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The Post Pandemic City: Challenges and Opportunities for a Non-Motorized Urban Environment. An Overview of Italian Cases

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Abstract: COVID-19 has forced city governments to reconsider the relationship between mobility, urban space and health in order to ensure physical distancing while meeting the travel needs of inhabitants. Therefore, cities around the world are already involved in the transformation of mobility through new models of sustainable transport. The World Health Organization (WHO) guidelines on mobility during the COVID outbreak are mostly directed at creating more spaces for cyclists and pedestrians, especially in densely populated urban areas, thus avoiding the overloading of public transport and the use of private cars. Through the analysis of the programs set up by the 10 main Italian metropolitan cities, chosen as a case study, this research evaluates the response implemented by local governments in order to transform urban environments in one of the world's most pandemic-affected countries in detail. Starting from the current mobility model, this paper focuses on local government policies concerning post-COVID sustainable mobility to understand policies, approaches and measures in depth, as well as the effectiveness of the ongoing actions in shaping future urban mobility. From the research, an almost homogeneous awareness among policy makers and planners emerges concerning the need to rethink urban spaces and mobility, to make up for lost time and to start a green revolution that is aimed at quickly decarbonizing urban transport and enhancing cycling and walking through the city.

Keywords: post-pandemic city; green deal; sustainable urban mobility; public spaces; active mobility; cycling; walking

1. Introduction

At the end of January 2020, the new coronavirus disease was declared a global emergency by the World Health Organization (WHO). The main reasons for this declaration were not related to the outbreak in China but to the potential spread in the rest of the world [1]. As expected, in the following five months, the global spread of the virus overwhelmed health systems and caused widespread social and economic disruption all over the world. As of the publication of this article, there are more than 10,000,000 confirmed cases and 500,000 deaths worldwide [2].

Due to the massive proportions of the crisis, the head of the WHO declared the pandemic to be much more than just a health crisis. The global economic fallout has been devastating: social and public health networks have been put under extraordinary strain and millions of people have struggled with job losses and family burdens [3,4]. This situation is causing profound changes to the daily lives of people all over the world.

In order to overcome this global crisis, a unified response from governments and society at large is required. Individuals and political leaders are being called upon to put strong measures in place to end the pandemic. It is a major challenge to respond to this global health crisis by planning an equitable and sustainable path of recovery for people, economies and the planet as whole [1].

It has become apparent that cities are at the forefront of this emergency and that they will continue to be in future health crises [5,6]. As key nodes in our complex and highly connected global society, cities facilitate the rapid flow of people, goods, money and services. In the same way, they are the most exposed areas to the risk of infection. Moreover, several studies have highlighted the relationship between pollution and the spread of the infection [7–10]. Since its outbreak, COVID-19 has killed thousands of people, mainly in urban areas. Data of the spread of the disease in the most urbanized areas all over the world, published by the Coronavirus Research Centre of Johns Hopkins University [11], clearly show that the biggest and most globally connected cities have paid a much higher toll in terms of infections and deaths.

Cities are not only at the front line of the response to the pandemic but are also being called upon to radically change their approach to crises of this nature, from their physical layout to their economic and social structures. Cities are making new commitments to fight the spread of the disease, implementing new strategies, actions, rules and planning tools with the aim of building a post-pandemic urban environment that is able to deal with future health crises [12].

The challenge is to guarantee a new "right to the city" which encompasses essential services, as well as a different way of life that is adapted to the new health crisis. The "right to the city" is also the right to reinvent and change the form of the city and the urban environment according to the new needs [13]; it is the right to create a new paradigm of city equity, opportunity and social innovation, which fights inequality, reinforces the sense of community, builds local resilience and sustainability and aids cities in their recovery from this crisis. [14].

The ambition of the post-pandemic city should be not to return to "normal" but to build a better, more sustainable and resilient society. The challenge is to respond to this health crisis by planning a fair and sustainable environment for people, economies and the planet as a whole. The "new normal" for cities should include new concrete measures that are put in place for recovery that support the required transition to a more sustainable, low-carbon, inclusive and healthier economy for people and the planet. As the Mayor of New York, Bill de Blasio, said, "*We need a new deal for these times, a massive transformation that rebuilds lives, promotes equality, and prevents the next economic, health, or climate crisis, and definitively changes the way we live in cities for years to come*" [15]. Coming out of lockdown could provide an impetus to take immediate action that has a positive effect on the overall quality of urban life.

The short lockdown will not solve longer-term urban issues such as dependence on fossil fuels, growing carbon emissions, loss of biodiversity, inequities in housing markets, divisions between the rich and the poor and marginality. The COVID crisis has offered a new perspective on these issues and the limits of the way that we have run our world to date.

Consequently, the real challenge for post-pandemic cities is to make better choices than before; however, we need policymakers and city planners to immediately make the right decisions and implement strategies and actions to carry our cities into the post-pandemic era. [16].

From the beginning of the lockdowns, we have witnessed heated debates carried out by the media, politicians, planners and researchers regarding the measures that cites around the world are putting in place to reimagine our future, rethink urban spaces and respond to the needs of their inhabitants [17–20].

While the scientific community begins to deal with the issue of the post-COVID measures in urban environments [21], cities are already planning for life after the disease, with environmental proposals being rolled out all over the world to ensure public safety and intensify the battle against not only the ongoing pandemic but also the breakdown of the climate [22].

Mayors from many of the world's most powerful cities have announced and started to implement measures for a low-carbon, sustainable recovery from the crisis, while national governments are beginning to implement massive economic incentive.

