soil consumption [12]. Soil consumption in Italy has increased by 7.64% in recent years, with an impermeable surface area of 23,039 square km [10]; +13% in Lombardia and Veneto, +10% in Campania. Only the regions of Sardinia, Valle D'Aosta, and Basilicata have managed to contain it by 3%. For each percentage increase in soil consumption, the meteoric peak intensity has been estimated to rise by 3%. The return times of the most critical phenomena have shortened. In March 2020, in the middle of a desolate St. Peter's Square, Pope Francis said: "We have not stopped despite your calls, we have not awakened despite wars and planetary injustices, we have not listened to the cries of the poor and of our planet that is seriously ill. We have persisted, undaunted, thinking that we would always stay healthy in a sick world".

3. Materials and Methods. Benchmarking Resilient Cities

The concept of resilience, as already stated, applies to different sectors of our society and its effects are primarily observed within its environment and the health of its people. Various acceptations belong to the concept of urban resilience, although, generally speaking, the term assumes the meaning of resistance, i.e., the ability of the urban organism to respond to external stresses by absorbing them and restoring its functions as soon as possible. It also means being ready for the future, making changes to adapt one's resources to face new challenges.

Within the research on resilience and adaptation, there are also purely urban planning and urban design studies that propose functional models of organization, with the building environment, on the one hand, and the infrastructural networks (energy, transport, water, natural environment, food cycles, agriculture, waste collection, etc.) on the other [13].

In another field of study, more purely engineering and geotechnical, the thematic focus is centered on natural disasters (earthquakes, eruptions, tornadoes, floods, landslides, etc.) and the vulnerability of urban systems. Resilience is considered the opposite of vulnerability; therefore, territorial analysis models and intervention projects/programs are proposed in the moment of emergency and the medium to long term [14]. According to these studies, a territorial urban system that is resilient to natural

hazards must not only be able to prevent and manage disasters but must pursue greater environmental and social quality. By limiting land use, especially in areas at greatest risk, disasters are prevented by also reducing the social and economic costs of urban development. The resilience of territorial urban systems becomes a crucial element in emergency management in the event of a calamitous event and must be pursued, not only by intervening on the vulnerability of exposed assets, but also the capacity for self-organization and mobilization of communities.

The UNISDR (United Nations Office for Disaster Risk Reduction) defines “resilience” as the ability of a system, community, or society, exposed to natural disaster, to resist, absorb, adapt, and recover from the effects of an extraordinary event in an efficient and timely way, through the maintenance and restoration of its essential functions. In this sense, the city’s perspicacity must be demonstrated not only in the management of the emergency phase, but also in the long term, as an ability both to adapt to the ongoing transformations and to respond to intergenerational challenges, ready to remodel, to withstand any external strain, to the bitter end. This implies cross-disciplinary strategies, involving the city in all its aspects. The theme has been the subject of in-depth studies, carried out for years by technicians and administrations at various levels and by researchers of urban phenomena.

UNISDR’s vision is anchored in the four action priorities established by the Third United Nations World Conference on Disaster Risk Reduction in 2015 in Sendai, Japan: Understanding Disaster Risk, Strengthening Risk Governance, Investing in Resilience for Reduction of risks, and improve disaster preparedness in order to pursue “Build Back Better” through recovery, rehabilitation, and reconstruction. In the line of studies on resilience and adaptation, the focus is on resilience as a strategy to deal with the effects of climate change and the reduction of energy sources from hydrocarbons. In this approach, the field of reflection is more limited and aimed at responding to climate and energy transformations, thinking about new settlement models capable of adapting to changes induced from outside the system.

The challenges of resilience are therefore manifold and primarily concern the natural and social changes taking place: On the one hand, climate change that implies an increase in hydrogeological instability, flood risk, coastal erosion, desertification, island production urban heat, the reduction of primary goods such as water and agricultural products and, on the other, demographic growth, the concentration of the urban population, the scarcity of energy resources, the growing gap between rich and poor countries. The areas of intervention to cope with urban stress and achieve the objectives of a resilience strategy concern various sectors and disciplines such as spatial planning informed to the reduction of land consumption and the development of large area, regional, and provincial planning; the management of the vulnerability of the territory in relation to hydrogeological risk through forecasting and prevention actions; the development of urban planning in the management and design of urban settlements; and actions to safeguard and manage the water resource.

The first city that resolved to undergo a process of rearrangement, undertaking the path of resilience construction, was Rotterdam. In 2008, the City committed to becoming fully resilient by 2025, with an aim to reduce CO₂ emissions by 50% compared to 1990, through the “Rotterdam Climate Initiative” and the “Rotterdam climate proof”.

“Rotterdam’s climate adaptation strategy is based on specific actions taken to optimise the water defense system, for instance, the improvement of resilience through adaptive measures to be implemented throughout the urban environment. This strategy shows great attention to some key actions, such as safe district systems, flood-proof construction, floating buildings (the Rijnhaven project), or water-based public spaces that increase the resilience of the system [15]”.

Rotterdam’s climate adaptation strategy is based on some optimization actions of the water defense system; improvement of resilience through adaptive measures to be implemented throughout the urban environment; and on the combined and agreed action with all urban stakeholders considering climate adaptation as a strategy that can innovate the city by making it more interesting and innovative. The enhancement of public areas used to store rainfalls is also planned, which will in part be used for the irrigation of urban greenery; the underground water storage capacity will be enhanced; collective water

gardens will be implemented and will be created in common private areas; and green roofs will be implemented that will allow the storage of the rainwater.

The resilience project does not only concern big cities since future challenges will affect urban settlements at all levels. Vejle, in Denmark, is a very small municipality, whose resilience strategy has been based on four key ideas:

- Climate resilience city: Using water and climate change as an additional boost to the city's development.
- Smart city: Using new technologies to improve efficiency and to increase productivity.
- Co-creating city: Fostering partnerships between public and private production sectors.
- Socially resilient city: Increasing economic and social cohesion to create the best conditions for future generations.

In April 2013, the European Commission (EC) presented a pivotal document: The European Climate Change Adaptation Strategy, which introduces a regulatory framework and the proper mechanisms to make Europe capable of tackling the current and future effects of change. The study Act-Adapting to climate change in time estimates that between 1980 and 2011, in Europe, more than 5.5 million people were affected by floods; comparatively, more than 2500 people died as a result of catastrophic events, while economic losses exceeded 90 billion euros. Estimates of future costs and benefits show that the annual cost resulting from the state of not adapting to climate change will amount to at least €100 billion in 2020, rising to €250 billion in 2050. The need to adopt a comprehensive strategy, based on a careful analysis of ongoing climate change in the definition of mitigation/adaptation policies, along with the employment of smart solutions and technologies to handle climate change, to make cities resilient, cannot be postponed.

In the study mentioned above, the priority objective is to reduce the risk of climate change by increasing the resilience of individual communities, as there is a close indirect relationship between the two concepts. This relationship tends to be reversed, depending on the factors we are tackling, for instance, whether we are working on impact management or vulnerability reduction, or if we are focused either on a contingency or on prevention. As long as the action is taken on the contingency field, especially if this is done too late and with cursory measures, the impacts of climate events are likely to be more significant, widening the gap between the risk and the capability of the system to absorb it, i.e., to be resilient. Within the Action 3 of the "Act-Adapting to climate change in Time" project, mentioned above, ISPRA (Higher Institute for Environmental Protection and Research) has prepared the Roadmap for the elaboration of Local Climate Change Adaptation Plans (LAP). The Roadmap is aimed at supporting the start-up needs and the implementation/realization phase in the process of adoption of locally tailored plans. It prescribes the definition of the most vulnerable sectors, which are to be prioritised by the Plans, identifies the approach and strategic guidelines to be held at local level, and provides recommendations for an effective adaptation process.