The network C40 Cities—a group of 96 cities around the world that are focusing on tackling climate change risks—has announced the launch of the Global Mayors COVID-19 Recovery Task Force.

This new initiative, similar to the EU Covenant of Mayors, aims to improve public health, reduce inequality and accelerate a sustainable economic recovery from the COVID crisis. C40 mayors are already sharing knowledge and expertise to overcome the immediate health crisis. This task force will allow mayors to cooperate worldwide to achieve an economic recovery from COVID-19 that puts resources into the hands of those who need them most, quickly gets people back to work and accelerates action to overcome the climate emergency [23].

The aim of the taskforce is to respond to the pandemic, establishing a common framework of practical measures oriented to improve public health, reduce inequality and accelerate sustainable economic recovery [24].

The strategies for the recovery of the public realm should be governed by principles oriented to improve the resilience of cities and communities, set up climate measures that can help the economy and enhance social equity, public health and scientific expertise in order to improve the safety of citizens.

Urban planning can play a leading role in outlining strategies to support the recovery of our cities and lay the foundations for efficient post-pandemic cities. In a recent sourcebook edited by UN Habitat Planning and the World Health Organization [25], researchers argue the central role of urban planning in the prevention of future disease outbreaks. Urban policies determine the quality of urban spaces, the way we move, how we have access to food and to health care for all. Planning choices can create or worsen health risks for citizens, or they can promote healthier environments which results in clean and resilient cities.

The lockdown has thrown us all into a real-time laboratory full of examples of what a more sustainable future might look like. City planners have a unique opportunity to study and explore which of these directions could lead to a more sustainable, and safer urban environment [26].

At the end of lockdown, local authorities, planners, civil society and associations, have started to define key principles, strategies and planning choices aimed at building healthier cities that should be adaptive and resilient in the nearest future [27].

One of the most rapid and significant impacts of the ongoing pandemic in urban areas, is related to urban mobility. In particular the relationship between mobility, urban spaces and health, needs immediate rethinking aimed at transforming urban environments through new sustainable transport models [28,29].

Starting from this key insight, this paper focuses on local government policies concerning post-COVID sustainable mobility, with the aim to understand, policies, approaches and measures, and the effective role of the ongoing action in shaping the future of urban mobility. Firstly, the paper provides an outline of strategies to recover from the COVID crisis in urban areas, particularly in relation to urban mobility. Next, it introduces the case studies and the methodology for analysing the data. Results and discussions are then highlighted in the last two sections.

2. Breaking Car Dependence to Recover from the Crisis

The ongoing pandemic has strictly connected mobility, urban spaces and health [21,30], highlighting the need to act immediately in transforming cities through new sustainable transport models.

People in cities are living the reality of travelling less, and the shifting of activities online. This is a big opportunity to rethink our practices on work, leisure and retail habits, and debate on encouraging affordable and sustainable travel for all. Action towards sustainable mobility can produce large public health benefits because of the reduction of greenhouse gas emissions, which leads to a cleaner environment [31]. Policies towards sustainable mobility and better land-use planning can effectively contribute to an increase in walking, cycling and the use of public transit, as well as reducing community divisions and minimize unnecessary journeys.

Addressing urban mobility is therefore a pressing issue for the post COVID cities [15,29,32]. In addition, the need of social distancing required by the COVID crisis, implies that public transport systems cannot run at full capacity. Therefore, public transit services may not be guaranteed to work

properly and may lose competitiveness compared to private cars [28,29]. If people turn to cars for their trips, cities could lose some of the greatest social and economic benefits of public transit and will be overwhelmed by traffic and air pollution.

The consequence of the COVID crisis is a real risk of decline in the sustainability of mobility in urban areas, which might prevent governments to meet their sustainable development objectives and the Paris Agreement targets. These effects should make us think on how mobility in cities will be after this crisis [33]. To respond to these challenges, the United Nations Economic Commission for Europe (UNECE) has created a task force to develop a set of principles for green and healthy sustainable mobility [34]. This collective effort is being launched under the Transport, Health and Environment Pan-European Program (THE PEP) [35], jointly led by UNECE and WHO Europe, a unique regional platform for the development of sustainable mobility.

The task force will be composed of representatives of member states, international organizations, civil societies, academia and other stakeholders. It will develop principles for an environmentally sound and healthy transport system based on sustainability and resilience and will explore long-term and strategic revolutions for the transport sector.

The issue is also being addressed by a number of city leaders around the world that are coordinating measures to support a low-carbon, sustainable path out of lockdowns. Many cities have already announced or implemented measures oriented to enhance sustainable mobility, and in particular, measures designed to allow people to safely move in urban spaces, while also considering that physical distancing will be the norm for the foreseeable future. In order to promptly respond to these new needs and to accommodate the reopening of businesses, many local governments are innovating and adapting urban spaces to cope with this new urban condition.

Most measures are oriented to enhance non-motorized mobility as well as the provision of public spaces and services within the city. In particular, the most widespread measures are oriented to change urban streets and public spaces and enhance the residents' safety. Emergency street design and transportation practices are at the front lines of city defence against this health crisis and are essential to stopping future epidemics.

Many cities are moving quickly to take advantage of the opportunities offered by this state of lower mobility, especially low car volumes, by implementing quality affordable mass transit and pedestrian and cycling facilities. The aim is to drastically curb traffic and, in turn, providing more road space for cycling and walking [36].

Among the most common measures adopted by the front-line cities, the following are the most effective:

(1) Removing motor traffic from residential streets and extending pavements near shops, schools and parks to make walking safe and enjoyable for transit and exercise;
(2) Establishing safe cycling routes to and from schools, offices, and close to main roads, by closing down roads and carriageways where necessary, so that people can have a safer alternative to private cars and public transport;
(3) Creating safe access routes on foot and bike as well as safe public spaces and green areas at the neighbourhood scale, closing roads and squares to motorized traffic.

Most of these measures are contained in a new guide to street design for the ongoing pandemic and future recovery, released by The National Association of City Transportation Officials (NACTO), whose chair Janette Sadik-Khan, declared: "*Today, people focused streets are a proven global best practice and the first-line response for transportation and transit agencies during the COVID-19 crisis. This is a historic moment when cities can change course*" [37].

The guide, named "*Streets for Pandemic Response and Recovery*" reports design examples and tools "*to keep essential workers and goods moving, provide safe access to grocery stores and other essential businesses, and ensure that people have safe space for social/physical distancing while getting outside*" [37].

The key principles in rethinking streets and public spaces for a post pandemic city are: supporting public health guidance, considering physical distancing, increasing the outdoor space available for people, creating safer street that prioritise public transit, cycling and walking, supporting local economies and bringing communities into the process. The report includes descriptions of emerging practices from around the world as well as suggestions for their implementation. The following street features are specifically addressed: dedicated lanes for biking & rolling, sidewalk extensions, transit lanes, slow streets, pick-up & delivery zones, outdoor dining and markets [37].

The guide is also inspired by previous experiences of urban transformations to accommodate people and non-motorized means of transport and in particular, street and public space design carried out in New York and other American cities [38].

In the footsteps of these experiences many cities have already announced or implemented measures like hundreds of miles of new bike lanes, pedestrian areas, street retrofittings, mass tree planting and investments in renewable energy.

In particular, a number of global cities, around the world, have turned their streets over to pedestrians and cyclists, using the COVID health emergency to start the necessary urban revolution for the green vision of the future. The ongoing crisis has become the starting point for a new urban revolution based on green principles [39].

Paris is already planning a radical transformation of the city by 2024. *Plan Vélo* [40] is a plan born out of the idea of "*ville du quart d'heure*", a city where everything a resident need should be reachable within a 15-minute non-motorized trip. The plan provides all neighbourhoods with every necessary amenity in terms of leisure, retail, schools and public services, all within walking or cycling distance. Launched in 2019, it has already produced an increase of more than 50% in the use of bicycles. The local government has already allocated € 300 million for a network of permanent and pop-up cycle lanes in the Ile de France Region, many of which will follow existing metro lines, to offer an alternative to public transport. The pop-up cycling network will be ready by the end of lockdown.

The Office of the Mayor of London and Transport for London, announced the London Streetscape Plan [41], a massive transformation of public roads aimed to create new walking and cycling routes along major corridors, including temporary cycle lanes. The plan will increase cycling and pedestrian spaces tenfold to encourage walking and cycling as people return to work. Due to physical distancing, almost impossible on crowded public transport, millions of journeys every day would need to be made by other means. With London's public transport capacity potentially running at a fifth of pre-crisis levels the number of people requiring the use of public transport would need to be kept as low as possible.

The mayor Sadiq Khan, who declared that COVID-19 poses "*the biggest challenge to London's public transport network in Transport for London's history*", announced that the city has already started to work with boroughs on the rapid construction of a strategic cycling network, using temporary materials. The network of new routes, will reduce crowding on public transport, and completely transform local town centres so that people can walk and cycle wherever possible in low-traffic neighbourhoods [42].

To enhance social distancing in Mexico City, one of the most populous cities in the world, the administration announced the provision of new bike paths to keep people off public transportation. The new "*Ciclovia temporal CDMX*" consists of 80 miles of temporary bike lanes as an extension of the ongoing *Plan de Movilidad no motorizada* [43] that the administration started in the past years. The new bike lanes, following the main lines of public transit, are planned to guarantee a valid alternative for sustainable urban mobility in respect of social distancing.

New York has unveiled plans to open up 100 miles of streets for "*socially responsible recreation*" during the COVID-19 crisis [44]. Mayor de Blasio announced that he would add temporary protected bike lanes to two of the busiest bike corridors in the city. These emergency lanes are an opportunity to re-appropriate the empty roads and to create spaces were walking and cycling are the preferred way to move around. Up to 60 miles of the provided open streets will be adjacent to parks, up to 20 miles will be the result of community consultations, and the rest will be permanent protected bike lanes.

These measures have already started to be implemented, although sparsely and not integrated with other land use policies. However, the mayors participating in the newly formed economic taskforce are working together to develop approaches to urban mobility and believe that this is the way forward to more radical long-term measures that will help tackle inequality and the climate crisis. There is a lot we can learn from this crisis as a springboard to the creation of more permanent urban policy choices to make life more pleasant and safer for all.

3. Materials and Methods

3.1. The Italian Case

Within the COVID-19 Pandemic, Italy is one of the countries that has paid the highest price, both in terms of infections and deaths. Italy was the first European country heavily hit by the pandemic as a consequence of several similarities with the countries where the infection originated, mainly due to social and cultural factors that can influence infection rates [45].

Although the pandemic spread differently in northern and southern regions, due to the exponential increase in contagions, the entire country went into total lockdown for two whole months, which put a strain on health authorities, social fabric and economic organizations throughout the country. The disease spread more severely in the Lombardy region and in particular in the Greater Milan Metropolitan area which presents some similarity to the Wuhan urban agglomeration were the epidemic started. [46]. The main metropolitan cities all over the country paid the highest toll in terms of cases and deaths [47].