Eight categories of actions have been identified in the Roadmap:

1. Ensuring political support.
2. Building technical-managerial commitment.
3. Planning.
4. Planning implementation.
5. Planning supervision, evaluation, and review.
6. Involving stakeholders.
7. Integrating adaptation into sectoral policies and programmes.
8. Communicating and disseminating.

In line with the directions stated in international and European documents, in 2015, the Ministry of the Environment, Land, and Sea defined the National Climate Change Adaptation Strategy (SNAC) [16], containing adaptation measures and policies to be implemented through Sectoral Action

Plans. Moreover, the SNAC outlines the set of actions and priorities aimed at reducing the impact of climate change on the Italian environment, socio-economic sectors, and natural systems.

More than anything, the SNAC outlines the scientific knowledge about sectoral impacts and vulnerabilities, while analysing the recommended priority actions to be taken, in order to ensure land safety.

The document supplies a national strategic vision on how to manage the impacts of climate change and, furthermore, it represents a reference framework for adaptation, both for Regions and Local Authorities. In 2017, the Ministry of the Environment adopted a National Plan of Adaptation to climate change, whose objectives are to protect the vulnerability of natural, social, and economic systems from the impacts of climate change, to increase their adaptive potential, to improve the exploitation of opportunities and to promote the coordination of actions at different levels.

4. Results

The following two paragraphs have been written within the field of Geotechnical Engineering and Transport Engineering. These disciplines are extremely important in the description and analysis of the current phenomena and the arrangement of appropriate strategies. Vulnerability analysis and risk assessment, as well as mobility and urban flow studies, are remarkably effective in urban design, as they contribute to improve monitoring, enhance data collection, interpret phenomena, and prepare the most effective climate adaptation and mitigation actions, in the short and medium term.

4.1. Impacts on the Stability of the Territory and Urban Areas

In recent years, we have witnessed the occurrence of several dramatic events, causing loss of life and considerable damage. In this context, the increase in global average temperature and the consequent alteration to the frequency and intensity of meteoric precipitation has led to an escalation of extreme phenomena, such as floods and landslides, and, to a greater extent, of climate change manifestations and its effects on hydrology [17].

In some urbanised areas, the level of risk is further aggravated by the combined effect of increased intensity and frequency of extreme weather events and by the population growth. In these situations, events related to heavy, short-term rainfall, in areas of limited size, are particularly noteworthy.

These episodes are not always easily predictable, therefore it is necessary to analyse future scenarios on a small scale, with particular reference to rainfall and the effects of climate change, to assess the risk associated with them. The metropolitan environment is extremely vulnerable to such climate change, both with respect to extreme events (floods, storms, mudflows, landslides) and to the microclimate (irradiation, rainfall, temperature, humidity level, ventilation). The urban climate affects the quality of life of citizens and their safety, as well as environmental and energy sustainability [18].

However, in the context of climate change, historical data are becoming less and less relevant, while the availability of advanced services and models, which enable the prediction of expected impacts on the ground at urban scale, are becoming increasingly important.

Metropolitan areas, as well as the infrastructure system the related activities depend on, represent a reference scenario for solutions to be tested. The main feature characterising these areas is the existence of high intensity economic/social interactions, which can also be observed through the flows of people and goods.

Thus, quantifying risks is an essential aspect in developing appropriate adaptation and mitigation measures. These actions require procedures capable of combining the effects of climate change and urbanisation with risk assessment. Furthermore, low-cost monitoring and warning technologies can be used to develop advanced systems to predict events, either for “near real-time” analysis or for information pertaining to the potentially exposed population.

Physical sensor systems for the monitoring of useful parameters can be utilised to feed predictive models managing the activation of natural phenomena, be they meteorological events, landslips, and/or floods [19].

The predictive factor can be based on two main families of models: The first family is prognostic, its specific function is to identify in which areas, among those monitored, the degree of susceptibility to a new event has exceeded a fixed threshold of attention. The second “near real-time” family of models is involved in recognising when the progression of some meaningful quantities is such as to foreshadow the loss of safety conditions.

The main challenge is to design and prototype multi-parameter sensor systems, with a sustainable life cycle for widespread application, contributing to increase the extension of the areas continuously monitored. For this purpose, different digital and analogical technologies can be utilised and combined, to record rotatory and translational displacements, through the use of inclinometers and accelerometers in MEMS technology, besides a combination of strain sensors, based on fiber optic technology, coupled with MEMS technology. Finally, the physical sensors directed towards monitoring significant parameters will be complemented by the citizens’ observations, which will be enhanced thanks to “human sensors” signals.

The gradually more available connectivity has encouraged the spread of mobile devices marked by high complexity and technology, enabling the performance of a variety of functions. This makes it possible and extremely effortless to collect both qualitative and instrumental observations/data by any observer, even when accidentally involved in extreme natural events. An example of this is the proliferation of amateur videos shot through mobile devices and posted on platforms, such as YouTube, during severe weather events or earthquakes.

Such observations, which are traceable to human sensors, could be employed in “near real-time” [20] analysis, to allow the sharing of information, captured in automatic mode, among all stakeholders (transport infrastructure operators, users, law enforcement, civil protection operators, etc.).

In the context outlined above, a desirable outcome would be the development of models and algorithms for the validation of forecasts based on data collected by sensor networks, in addition to models for the nowcasting and forecasting of climate conditions at urban scale and for the “real time” alert of citizens, in relation to the expected effects on the ground. This should be matched with implemented and validated (real-time or near real-time) models, which may be used to support local and global alerts, along with decision support models enhancing risk reduction solutions and increasing the resilience of urban systems to climate change [21].

4.2. The Pandemic and the Resilience of Urban Mobility

There is a documented relationship between city shapes and mobility patterns. The complexity of the Italian settlement system, with its articulation and peculiarities, constitutes quite a relevant component in assessing the potential and weaknesses of the new mobility scenarios. In Rome, the anti-fragile mobility strategies for urban resilience are linked to wide-ranging strategies for the mobility, which may be easily transformed from emergency into ordinary mobility measures, provided that ordinary and extraordinary funds for the post-COVID-19 phase are exploited systematically. This kind of strategy should be put into practice in a prompt and pragmatic manner. The opportunity granted by the restrictions on travelling, still underway, might be taken advantage of to maximise the potential of underused mobility spaces, also thanks to the employment of new applications. On the one hand, the lines of action of the new strategy should converge on the reorganisation and upgrading of public transport and infrastructure for sustainable mobility. On the other hand, they should focus on the rearrangement of mobility spaces, adopting tactical urban planning practices, i.e., low-cost strategies, in addition to the testing of varied temporary (extendable and replicable) applications of spaces and transport.

In this context, the various forms of mobility take on different values and roles. Notably, there are three operational criteria: The hierarchical reorganisation of the forms of mobility towards sustainability, their declination, according to the forms of settlement, the promotion of new ways of managing mobility, under the aegis of flexibility and on-demand transport. With regards to the reorganisation of the

procedure of the “hierarchy” and, consequently, of the mobility stakeholders, which is indispensable at this juncture, the most qualified reference is the exemplary case of Barcelona.

Consequently, pedestrian mobility must represent the primary form of mobility, to be privileged and guaranteed, given the rediscovered value conferred to “proximity”. Soft mobility (bicycles, scooters, etc.) can and must represent the ideal alternative, marking the phases 2 and 3, especially in the most extensive parts of the city, thanks to the use of the spaces previously dedicated to transit and private vehicle parking.

Local public transport (buses, trolleybuses, trams, metro, regional railway) and taxis must catalyse medium- and long-distance travel, within different neighbourhoods or municipalities in the metropolitan area and the rest of the region. This can be done turning to new ways of handling users’ access, to ensure social distancing and safe transport, supported by new, if not even promotional, mobility management apps (following the model Mobility as a Service). Complex urban systems are often characterised by a number of critical issues and their vulnerability increases in the face of contemporary shocks and stresses. The identification of exogenous factors that contribute to the transformation of the urban context is as fundamental as the identification of possible shocks and stresses in the city.

The ISO 37120 transport indicator requires cities to report on the extent of their mass and non-mass transport infrastructure, general transport security, and the interconnectivity of direct flight. In general, large mass transit systems typically go beyond the boundaries of cities and this makes it more difficult to measure data (titled core indicators) such as kilometers of high-capacity public transportation per 100,000 population and/or the number of personal automobiles per capita. Other variables (titled supporting indicators) such as the number of two-wheel motorized vehicles per capita and Transportation fatalities per 1,000,000 population and others are included to aid these measurements. Increasing the resilience of the transmission network involves three related capabilities: Providing absorption capacity so that the network can withstand disruptions, providing adaptive capacity so that flows through the network can be accommodated through alternative routes, and providing resilience so that recovery from a disruptive event can be achieved quickly and at minimal cost. On the other hand, best-practice guidelines are efficient tools to encourage and promote resilience and provide a level of reassurance not otherwise available through specific indicators related for example to morphological or socio-economic factors or related to the use of an appropriate architecture and design. From the perspective of urban resilience, cities and their metropolitan areas cannot be defined as static systems in a condition of steady, invariable equilibrium. Resilience does not boil down to a greater skill developed by a city when adapting to external factors. On the contrary, it is based on the ability to map the weaknesses and opportunities of an area, to launch innovative actions and radical transformations. These radical shifts should involve the governance of urban services, the construction of public policies, the planning of networks and systems to access natural resources, and organise human resources that are indispensable for continuous sustainable development. Therefore, actions aimed at making a context resilient must consider different scales of analysis, different dimensions of areas, different people, and funding involved.

In general, the resilience of an area is to be assessed in a cross-sectoral manner, which implies the reduction of vulnerability to major disruptions damaging society, economy, and the State, and the improvement of subsidiary aid to the managers of disasters and emergencies.

The adoption of participatory planning aimed at the implementation of sustainable mobility together with constant monitoring of infrastructure and transport demand is a valuable tool to improve not only travel, but also the urban environment on which they are implemented and also to promote rational use of land.

Urban planning is linked to the concept of democratic planning, which means that preventive or mitigation assessments of impacts on the mobility sector (but also on other areas) refer to the assessment of judgements expressed by local population groups, contributing, through interviews or questionnaires, to a more authentic estimate of the situation endured by the city and its infrastructure.

In terms of planning, it is necessary to provide for the implementation of Sustainable Mobility Plans (SUMP), to combine the different aspects of mobility with the urban context, reducing congestion phenomena, noise, and environmental pollution, while promoting sustainable mobility. As far as local authorities and competent bodies are concerned, making a city resilient means being able to respond to a crisis faster. A deep understanding of the impacts of an emergency is the basis for mitigation.

In addition, provided the citizens are well informed on how to behave, they will react to the event more sensibly. To assist its citizens, it is vital to provide useful resources and tools where needed in the city, provide citizens with awareness training program, increase the use of safer infrastructures, enable reasonable economic resources, and make more effective interventions. Hence, assuming different natural and non-natural factors, the evaluation can be conducted through the assessment of three wide-range areas, such as urban planning, mobility, and geo-morphological context analysis.

COVID-19 has been the first actual “deep destabiliser of the routine [22]” within the Anthropocene. The post-pandemic city, deeply transformed in its basic beliefs, leads to a deep systemic reflection on the crisis and the plausible interrelationships between the pandemic and environmental/climate change.

The idea of an urban space increasingly reconciling environmental and social aspects, as well as the concept of resilience progressively associating the characteristics of the environment and their impacts on human health, are gaining ground. The pandemic aspects still in progress lead us to relocate the birth of urban planning as a discipline at the end of 1800, with its first organic laws counteracting and restoring cities from the cholera epidemic.

The current pandemic cannot be dissociated from the environmental and climate crisis that has been exacerbated for some years and that requires profound changes in the laws regulating the city and urban communities, be they informal or uncodified.

The pandemic has highlighted that cities are not monolithic administrations: They include various interconnected systems, which often leave urban ecosystems susceptible to their weaker portions. The present crisis, as a whole, is the result of an extreme and rapid series of cascading failures, across multiple systems.

The pandemic has represented a health shock, paralysing the whole health system. It has also led to a second catastrophic shock: The lockdown of the economy, local businesses, and schools.

However, although it has exposed our weaknesses, COVID-19 and the subsequent period of recovery are not devoid of opportunities. Any crisis provides a clear and microscopic lens emphasising the identification of weak points within a community. City leaders need to work with communities to pinpoint their needs—both regarding vital needs, for example, in grocery stores, parks, schools, and public transport.

To heal and prosper, communities necessitate help to articulate and to work beside city leaders, who are bound to ensure that the main needs are met. While communities define these needs, we also have to imagine dynamic and flexible structures capable of adapting to the evolving needs of post-pandemic communities.

This pandemic is a shared experience that provides city residents, communities, organisations, and administrations with an unmistakable cue to talk about the crisis.

Transport resilience is defined as the ability of a transport system to move people in the face of one or more major obstacles to usual operation. These obstacles can include extreme weather events, major accidents, in addition to equipment or infrastructure failures.

More specifically, the concept of transport resilience has even more precise implications, as shown in Figure 7.

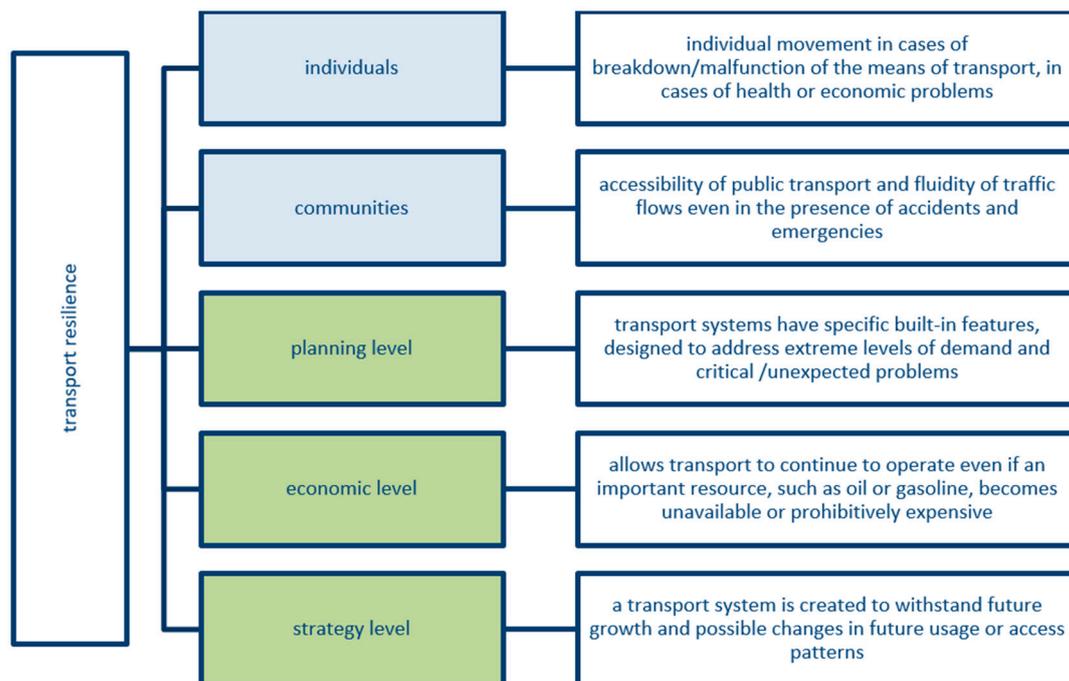


Figure 7. Survey levels of transport resilience. Authors' elaboration.