Data from the ten most populated Italian cities shows that almost a third of the Italian cases are concentrated in metropolitan cities (over 65,000 cases, that represent 27% of the total Italian cases) (Table 1). The data is even more relevant considering that the ten cities have a total population of almost 9,000,000 inhabitants, which represent 14% of the entire Italian population.

Table 1. COVID cases in the most populated 10 Italian cities [48].

City	Population	COVID Cases	Region	Population	COVID Cases	City/Region % Cases
Rome	2,847,490	5917	Lazio	5,898,124	8033	74
Milan	1,388,223	24,210	Lombardy	10,018,806	93,173	26
Naples	955,503	2644	Campania	5,839,084	4634	57
Turin	875,063	15,858	Piedmont	4,392,526	31,254	51
Palermo	659,052	498	Sicily	5,056,641	3073	16
Genoa	575,577	5867	Liguria	1,565,307	9939	59
Bologna	392,027	5181	Emilia-Romagna	4,448,841	28,260	18
Florence	379,578	3518	Tuscany	3,742,437	10,217	35
Bari	319,482	1491	Apulia	4,063,888	4529	33
Catania	310,527	777	Sicily	5,056,641	3073	25
TOTAL	8,702,522	65,961		45,025,654	196,185	34

Despite the huge differences among regions, the north being hit hardest by the pandemic, data shows that the percentage of cases in cities is always higher compared to the total cases of the corresponding region. Cities like Bologna (18% of total regional cases) and Rome (74%) confirm that main cities are the most vulnerable places in the country (Table 1).

After the strictest phase of lockdown, the country is slowly returning to normality due to the decrease of contagion and death rate. With a specific law recently released, the Italian government imposed less restrictive rules for the so-called Phase 2, which has begun the first reopening of the country with several changes in lifestyle for the citizens.

The rules are aimed at avoiding new flares of the epidemic and put aside funds for restarting, after the first two months of total lockdown [49]. Among many measures, the act provides economic incentives for sustainable mobility in favour of citizens, to buy bikes, e-bikes and micro-mobility, as well as new rules aimed to incentivize and facilitate the building of cycling lanes in exiting urban roads.

Despite the lack of a governmental recovery strategy specific to the metropolitan cities, research institutions, environmental and eco mobility associations, have started to release studies, proposals and guidelines for recovery strategies in cities. Some research highlights the social distancing effects on travel modal choices, and how to face the unavoidable reduction of public transport travel demand [50,51]

The Italian National Institute of Urban Planning (INU) recently released a document containing some proposals for overcoming the emergency and to re-launch the country. The proposals aim at integrating economic recovery and combat climate change, highlighting the leading role of the metropolitan areas in setting effective mitigation and adaptation strategies. Therefore, INU proposes the re-launch of the Green New Deal European strategy [52] as a way of action for the immediate future urban recover policies. The proposed strategies include: the mitigation of flood risks, improving energy efficiency, enhancing public spaces and green areas and enhancing sustainable mobility with particular attention to pedestrian and cycling network [53].

Sustainable mobility in urban areas is also the topic of "*Post-Covid urban mobility*" a document released by Bikenomist, an agency of consulting, communication, training and research on themes related to bicycles and cycling [54]. The document, inspired by the NACTO guide [37], proposes guidelines for new mobility. The proposal is centred on providing emergency mobility networks for cyclist and pedestrians, as well as policies for restricted and traffic calming areas in the inner cities. Technical solutions and best practices are also outlined in the document, in order to offer a useful support to local government for non-motorized mobility policies and implementations [54]. Following these guidelines, research and debates, and after the observation of the most effective international experiences, main Italian cities have developed urban strategies to respond to post-COVID mobility needs.

3.2. The Method

The research method is based on the analysis of official acts concerning post-COVID mobility, recently released by the local governments of the ten most populous Italian cities. The goal is to build a conceptual framework that enables the comparison of policies carried out by local governments, highlighting approaches, challenges, design problems and critical issues (Figure 1). Policies and measures are interpreted and evaluated in light of existing sustainable mobility policies as well as the contents of the Sustainable mobility plan already approved by municipalities. A description of post-COVID measures undertaken by cities, is reported in the following subsection.

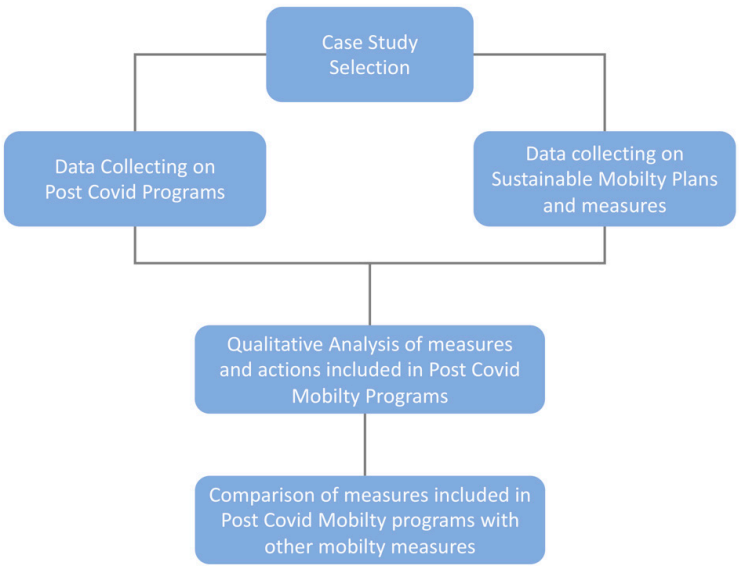


Figure 1. Steps of the method.