Companies managing services and infrastructure, but also people travelling (especially commuters), must pay particular attention to the availability of transport supply, considered as a means of transport for the optimal functioning of both entities. Moreover, transport resilience is a crucial factor for organisations managing a high concentration of commuters.

The more dependent these commuters are on vehicles for individual use, the more important these vehicles become. All kinds of unforeseen events can disturb commuting—car problems, bad weather, traffic congestion, transit interruptions, and accidents. The key factor to transport resilience is to offer commuters alternatives that may allow them to travel despite these problems. The evolution of the different forms of transport (private, public, and shared) enable the users to optimise the transfer service while offering them different options to meet their travel needs.

Some aspects related to transport resilience are beyond the control of an organisation, especially when considering catastrophic or calamitous events [23]. Given traffic congestion as one of the most critical problems in recent years in several European cities, and taking into account that it can cause significant delays along usual driving routes, commuters can only opt for public transport or other alternatives, ensuring they avoid critical areas, get to work on time, and maintain their normal productivity levels.

To support operators of critical infrastructure (which are considered particularly important in the management of emergency, crisis, and continuity situations), preventive action plans for citizenship safety, performed by protection partners (police, fire brigade, civil protection, etc.) and armed forces, are systematically arranged and updated. The protection of critical infrastructure is a cross-cutting task, interfacing with various policy and operational areas (energy policy, security policy, protection against natural hazards, etc.).

Therefore, transport resilience closely relates to the transport adaptation ability to match supply with demand, even after an event of great impact.

Examples of changes to be made, in comparison to usual operation, are linked to the following events: Earthquakes, floods, terrorist attacks, traffic blocks, running marathons, and tramway works. In general, the transport demand is characterised by random variables, often related to the behaviour, traditions, or lifestyle of a city.

Supply, on the other hand, pertains to the proper infrastructure and services in charge of meeting the need for any demand shift.

In connection with this is the concept of road maintenance for the optimisation of infrastructure performance and the analysis of safety to reduce the number of deaths and injuries. Depending on the type of travel, different forms of mobility can be used in a single or multi-modal way, starting from the simplest one: Walking.

Moreover, it is evident the transport system has undergone several transformations in the last 20 years, progressively considering the concept of mobility as Maas (Mobility as a Service), i.e., integrated services enabling the users to easily perform trips in an urban/non-urban environment [24].

Several works in the literature prove that the design and maintenance of infrastructure achieve better results if type I-BIM models are put into practice.

They refer to design and maintenance, considering not only their functional geometric aspects but also costs and safety measures (through the evaluation of different indicators, such as the Infrastructure Service Level).

The use of ITS technology and tools [25] makes it easier to monitor various structural features, infrastructure, and transport parameters in real time.

The use of new digital applications to book public transport (mobility on demand or Demand Responsive Transport-DRT, supporting local public transport), combined with the spread of reduced fares and incentives, should allow the testing and dissemination of Mobility as a Service System. This has to be aimed at ensuring the maximisation of the use of sustainable transport, in line with the guarantees of social distancing and opportunities for savings on transport costs, both for operators and users.

The opportunity to reserve trips, combined with the reduction of traffic and the construction of corridors dedicated to mobility, will return sustainable mobility both the credibility needed to perform the modal transition and the essential conditions to maximise it in the post COVID-19 phase.

The COVID-19 pandemic event has blocked mobility in different parts of the world for a long time. In the lockdown phase, only the main transfers were guaranteed, through the use of slow mobility or private vehicles. In fact, during and after the pandemic, public transport has collapsed, due to the need to adapt waiting areas, terminals, and on-board spaces to social distancing. This has led to a decrease in the demand for public transport, resulted both from the low occupancy coefficient and from the widespread fear of possible contagion.

Therefore, since the end of the second pandemic phase, a number of countries have been pursuing a series of transport strategies to encourage the use of soft mobility, i.e., walking or cycling, in order to contain the use of private vehicles. Several actions have been taken by the European Union to finance the adaptation of existing infrastructure, by creating “pop-up” cycle lanes, including the design of new cycling infrastructure and incentives for the acquisition of micro-mobility and the strengthening of short and medium distance walking.

Urban mobility prior to COVID-19 was characterised by a series of interventions aimed at stimulating public and shared transport, taking into account the evolution of smarter cities and the assessment of transport demand within different population groups, i.e., workers [26], students [27], or tourists [28].

The emergence of several private companies managing shared mobility with cars, vans, and bikes have spread unevenly in different parts of the world. Moreover, this spread has been marked by a gender gap, due to cultural motivations and security perception.

To prevent jeopardising the achieved decrease in air pollution, it has been planned to augment the fleet of electric vehicles produced by companies. This choice will leave the fleet of other vehicles intact, to be used only at certain times or in specific areas/circumstances. The most accredited means of transport remains the bicycle, either personal or shared (although electric scooters are being advertised as well).

This is so, even if the pre-pandemic data did not provide convincing statistics to support the use of this solution, though it may now be more valid than ever. Finally, the current massive development of technology is under analysis. Specific apps might be a real help for shared mobility, real-time updates of traffic consistency, and means availability. Once the contagion peak has been overcome, thanks to distancing, cities and citizens have entered a phase of coexistence with the virus, defined as “phase 2”, which, in all respects (given the direct and indirect risks of contagion following the more radical social distancing, characterising “phase 1”), draws greater attention to the theme of people’s mobility.

Nevertheless, globally speaking, transport (including buses, trains, subway, light rail, private chauffeur-driven transport, and shared mobility options, such as bicycles and scooters) has decreased:

- 86% in Milan;
- 84% in Madrid;
- 54% in the metropolitan area of New York.

In spite of that, the restrictions aimed at containing the contagion—by virtue of the ascertained slowdown in the pandemic spread—will be soon reviewed, allowing the gradual restoration of mobility.

Except for the initiatives mainly introduced by some airline companies (fast serologic tests, temperature/beat/oxygen check, etc.), which cannot replace medical diagnosis, though assessing certain indicators of infection, public or private transport, first and foremost, will have to acquire new habits and a reviewed education with regards to mobility. For example, in cities with a metro network, an attempt is being made to calibrate the use of vehicles according to the capacity of the platforms, by calculating the minimum distance between waiting passengers of about 1.80 m (6 feet), after thermal scanning at the ticket barriers.

This phase enhances the diffusion of a series of urban resilience strategies based on “anti-fragile” scenarios [29], seizing the crisis as an opportunity for urban and social transformations, capable of strengthening the balance of the complex “city” system. Some cities are facing the complicated challenge of the rearrangement of mobility. In this context, the partial reopening on 4 May 2020, implies the resumption of some productive activities and the consequent increase of mobility flows. Several metropolies in Italy have put into action significant measures, such as the strengthening of public transport during peak hours and the implementation of cycle paths, already established by the PUMS [30]. The growing presence of electric vehicles and micro-mobility [31] ensures a lower impact both of noise and environmental pollution, positively affecting the collective wellbeing. Some cities have been immediately engaged in the reorganisation of mobility, following the example of other European cities (such as Barcelona, Paris, Vienna), pursuing clear objectives of environmental, social, and economic sustainability.

The evolution of cities must be related to the strengthening of accessibility and walkability, which are now measurable through various indicators in the literature [32]. This means allowing all segments of the population to move easily on foot, with minimum consumption and enhancing all those services that can increase options such as the creation of relaxation areas, the improvement of sidewalks, or the spread of restricted traffic areas.

As far as mobility provision is concerned, social distancing practices have severely undermined public transport, which in normal times is or should be the backbone of mobility provision, but which, due to the necessary adoption of safety standards, will suffer a serious reduction in transport capacity.

At this stage, buses must become the backbone of the new urban transport. The rationalisation of lines, the increase in the number and punctuality of journeys, thanks to the reduced presence of private vehicles on the road, will have to be combined with measures to rearrange the driveway areas for routes and stops.