Post Pandemic Mobility Programs

In order to develop a strategy for *Phase 2*, Milan City Council implemented the ongoing adaptation strategy "Milan 2020", with the goal to reorganize the city to accommodate for social distancing and other measures aimed to curb the infection.

Urban Sustainability and Mobility are the pillars of the entire strategy, further detailed in the program "Open Streets" [55] that brings together a set of almost immediate actions including the creation of a 35 km long network of pedestrian and cycle paths, 22 of which are already under construction and will be completed by this summer (Figure 2).

Most of the paths will be realized using tactical urbanism actions, in order to reduce costs and construction times. The project is the result of an integrated consultant activity between the city councilors for Mobility, Urban Planning and Green and Agriculture.

The Municipality of Milan, however, is not new to tactical urbanism strategies: their experience stems from 2019's with the "Open Squares project", in collaboration with Bloomberg Associates, National Association of City Transportation Official (NACTO) and Global Designing Cities Initiatives.

In Turin the strategies for post-COVID urban mobility were recently approved with a municipal act that provides a massive transformation of urban roads with the goal of creating 50 km of cycling lanes within the city [56]. The new cycling lanes will be installed beside main urban roads, using existing car lanes. Maximum speed on the lanes will be 20 km/h in order to give priority to cyclists and pedestrians. Moreover, the plan provides other cycling lanes, that will be ready by the end of the summer. To complete the plan, a sharing program for bikes and scooters with 100 sharing points within the city will be implemented. All measures are included in the Sustainable Urban Mobility Plan and in the bike-plan recently approved by the local government.

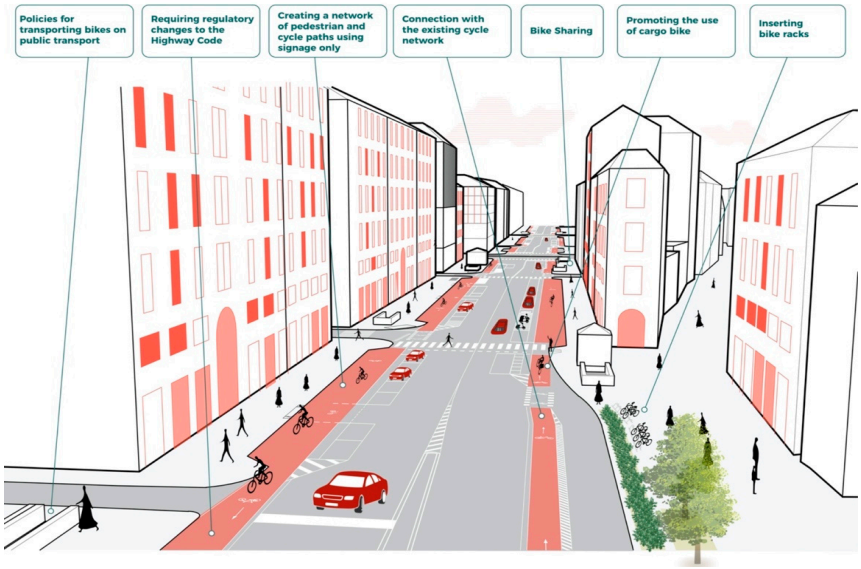
Smart Move [57] is the program approved by the Genoa municipality, to organize sustainable post-COVID urban mobility. The program consists of 40 measures already outlined in the Sustainable Urban Mobility Plan recently approved by the local government. Among the measures 3 emergency bike lanes will be built, for a total length of 30 km, partly realized using tactical urbanism tools. The new lanes are part of a 130 km long network that will cover the entire city in the near future. The program, designed and implemented by the new "Smart mobility office", includes a number of traffic calming areas within the city, as well as a bike and scooter sharing program.

The municipality of Bologna launched the Urban mobility and sharing urban spaces program [58] for reimagining mobility for the post lockdown. The goal of the program is to increase non-motorized mobility, according to the Bologna Sustainable Urban Mobility Plan, recently approved by the local government.

The program provides 15 km of emergency cycling lanes in addition to other 13 km under construction. Cycling measures are integrated with other actions aimed to enhance public spaces liveability and to create new pedestrian zones in densely urbanized areas.

The program will provide spaces for social recreation in every neighbourhood following the idea of the polycentric sustainable city where main services, retail, leisure, public spaces, schools are located within cycling or walking distance.

The post-COVID mobility project [59] is the program launched by the municipality of Rome with the aim to enhance sustainable urban mobility at the end of the lockdown. Delving in the details of the plan, it provides 150 km of new temporary bike lanes, according to the Sustainable Urban Mobility Plan recently approved by the municipality (Figure 3). The lanes, in part already under construction, will become permanent in the near future. In total the implementation of the plan will cost over € 3 million and will be realized in several phases. The plan also provides services of sharing mobility (e-bikes and scooters), as well as pedestrian and traffic calming areas within the city.



(**a**)

(**b**)

(**c**)

Figure 2. Milan. New Cycling path along Corso Buenos Aires design sketch (**a**) implementation (**b**), Piazza Sicilia (current and project) (**c**) (Source: https://www.comune.milano.it).

Figure 3. Rome. New Cycling path along Viale Egeo, Eur (Source: Rainews.it).

The Naples municipality recently approved Naples Restart [60], a program of measures and actions to support non-motorized mobility for the post-COVID. The aim of the program is to improve cycling and pedestrian mobility using the pandemic as an occasion for a permanent change in urban mobility.