To increase the current offer of protected lanes, entire roads will have to be set aside only for buses, designing a massive network of public transport corridors, with increased spaces dedicated to stops (to reduce the possibility of grouping). During this period, it will be essential to ensure the efficiency of the vehicle fleet, possibly by providing for the utilisation of vehicles owned by private car-service

companies, which are temporarily unused, because of the tourism block. Taxi, Uber, and NCC will fulfill the offer of public transport, performing services exclusively upon reservation and transporting one passenger at a time (or two, as long as they live together). An appropriate measure would be to agree on a price control policy, to pave the way for the users who have no other travel options. The use of private cars, limited to authorised journeys, will have to follow stricter and stricter rules, depending on the areas of the city, according to concentric bands, starting from the historical centre to the outskirts, where cars are a necessary support to the LPT.

Therefore, in Rome, the declination of mobility modes in relation to the settlement forms highlights the urgency of specific interventions. In the City Centre, despite what has been established, the LTZ should be restored, experimenting further perimeters, identifying Zone30, rethinking and updating the LPT preferential corridors, based on the needs of phase 2 and 3. Through the creation of Zone30 and the concomitant reduction of the roads reserved for cars, which will make it possible to identify new pedestrian areas within the districts, the “central places” (a network of public transport corridors connecting the single districts directly) will be outlined. In this framework, pedestrian mobility will have to be as widespread as possible, particularly in the historical city centre, but also in all those areas of the so-called “15-min-city” (where, walking for no longer than 15 min, most of the basic needs will be met, including reaching the workplace).

Soft mobility (bicycles, scooters, etc.) represents the great alternative to focus on, especially in the “Modernist City”, which is uncomfortable to walk around, but widely reachable by bicycle. Thus, it will be necessary to identify protected routes for bicycles, exploiting the corridors of the LPT in a blended system. In the peripheral urban fringes, it is possible to rationalise the circulation of private cars, defining the complementary network of “fluid” roads. In this sense, fixing some LPT corridors, aimed at increasing accessibility to “central places” and promoting intermodality, is a must.

5. Discussion. Strategies for Climate Adaptation and Urban Resilience

A number of territorial contexts, as a result of constant pressure within the EU, are investigating how and with what effects the climate change issue can be tackled, by employing the tools of territorial governance and urban policies. Lombardia, Sardegna, and Emilia Romagna are just some of the regions that have directed their policies towards climate innovation with greater consistency and results. Some cities, such as Milano, Mantova, Trento, Torino, Reggio Emilia, Bologna, Padova, Venezia, Ancona, and Cagliari have combined mitigation and adaptation objectives, increasing “the level of relationship between voluntary routes and ordinary planning [33]”.

The decision to move from a voluntary dimension (though set in the mere statement of shared principles) to a more project-oriented condition requires the formulation of a new approach to the governance of the city and the territory, which has to be able to involve the different areas of public administration. All this implies the activation of processes aimed at innovating tools, priorities, actors, and organizational structures. This approach can represent a cutting-edge way to face and manage the challenges of climate change in the direction of a “climate proof urbanistic dimension”. The experience of Veneto ADAPT project moves towards this goal. In particular, the adaptation path undertaken by the Metropolitan City and the Province of Venice is oriented towards a systemic and integral approach of territorial planning for climate risk reduction.

In Reggio Emilia, the UrbanProof project to implement the strategy of adaptation to climate change becomes RE-silient: Innovation for urban instrumentation is put at the service of the inner-city. The Regional Strategy for adaptation to climate change, adopted by the Regional Council of Sardegna in February 2019, systematised the actions taken and defined the methodological path and the strategic priorities for regional and local planning. Among the various actions, it has made an investment on the study of the regional specificity, in terms of vulnerability and risk of our territory facing the consequences of the changing climate.

In the collective imagination, the concept of “zero soil” consumption was devised assuming the confinement of new soil transformation activities, affecting areas not yet artificialised, within the

urban context. In reality, the meaning of “zero soil” consumption, given in Italy by some regional laws, is aimed at rejecting—within the framework of municipal urban planning instruments—any new areas of land transformation that have not been the subject of prediction by a previous PRG or Construction Programme.

This orientation does not help to preserve the territory, as it is well known that the old generation’s urban planning tools are oversized compared to the real needs and the demographic trend. In Italy, the sudden change in social dynamics does not support past planning choices aimed at foreseeing various “expansion” (ex “C”) areas, or traditionally “productive” zones. These were located in contexts functional to an urban design that is no longer up-to-date and responds to obsolete logics, swallowed up by building processes unequally programmed, with a regressive need of standard areas presently satisfied through equalisation. It is true that urban areas are expanding at a higher rate than population growth, but it is becoming increasingly difficult to predict the phenomena to understand their logic and prepare to manage them. Therefore, the approach orientated towards densification (or re-densification) and the recovery of unused or badly used urban areas, with no further land consumption, needs to be carefully reviewed.

On the other hand, measures for tax provisions are necessary, to incentivise regeneration interventions, with particular reference to disused and reclaimed production areas, intended by the law on land consumption under discussion. Given that, presently, the focus is no longer on the confirmation of the residual building capability, but, instead, on the new design requirements and performance criteria that the city, as an urban “organism”, must possess to respond to the current challenges (such as the demand for urban security, social inclusion, accessibility and energy saving, service performance, rationalisation and optimisation of environmental resources, and energy efficiency as a whole), the paradigm of zero consumption seems to be the panacea for all evils. The awareness that the continuous increase of built or urbanised land represents a cost for the community, having a strong impact on the environment, as well as the knowledge that the urban sprawl has settled as a form of urbanisation out of control, amplifying the consumption of land, are now widespread beliefs. However, it is necessary to reflect on how to build high-performance cities, to ensure their proper functioning in a constantly changing environment.

Within the new models, it is necessary to understand how the management of urban transformation can set the most suitable urban organisation. Moreover, it is mandatory, as established in the national law draft about soil consumption (which has been under discussion for several years), to implement environmental compensation measures, aimed at recovering, restoring, or improving, in proportion to the extent of the intervention itself, the functions of the soil already sealed, by de-waterproofing it and restoring its natural conditions.

The condominium shared balconies, gardens, and terraces, as well as any small surfaces overhanging from an apartment block facade, in consideration of the lockdown and post COVID-19 period, may be transformed into places for smart working, dining, entertainment, music, or reading. This reflects the multitasking philosophy, presumably derived from the now obsolete concept of multi-purpose or multifunctional public spaces.

Thanks to the various decrees issued during the COVID-19 pandemic in Italy, public spaces can now be considered the outdoor extensions of catering activities, as long as the “outdoor” venues are skilfully set up, according to the distance rules. In the future, it will be necessary to devise new and different criteria for the design of public spaces, to plan their use according to the probable and cyclical recurrence of the pandemic. Furnishings, benches, play areas, lighting, and refreshment points will have to be set in accordance with anti-gathering standards. These places will have to be equipped for multiple functions, with Wi-Fi network (5G), points for battery recharge of digital devices, and with parking areas for electric bikes. Some spaces must be able to provide for everything needed to manage emergencies in case of disaster. They should be made with draining surfaces and systems for collecting and reusing rainwater. Green and multitasking public spaces, besides symbolic places and

entertainment areas, will have to be arranged, so that they do not become “non-places” or “places of alienation”, where the distance rules risk to turn into isolation.

First the lockdown, then the progressive post-COVID-19 reopenings, have taught us a lot, although they have destabilised the social community model, or rather forced us to rethink human relationships and solidarity, introducing new ways of using living spaces, condominiums, and urban areas. Time and space have shown forgotten connotations to each of us: The LPT, the sustainable mobility system, remote working (which is different from “smart working”), and immaterial infrastructures. We have learnt that it is necessary to invest in smart working and, consequently, to shift from hour-based to objective-oriented working. We have developed distance learning/teaching, which has been evaluated by the teachers’ ability to manage it, notwithstanding the unacceptable digital gap among the users. We have witnessed the need for a fast and pervasive network connection, in spite of the lack of knowledge of 5G and the proliferation of scientific misleading information.

All considered, the fields of action are now extended and a more eco-friendly vision is required, but still, this is not enough: Greater social cohesion, solidarity, and connection are needed. The desired direction is towards a “5.0 Society”, where Information Technology and Artificial Intelligence will shape a new profile of the community. While the “4.0 Industry” aims at improving business and production with the use of IT, the “5.0 Society”, the context where a lot of information (big data) are running (5G), necessitating Artificial Intelligence to enable its processing.

All this looks like a condition already underway, in which we will have to articulate the next funds, especially in the medical, tele-medical, administrative, and research sectors. We will have to rearrange our lives considering new legal and administrative methods, new knowledge about digitisation (training and research), new labour market and skills. How far is this inescapable world? Is this the only winning model? We have experienced it during the COVID-19 (ICT—tracking, containment, mapping, etc.) through the app Immuni, raising issues concerning freedom and democracy.

It appears that the whole cultural process leading to the social formation of a high-tech Humanism, that we have not matured yet, but which we seem to understand better today, is absent. The moral, ethical, and economic principles of digitisation are rooted in this human-centered society with a high quality life, giving value to the relationship between man and machine. All this is possible by incorporating advanced technologies in different sectors and social activities, while promoting innovation to create new value. This new social production will generate real and virtual spaces in addition to the planning of virtual, overlapping, increased spaces. In questioning urban organisational forms, we will also have to deal with this transition phase. An ethical revolution that considers the digital tools as a necessity and a priority service for the community that, as such, must be guaranteed to all and must be regulated in terms of supply and access. The city becomes a platform of data, mobility, flow, smart road, driverless vehicles, smart working, alert sensors for hydrogeological, weather, seismic instability, and, therefore, the ecological culture is accompanied by the deepest need for a new technological Humanism.

The pandemic emergency, marking the new century, has caught all cities unprepared, although, in the face of the global threat, cities with more gaps reveal their management weaknesses dramatically. In addition, the block of activities has caused a disruption on the urban layout and daily life. The ongoing adaptation initiatives take into account social distancing, and the fall away from highly attractive places for tourists. Some of the extraordinary measures introduced were regarded as suitable even for the post-crisis period, therefore they have been confirmed, adapted, and developed for the precautionary phase.

The perception of a “radical” change in urban behaviours will be a consequence of the situation caused by a global, borderless threat. The means and ways we live in urban spaces will change. There will probably be a rediscovery of the potential of less attractive areas in terms of human flows. Strategic directions, imposed, endured, or accepted, are turning into new lifestyles and, consequently, a new demand for cities. Significant responses, aimed at rearranging urban models, have been drawn from this experience. It will be necessary to become aware of the new solicitations

produced by the internal areas of the territories subject to shock and territorial rebalancing policies. Decoding signals and questions, as well as implementing the necessary responses, will be mandatory. What strategies, underlying a territorial shock, will have to be put into place? Although climate change is a global phenomenon, its effects are varied, depending on the environmental, economic, and social characteristics of different territories, with repercussions on a local scale.

In the Italian National Plan for Adaptation to Climate Change, particular attention is paid to urban areas, which not only “host” more than 90% of the Italian population, but also provide essential social and cultural services. As a result, they assume the role of “hot spots” for climate change, concentrating the effects on a high percentage of targets and activities. Since they are artificial systems, their resilience must be ensured by human actions. They are also characterised by a high heterogeneity, determined by topographical, morphological, demographic, and socioeconomic features.

It is important to stress that, in the majority of cases, the climate element is just a factor that aggravates past criticalities, generally due to careless planning and resource management. In this sense, the scarcely controlled urbanisation process in the last century, the systematic soil waterproofing, and the transformation of watercourses (by drying out, tapering, or concreting riverbeds), associated in most cases with inadequate drainage systems, have contributed to an increased risk of urban hydrogeological instability. The scarcity of vegetation, and the density and height of buildings, intensify the vulnerability to temperature increase with negative health effects. The water network is agonizing and drinking water withdrawals are increasing; even in the face of decreasing demand, inefficiencies grow, aggravating the demand pressure.

Climate change could affect the quality of water resources by altering both physical (e.g., thermal stratification temperature, pH, turbidity) and chemical parameters, such as nutrient concentration, organic substances, dissolved oxygen, and heavy metals, with drop-down implications for biological and ecological characteristics (Table 1).

Table 1. Criticalities and effects of climate change based on the study system.

	Categories	Criticality	Strategy
Water resources	Marine environments, biodiversity, and ecosystem services	Increase in surface temperatures, deep-water mass stratification, increased mortality of organisms, suspected reduced connection between deep-water systems and coastal environments.	Mitigation measures related to the exploitation of water basins and the dissemination of sustainable actions
	Ecosystems and biodiversity of lakes and rivers	Alteration of the ecological status (increase in temperature, reduction in snow cover, high seasonal variability of precipitation with consequent alteration of the hydrological cycle).	
	Coastal areas	Heating and acidification of seawater, sea level alteration, coastal erosion, change in water density.	
	Geological, hydrological, and hydraulic system collapse	The impact of climate change on hydro-geological, hydrological and hydraulic risks is due to increased temperatures and alterations in rainfall patterns (highly variable in space and time) and is influenced by local natural and anthropogenic conditions.	
Earth Ecosystems	Desertification and drought	The increase in aridity and extreme weather phenomena, such as drought and heavy rainfall, will affect ecosystems by changing the competitive relation among organisms (possible loss of biodiversity), with consequences on other ecosystem assets and the services provided.	Mitigation measures related to land exploitation and planting in semi-deserted areas. Dissemination of good practices for sustainable mobility and reduction of soil/energy consumption.
	Forests	Alterations in growth and productivity rates, resulting in local loss of biodiversity, increased risk of fire and pathogen damage, variation in the water and carbon cycle.	
	Agriculture and Alimentation	Variations in terms of duration of the phenological cycle, productivity, and displacement of typical cultivation areas (northwards and at higher altitudes).	
	Tourism	Direct effects (displacement towards higher latitudes and altitudes) and indirect effects (tourists increasingly present in their countries of origin).	
	Transport	The transport sector is undergoing a hardly resolvable spiral since it contributes significantly to trigger the phenomena causing damage.	
	Cultural Heritage	Degrado sia in ambiente esterno (principalmente patrimonio architetonico, archeologico, etc.) che in ambiente interno (musei, chiese, ipogei, etc.).Decay both in the external settings (mainly architectural and archaeological heritage, etc.) and in indoor spaces (museums, churches, hypogea, etc.).	
	Energy	Increased electricity consumption during summer, also due to the greater use of air conditioning systems (higher frequency and intensity of heat waves).	
Health	Direct and indirect health impacts (interaction with other anthropogenic stressors leading to synergy effects).		

6. Conclusions. Actions and Strategies for the Resilient and Post-Pandemic City

The changes made to the way cities are planned, built, managed, and powered can lead great results in terms of reducing harmful gases. Well-designed, compact, and accessible cities, equipped with efficient public transport, significantly reduce our carbon footprint per capita and are crucial elements to achieve most of the Sustainable Development Goals, of which climate action is a fundamental part. The conscious use of the soil and continuous monitoring of areas subject to collapses or washouts, together with greater attention to urban forestation, will reduce the impact on the soil and increase the land permeability.