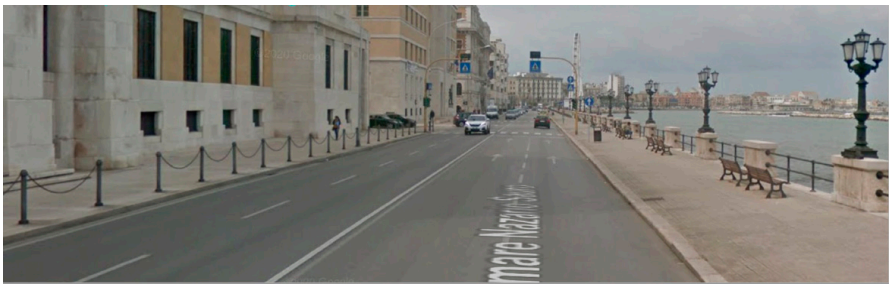
The plan provides a network of temporary bike lanes, 20 km in length, with the aim to reinforce and upgrade the existing network. In addition, the program provides services of sharing mobility (bikes and scooters), as well as pedestrian and traffic calming areas (zone 30 and 20) within the city. To make these measures more effective, the municipality launched a program for enhancing smart working in public and private sectors and a plan for coordinating the opening times of local business and services across the city.

Bari is one of the few southern Italy metropolitan cities that is developing a mobility strategy for the post-COVID. Bari Open Space [61] is the program realized by the municipality in order to enhance sustainable mobility, public open spaces and green areas within the city. The program, based on tactical urbanism principles, aims to realize temporary and fast urban transformation as a response to the COVID crisis and social distancing measures. It consists in the development of 57 km of cycling paths, pedestrian areas and public spaces in densely urbanized areas within the city (Figure 4).

New bike lanes and sharing mobility are the measures proposed in the sustainable mobility plan recently approved by Florence local government to face urban mobility issues for the post lockdown [62]. The plan includes 6 new lanes, for a total cost of € 450,000, as well as traffic calming areas and a sharing mobility program. Economic incentives are provided for citizens who use a bike for commuting.

The Palermo local government recently announced Palermo Safe [63] a program of measures and actions to cope with the COVID emergency. One of the key principles of the program, which is yet to be approved by the local government, is "pedestrianization, in compliance with the city masterplan and the recently approved mobility plan. The program includes the pedestrianization of two of the main streets of the historical city centre.

The program also provides for the building of a new cycling lane and for the renewal of pre-existing ones. Traffic calming areas and the sharing mobility program complete the set of measures oriented to curb the use of private cars and the consequent congestion.



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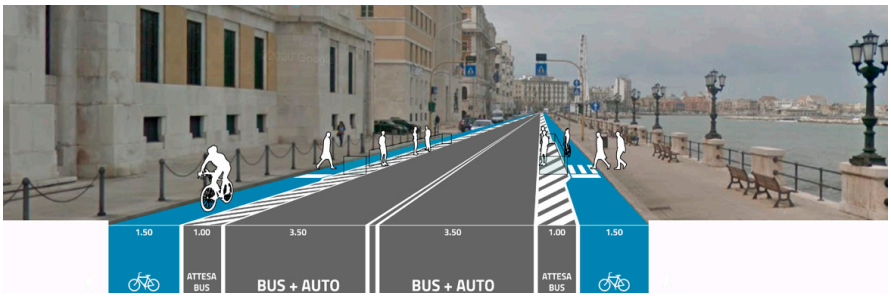

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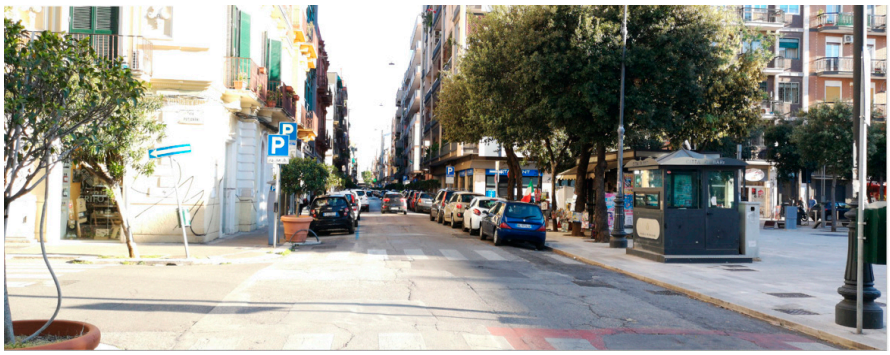

(**c**)

(**d**)

Figure 4. Bari. New Cycling path along Lungomare Nazario Sauro current (**a**) design sketch (**b**), Via Manzoni current (**c**) and design sketch (**d**) (Source: comune.bari.it).

The city of Catania is characterized by poor quality of land use and transport planning, as well as major environmental problems due to uncontrolled traffic congestion and to the widespread use of private cars as urban means of transport [64]. It is the only city, among the Italian metropolitan cities, that has not approved or announced any programs for the post pandemic urban mobility. No declaration was made by local government, which does not seem to be concerned by sustainable urban

mobility. The public debate was primarily focused on the economic recovery of the retail and food services sectors. In order to help the latter, a local government act provides for the free use of public roads to expand food activities. No pedestrianized or traffic calming actions have been implemented. After almost two months since the beginning of *Phase 2*, despite several appeals by environmental associations, cycling activists, research centres and academics [65], the local government is yet to announce any measures.

4. Results and Discussions

Measures and actions carried out by the ten examined cities, are summarised in the following Table 2. Data shows that, excluding one case, cities have implemented several effective actions to deal with the pandemic emergency.

Table 2. Post COVID urban mobility programs in main Italian cities

City	Program	Actions	Bike Lanes Length (km)	Costs (euro)	Start Date
Rome	Post Covid Mobility Project	Temporary bike lanes/sharing mobility programs	150	632,000	4 May
Milan	Open Streets	Temporary bike lanes/permanent bike lanes/new pedestrian areas/public spaces renewal/sharing mobility programs	35	not declared	29 April
Naples	Naples Restart	Permanent bike lanes/traffic calming areas/restricted areas/sharing mobility programs	50	250,000	4 May
Turin	Bike Pride	Temporary bike lanes/restricted areas	80	not declared	12 May
Palermo	Palermo Safe [1]	Temporary bike lanes/permanent bike lanes/traffic calming areas/pedestrian areas/sharing mobility programs	not declared	not declared	July
Genoa	Smart Move	Permanent bike lanes/restricted areas/sharing mobility programs	30	not declared	15 May
Bologna	Mobility and emergency sharing spaces	Temporary bike lanes/permanent bike lanes/new pedestrian areas/traffic calming areas/sharing mobility programs	28	not declared	8 June
Florence	Operation Bartali	Temporary bike lanes/permanent bike lanes/sharing mobility programs	22	450,000	4 June
Bari	Open Space	Temporary bike lanes/permanent bike lanes/traffic calming areas/sharing mobility programs/new pedestrian areas/public spaces renewal	57	not declared	8 June
Catania		No measures	-	-	-

[1] Program announced but not approved by local government.

When comparing the implemented programs, the most adopted measures concern new cycling lanes (nine cities out of ten), both temporary (seven cities) and permanent (seven cities). This datapoint clearly reveals the awareness of local administrators that cycling, which ensures social distancing and does not pollute, is the most effective means of transport for the post pandemic mobility in urban areas.

In addition, the newly adopted formula of temporary or pop-up bike lanes, drastically reduces implementation times and costs, allowing local government to define in short time and with low budget, extensive networks widespread in the city. From the 22 km of Florence to the 150 km of Rome, reasonable networks of new cycling lanes will add on to the existing network, strongly contributing to generating real cycling cities for a near future.

A number of actions are focused on enhancing public spaces and on the rethinking of roads to promote walking and cycling. The aim is to reconsider and reorganize streets, squares, parks and other public spaces on a human scale, in order to promote neighbourhood life. Some of the common strategies that can be observed in many of the case studies are: giving more space to the people,

improving environmental conditions in the city, increasing more sustainable and non - polluting means of transport, redefining urban streets for recreational and cultural uses or retail and respecting social distance requirements. Participatory planning which is widely recognized as an effective planning tools, where present, played an important role in setting the strategies [66].

New pedestrian areas and traffic calming areas (five cities), public space renewals (two cities), and new restricted areas (two cities) clearly show that local governments are determined to give priority to new transport modes, giving more importance to pedestrians and cycling and curbing spaces for private cars.

Sharing mobility measures are also included in a number of programs (eight cities), in many cases as extensions of existing sharing programs aimed to include new kinds of sharing vehicles, such as e-bikes, e-scooters, or other forms of micro mobility. In some of the analysed cities the calls for tender for the new sharing programs have already started.

In addition to the measures reported above, most of the programs provide for further urban policies oriented to enhance sustainable urban mobility within the city.

Actions to promote intermodality, traffic data monitoring and new parking rules are included in almost all programs. Furthermore, some programs include tactical urbanism actions for the renewal of existing cycling lanes and public spaces, as well as strategic plans for the "*15 min city*" and to regulate opening times of city activities.

Local incentives for the purchase of non-motorized means of transport, (discounts for the purchase of bikes, e–bikes, cargo bikes, scooters) are also provided by some municipalities in addition to those provided by the national government.

The detailed evaluation of the programs released by the 10 cities, clearly highlights a common strategy undertaken by local governments to cope with the new sustainable urban mobility needs. A common idea of mobility in the post pandemic city, in many cases corresponds with strategies and actions in favour of sustainable mobility, already included in Sustainable urban Mobility plans and Bike plans, implemented by local governments.

Furthermore, reading these programs in the light of current urban mobility data (car rates and public transport passengers, rates of cycling lanes, pedestrian and traffic calming areas), clearly shows that the analysed city programs were designed with care towards the exiting mobility and in line with strategies already developed in previous mobility plans.

The effect of the COVID 19 crisis was to speed up the implementation of these pre-existing measures in the analysed cities.

The detailed evaluation of the programs released by the 10 cities, clearly highlights a common strategy undertaken by local governments to cope with the new sustainable urban mobility needs.

Comparing current mobility data with contents of the programs, also reveals that the most effective and complete programs were proposed by those cities that already present well-organized sustainable transport strategies (Table 3).

Cities like Milan, Bologna or Florence, well-known for their low private car ownership rates, capable public transport systems, high coverage of cycling lanes, pedestrian and restricted areas, innovative and effective mobility plans, have proven to be ready to face the emergency. In these cities local government developed, in a short time, effective programs thanks to their powerful vision for a new green deal and for a sustainable future.

Table 3. Population and urban mobility data on the most populous Italian cities [67].