The importance of overcoming sectoral policies and promoting the adaptability of cities to climate change are two fundamental points in the 2014–2020 EU cohesion policy: “the various dimensions of human life—environmental, economic, social and cultural—are intertwined and success in urban development can only be achieved through an integrated approach. Measures related to urban physical renewal must be combined with measures aimed at promoting education, economic development, social inclusion and environmental protection. Furthermore, the development of strong collaboration between local citizens, civil society, the local economy at various levels of government is a pre-requisite” [34]. In light of what has been extensively examined, according to the National Climate Adaptation Strategy and the National Climate Change Adaptation Plan [35], the need to develop Climate Adaptation Plans for urban resilience emerges. Our research team has started the study of specific tools: Pda_for Resilient City, in the form of wide-ranging guidelines, since several phenomena, calamitous events and catastrophes in general, know no administrative limits. The recent COVID-19 pandemic is an example of this. It is also true that there are climatic, geographical, and morphological conditions that equate different realities, whether more or less contiguous.

Furthermore, it is necessary to adopt Local Adaptation Strategies, SLa_forResilientCity, to contextualise the actions and limit the impacts of climate change, by reducing the vulnerability of territories and local communities. In this case, the second-level kind of tools will be operational and will identify timely strategies, actions, impacts, repercussions, in addition to back-up measures for finance interventions. Nevertheless, the Adaptation Plan will not only be linked to climate change but will also have as a priority objective to make the city resilient to extraordinary events, disasters, and pandemics. For this reason, compared to the strategies already present in the PNACC, it will have to contain guidelines on probabilities and response options.

In urban areas, adaptive design interventions can represent a strategic action in both the short and medium term, while mitigation actions inevitably travel over medium-long times. Resilient design, in the strategies aimed at creating a waterproof city, must interface with various disciplines and techniques of engineering and architecture. The Climate Adaptation Plan for Urban Resilience, Pda_forResilientCity, will necessarily have to be outlined as a plan of guidelines and directives and, at the same time, it will have to be programmatic and far-sighted. Its implementation will be entrusted to specific tools, such as the Local Adaptation Strategies, SLa_forResilientCity, adopted by local governments to make the actions taken for urban resilience consistent with the Adaptation Plan, also considering the effects they will have in terms of relaunching the productive, economic and social system.

The Pda_forResilientCity will contain some general recommendations, based on shared principles of good adaptation and participatory construction of the resilient city, and specific suggestions for the local administrations in charge of drafting the SLa_forResilientCity (Table 2).

Table 2. Tools and targets for climate proof and post pandemic city.

Tool	Scale	Targets	Structure
Pda_for Resilient City	Wide-ranging Guidelines	Make the city Resilient to extraordinary events, disasters, and pandemic	Guidelines and Directives (Guidelines on probabilities and response options)
SLa_for Resilient City	Local Adaptation Plan	Reduce the vulnerability of territories and local communities	Operational (It will identify strategies, actions, and impacts)

During the whole process of adaptation policy definition, within the PDA, specific cross activities will have to be carried out: The involvement of stakeholders and communities, the integration of adaptation policies within the planning and programming tools already set by the Institutions, internal and external communication and awareness raising, monitoring, and dissemination of results, and online data implementation.

The SLA will have to indicate specific actions to be taken.

The issues that cities must respond to are:

- People's frailty, as well as the fragility of material and immaterial infrastructures;
- Usability of activities and services, connections, and accessibility;
- Knowledge and, therefore, the availability and use of data for the city government;
- Information sharing with citizens and their participation in decision-making processes;
- The recovery of urban economic activities with particular attention to innovative areas, which will hopefully boost sustainable urban growth.

We are currently facing a climate alarm that is reflected in a huge, global anthropological shock, with direct repercussions on the resident populations' health and strain.

The change in the characteristics of rainfall events of maximum intensity is causing surface morphological changes (increase in pedogenesis, landslides, soil erosion, rapid mud, and debris flows) and variation in surface runoffs that can be disastrous for the anthropized environment [36].

Among the UN objectives in Agenda 2030, regarding Sustainable Development, in position number 13 we find Climate Change, with a subdivision of the general objectives into five sub-targets, to be achieved by 2030. Mainly, they mention strengthening resilience and adaptive capability to climate risks and natural disasters in all countries, integrating measures to tackle climate change into national policies, strategies, and plans.

Effective actions are needed, regarding:

- Human habits;
- The settlement system (green roofs, green walls, building technologies to reduce the demand for energy derived from fossil fuels and to improve indoor thermo-hygrometric wellbeing, by managing the heat exchange through the covering in a controlled way);
- Mobility and infrastructure (fewer cars, more pedestrian spaces, boulevards, resilient public spaces, increased presence of cold paving, enabling to favour the albedo);
- Geomorphological and hydraulic components (surface runoff improvement and reduction of hydraulic risks);
- The environmental system (permeability, naturalisation, "more soil for urban trees", reduction of land use, water storage elements, such as water squares and rain gardens, slowing down the surface run off, facilitating absorption and natural runoff, increasing the hydraulic inertia of the system by increasing porous surfaces, recovering the functionality of natural drainage systems, separating the discharge nets, and allowing the storage of rainwater for unhygienic uses).

The ideal operational size is the district, which can be defined as the "Local Climate Zone [37]". Actions could be delineated by sectors (Table 3), e.g., actions focused on urban overheating could be

increasing natural ventilation, lowering latent heat, and reducing energy consumption, by preserving green areas and creating green corridors and wetlands. To improve surface runoff, actions could be promoted for the creation of meteoric storage areas, especially in correspondence with paved surfaces, such as roadways and underpasses. Actions on soil permeability may be taken by increasing the share of permeable surfaces through the arrangement of infiltration areas and underground storage tanks, but also through natural infiltration areas, in particular green roofs, which slow down water ground speed and allows for an improved collection and progressive filtration process. A very interesting work on roofs has been accomplished by the Municipality of Milan and the Resilient City Project Management of the Department of Ecological Transition (see www.comune.milano.it).

Table 3. Actions and indicators in the analysed sectors.

Sectors	Main Elements	Main Results	Indicators (ISO 37120)
Human habits	Human and communities behaviour	Risk mitigation aimed at a sustainable habitat is focused on the need to improve governance at various levels, such as the social cohesion and the welfare	<ul style="list-style-type: none"> Community vulnerability Healthcare Systems
The settlement system	Green roofs, green walls, building technologies	To reduce the demand for energy derived from fossil fuels and to improve indoor thermo-hygrometric wellbeing, by managing the heat exchange through the covering in a controlled way...	<ul style="list-style-type: none"> Resource use Municipal capacity and Governance Outcomes and impacts
Mobility and infrastructure	Fewer cars, more pedestrian spaces, boulevards, resilient public spaces, increased presence of cold paving, enabling to favour the albedo... It is necessary to increase the drainage of water in large public road surfaces and to extend the limited traffic zones and zone 30, as well as intervening on the infrastructures that are most exposed to climatic events	To reduce the use of private cars and encourage shared mobility and public transport, to strengthen urban low speed travel and mobility systems (pedestrian and cycle ways), thus improving safety and accessibility and reducing the production of climate-altering substances.	<ul style="list-style-type: none"> Quality of infrastructure services Outcomes and impacts
Geomorphological and hydraulic components	Water reuse actions, water storage elements, such as water squares and rain gardens, slowing down the surface run off, facilitating absorption and natural runoff, recovering the functionality of natural drainage systems, separating the discharge nets, allowing the storage of rainwater for unhygienic uses...	Surface runoff improvement and reduction of hydraulic risk.	<ul style="list-style-type: none"> Environmental quality Resource use Emergency response capability
The environmental system	Permeability, naturalisation, "more soil for urban trees", reduction of land use. Combination with element belonging to hydraulic components.	To increase the hydraulic inertia of the system by widening porous surfaces; to improve vulnerability of the whole system.	<ul style="list-style-type: none"> Environmental quality Resource use Emergency response capability

Roofs are strategic design elements since they are the main water collection surfaces (together with public spaces). A remarkable and effective policy could be focused on replacing traditional tile roofs with cold materials enabling albedo. Solutions like these have already been tested in the climate adaptation and resilience strategies developed in Mantova, Padova, and Reggio Emilia.

Water-reuse actions should be encouraged, since water should be considered as a resource and not as a danger in urban resilience strategies. Dutch Resilient Strategy policies underline this aspect

and move away from the definition of water as a *gewaar*, i.e., a danger to urban systems [38]. In this sense, appropriate rainfall and surface water collection systems should be provided, using storage elements, such as drainage basins, reservoirs, and water-squares, located depending on the possibilities offered by the morphological and topographical conditions of the context. A careful study of urban geomorphology is needed in order to avoid water stagnation and surface runoff, enhance depaving to “de-waterproof” the soil, and remove the surface layer of asphalt or concrete, which does not allow water to infiltrate the soil.

A series of purification systems for the abatement of pollutants must be set up in such a way as to allow the water resource to be reused for irrigation and non-drinking civil uses. It is necessary to propose the renaturalisation of soils with the installation of suitable vegetation systems; to favour the increase of urban and territorial permeability and porosity; to guarantee rivers the necessary surface for the run-off of water without danger of flooding; to avoid the modification of the morphology of the site with artificial systems; and to reduce the transformations that involve processes of geomorphological alteration of the soil, waterproofing, and spilling of pollutants.

It is indispensable to increase the drainage of water in large public road surfaces (parking lots, roads, cycle-pedestrian paths, squares) and to improve the draining of dense urban fabric through micro-interventions, spread throughout the territory on limited areas. It is also advisable to plan, in a coordinated way, structural and maintenance interventions on the joint sewerage network, on watercourses, and on drainage and reclamation networks, to ensure an adequate hydraulic response (some of the actions mentioned above are derived from the Climate Adaptation Strategy in Reggio Emilia, presented in July 2020) [39]. The most innovative urban plans tend to define the water system, the urban blue networks, as a matrix for the configuration of the settlement and landscape assets. The blue lines have a strong urban, landscape, hygienic-sanitary value, since their presence improves microclimate regulation, absorbs nitrogen oxide, contributes to the fixation of particulates, reduces noise. The purpose of a careful design of the water cycle, besides preventing and reducing the hydraulic risk, is directly related to human health and wellbeing.

Interventions on mobility and the transport system should limit the use of private cars and encourage shared mobility and public transport, strengthen urban low-speed travel and mobility systems (pedestrian and cycle ways), improving safety and accessibility and reducing the production of climate-altering substances. Actions should also be taken on infrastructure and public spaces, by allocating wider areas to slow mobility, relocating parking spaces in more strategic areas, and assigning the spaces freed from car use to the urban community and sociality. It is essential to extend the limited traffic zones and Zone30, as well as intervening on the infrastructures most exposed to climatic events, by defining windbreak barriers and boulevards to contain climate-altering effects. It is mandatory to increase the greening and shading of road infrastructures (in particular car parks, pedestrian and cycle ways, and bus stops), favouring its usability and creating green corridors of interconnection, enhancing the availability of public greenery (urban forestation), and overcoming the fragmentation and scarcity of greenery within the old town fabric and the dense residential areas.

“Eliminating parking would create space for large trash receptacles and more bike lanes. Additional crosswalks would make it easier for people to safely cross the street. Instead of fighting a war on cars, Toderian told me, urbanists should fight a war on car *dependency*—on cities that leave residents with few choices other than cars. Alleviating car dependency can improve commutes for everyone in a city. And cars take up space even while they’re not in use. They need to be parked, which consumes yet more space on the sides of streets or in garages” [40].

Therefore, proximity must be a watchword to keep in mind when planning the cities of the future: It is no coincidence that even the Mayor of Paris, Anne Hidalgo, remarked that in an ideal metropolis, every citizen should be able to find all the services to meet his needs within a 15-min walk. The abatement of distances and environmental costs linked to mobility and transport are an integral part of a strategy aiming at sustainability and resilience. Milan is experiencing this strategy effectively.

These Climate Change effects have the greatest repercussions in urban areas, areas where the greatest social costs of climate change occur because the transformations of the last century and the massive sealing of soils have caused effects such as the heat island and various changes in the flow of water, which are causing significant environmental impacts. In cities with higher densities, a considerable amount of thermal energy accumulates, caused by the presence of redundant infrastructural networks and by the large waterproofed surfaces, with consequent greater pollution of the air and water tables; thus, increasing the vulnerability of the territory verifies the worsening of climatic comfort for citizens and settled communities, essentially due to the change in the urban microclimate. The risks, therefore, are higher because this process increases the vulnerability of the environmental system.

A resilient project is a simple and complex design experience. Simple, meaning that it is made up of many urban microactions that can be easily implemented since they concern limited areas (e.g., flowerbeds, traffic dividers or condominium courtyards) and most of them are low cost and feasible in the short term with a great popular consensus. Difficult, meaning that there is still a lack of culture and knowledge of the motivations behind resilient design, since this term and its applications are still not correctly defined in the Italian legislation, forasmuch as there is still a wide range of deniers of the effects of climate change. Although, perhaps, the most important and decisive reason is that Italy lacks the dimension of strategic planning, which is the crucial design reference to address appropriate actions to the temporal location (short-medium-long term), to the interdisciplinary validation (i.e., the definition of the disciplines that must contribute to urban transformation), to the financeability of interventions and the search for democratic consensus in urban laboratories.

In the proposed urban planning, it is appropriate to promote energy efficiency, saving water resources, a permeability of soils, care for greenery, and the safety and comfort of existing buildings; it is necessary to limit urban sprawl, increase the permeability of soils, promote sustainable mobility and reduce pollution, decongest the flow of private mobility, protect greenery and public spaces, organize the storage of rainwater, limit waste and reuse waste, intervene on the orientation of buildings and facades, promote garden roofs and green facades, and favor the albedo of surfaces to reduce the accumulation of thermal energy.

In light of the various considerations made, two main issues, which are different though interacting, call into question the paradigms of environmental and social sustainability linked to the conditions of resilience: Climate Change and the management of Post-COVID-19 complexities, both in terms of planning response/urban planning, and innovation.

We have to think that pre-COVID-19 lifestyles and housing models have undergone and will undergo radical changes, considering what is looming as a cyclical risk mechanism. The new vision on ecology takes into account both the dense “urban form” and the widespread dimension of the national system, made up of small municipalities, villages, and inland areas. Risk mitigation aimed at a sustainable habitat is grafted on the need to improve governance at various levels, such as the social cohesion, widely stimulated in the emergency closure phase, and the welfare (not only in terms of widespread territorial healthcare but also in urban terms). Hence, it is clear that climate change will have a deep effect on the environmental components, structure, and functions of various ecosystems, including the urban ones, influencing their composition, productivity, capability to regulate natural cycles, and soil characteristics. Although, these will be just some of the complex variables we will have to deal with.

Climate change may accelerate widespread processes of urban degradation through complex and unexpected feedback mechanisms of the systems involved. These effects, also in social and economic terms, might be considerable.

To be “antiviral”, cities must provide different responses, linked to emergency management and the reorganisation of services, social welfare, and reception. It is necessary to review the urban, city planning, and welfare parameters articulated by areas of urbanisation, from metropolitan cities to medium cities, villages, and small municipalities. There are no univocal, but only “tailor-made” responses.

A resilient city is a system capable of modifying itself by adapting to respond positively to the effects of climate change, it is a city capable of changing its balance as the surrounding conditions change; it is a system that must tend to be: Diversified, efficient, strong, adaptable, and collaborative. The resilient and post-pandemic city is an adaptive city, aware of its vulnerabilities and working to reduce them [41]; both climate change and health epidemics are a shock and the best common response to both risks is adaptation, by strengthening strategic planning and interdisciplinary urban interventions.

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