City	Population	Car Rate Ownership (car/100 inh[1])	Public Transport Offer (places × km/inh)	Public Transport Demand (pass./inh)	Pedestrian Areas (sqm/inh)	Traffic Calming Areas (sqm/inh)	Cycling Lanes (km/10.000 inh)
Rome	2,847,490	62	7149	331.6	0.14	2.03	0.85
Milan	1,388,223	50	15,219	480.1	0.46	6.75	1.6
Naples	955,503	57	2293	112.6	0.47	1.44	0.16
Turin	875,063	66	6946	320.1	0.53	3.01	2.27
Palermo	659,052	59	2159	42.3	0.5	0.36	0.75
Genoa	575,577	47	4629	233.9	0.07	0.89	0.2
Bologna	392,027	53	3765	289.5	0.3	8.3	3.3
Florence	379.578	52	5549	245.3	1.08	13.46	2.34
Bari	319,482	56	2996	75.6	0.5	2.48	0.8
Catania	310,527	72	2556	54.0	0.21	0.39	0.36
TOTAL	8,702,522	572	5326	218.5	0.42	3.91	1.26

Note: inh = inhabitants; pass = passengers; sqm = square meters

Other cities that have already started a change process toward sustainable mobility, but are still showing high car density or low efficiency of public transport, such as Rome, Turin and Genoa, developed programs aimed to overcome the gap and improve sustainable urban mobility. Those programs are oriented to remove weaknesses of public and private transport systems, by enhancing non-motorized mobility.

In Southern Italy, cities like Bari and Naples released reasonable programs, in line with their current mobility conditions. The proposed measures are mainly oriented to increase pedestrian areas, cycling lanes and sharing mobility programs, introducing non-motorized means of transport, currently absent, in urban mobility habits.

Palermo and Catania, two cities with private car ownership rates among the highest in Italy, with some of the lowest rate of capable public transport, as well as a huge lack of cycling lanes, pedestrian and restricted areas, do not seem to be currently ready to face the post pandemic scenario. Despite several studies concerning non-motorized mobility and sharing mobility demonstrating the increasing interests by local administrations on these solutions [68,69], the two Sicilian cities still show a lack of policies and strategies for enhancing sustainable urban mobility, as well as a failure to implement mobility plans. As a consequence of the lack of vision concerning sustainable urban mobility, Palermo presented a weak program, not fully approved by the municipality, and Catania did not announce any program or measures oriented to face the emergency. Given that these are two of the cities that have made the least progress in sustainable mobility, this is a strong signal that without solid strategies, already engaged by local governments, it is not easy to envision and realize such structural changes in urban mobility and in cities as a whole.

Looking at the existing measures and plans concerning sustainable mobility (Table 4) it becomes clear that cities that are already involved in planning processes, concerning sustainable mobility and that have already embraced strategies in favour of active mobility, such as cycling and walking, are able to better plan for the emergency.

On the contrary, the most congested cities, that have not previously focused their strategies on sustainable mobility, show real difficulties in implementing reasonable programs and consequently they step away from suitable sustainable urban mobility standards.

Therefore, if the virtuous cities have used the emergency for further improve their programs, the less virtuous ones have remained bounded to the existing harmful and obsolete models based on massive use of private cars. As a matter of fact, not even the ongoing health crisis has fostered change for these latter cities.

Table 4. Existing sustainable mobility measures on most populated Italian cities.

City	Sustainable Urban Mobility Plans	Bike Plans	Mobility Sharing Programs	Tactical Urbanism Actions	Municipal Bike Agency
Rome	approved	approved	active	presents	not presents
Milan	approved	not approved	active	presents	not presents
Naples	in progress	not approved	active	presents	Present
Turin	approved	approved	active	presents	Present
Palermo	in progress	not approved	active	not presents	Present
Genoa	approved	in progress	active	not presents	not presents
Bologna	approved	approved	active	not presents	present
Florence	approved	not approved	active	presents	not presents
Bari	approved	approved	under construction	not presents	not presents
Catania	not approved	not approved	not active	not presents	not presents

5. Conclusions

This paper presents an overview of several experiences of urban environment transformation, carried out in the main Italian cites in order to cope with the COVID-19 pandemic and enhance the city resilience for the future. Comparing the analysed experiences clearly highlights the awareness of local governments and policy makers of the need of deep urban transformations based on green principles.

While urban life quickly returns back to the usual rhythms of work, leisure and other social behaviours, our cities will never be the same, because of our newfound awareness that another health crisis might strike. Consequently, the ongoing crisis has become the starting point for a deep change in urban organization. In particular, urban mobility is going through a new kind of green revolution. There is a remarkable change in the understanding that our streets and public spaces are incredible assets that can be used to definitively change urban mobility. Following the lessons of a number of cities around the world, the main Italian cities are temporarily reallocating road space from cars to people, keeping them moving, during the restart phase, healthy and active while socially distancing. Comparing the programs, we can argue that the adopted actions, such as cycling lanes, pedestrian and traffic calming areas, sharing mobility programs and others, are recurring in several programs. In addition, the analysis shows that temporary interventions based on tactical urbanism tools are widely used to implement the new measures.

The presented analysis framework also emphasizes the central role of local governments concerning, in particular, the planning choices in favour of sustainable urban mobility, that occurred before COVID. Cities that have not implemented appropriate policies, risk missing out on the opportunity to participate in the ongoing revolution, remaining anchored to old unsustainable models, despite the serious pandemic in progress and the risks of similar events in the near future.

As underlined in the results, the measures included in the analysed programs can be easily implemented in different urban contexts, both as temporary and permanent. Therefore, this study could be used by policy makers and planners in structuring green policies, finding models, strategies and actions that are fit for their specific urban environments. Cities must now take up the new challenge and quickly start their own urban revolution based on a green new deal, implementing sustainable mobility plans, rethinking the way we move through the city and the way we use urban spaces.

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