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

Vol.13 n.1 April 2020

print ISSN 1970-9889 e-ISSN 1970-9870
University of Naples Federico II

TeMA Journal of
Land Use, Mobility and Environment

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

1 (2020)

Published by
Laboratory of Land Use Mobility and Environment
DICEA - Department of Civil, Architectural and Environmental Engineering
University of Naples "Federico II"

TeMA is realized by CAB - Center for Libraries at “Federico II” University of Naples using Open Journal System

Editor-in-chief: Rocco Papa
print ISSN 1970-9889 | on line ISSN 1970-9870
Licence: Cancelleria del Tribunale di Napoli, n° 6 of 29/01/2008

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The cover image is a photo of a street in the city of Naples during the COVID-19 pandemic quarantine (April 2020)

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TeMA Journal of Land Use, Mobility and Environment

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1 (2020)

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TeMA 1 (2020) 55-80
print ISSN 1970-9889, e-ISSN 1970-9870
DOI: 10.6092/1970-9870/6606
Received 13th January 2020, Accepted 22th March 2020, Available online 30th April 2020

www.tema.unina.it

How Italian metropolitan cities are dealing with the issue of climate change?

The study cases of metropolitan cities of Bologna, Milan and Venice.

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Abstract

In recent decades, climate change has become one of the most discussed topics within the territorial planning debates. Urban and territorial planning addresses the topic in different ways, according to the level of government of the territory involved. In the following article the focus is to the Italian territorial context; in particular it's about to the role that the level of government of the metropolitan city can play within the environmental challenges. In 2017, Italian metropolitan cities signed the "Bologna Charter", a document that places them as protagonists of environmental protection and sustainable development. The process of analysis of metropolitan cities and their planning tools has enabled the identification of virtuous metropolitan planning cases, which were found to be the ones of the Metropolitan Cities of Bologna, Milan and Venice. Subsequently, the actions that the three metropolitan cities were analyzed. Precisely through this critical reading, it was possible to identify the best practices implemented. The conclusion reached appears to be the belief that Italian metropolitan cities could actually play a coordinating role in climate change policies, promoting an integrated approach to spatial planning.

Keywords

Climate change; Metropolitan cities; Urban planning; Territorial planning.

How to cite item in APA format

Molinaro, W. (2020). How Italian metropolitan cities are dealing with the issue of climate change? The study cases of metropolitan cities of Bologna, Milan and Venice. *Tema. Journal of Land Use, Mobility and Environment*, *13* (1), 55-80. http://dx.doi.org/10.6092/1970-9870/6606

1. Introduction

During the last decades the attention towards climate change has grown more and more, institutions and scholars have started to interface with this issue. Luca Marchesi, general manager of ARPA Friuli Venezia Giulia states that: "Climate change is now a priority issue that runs through science, society and politics and the social awareness of the issue has grown a lot in recent years".

Simin Davoudi, one of the leading scholars of climate change planning, also said in 2011 that awareness of climate change as grown. Increased awareness as led to increasingly decisive action to counter the negative effects of climate change.

At the end of the 90's, the themes of climate change began to be associated with spatial planning. Bulkeley (2009), affirm that "in the 2000s, climate change was considered to be the greatest threat and was posed as key problems for planning" (pp. 284-297).

All entities with both territorial and urban planning skills are equipping themselves with tools that formulate mitigation and adaptation policies.

There are specific planning tools that are being developed such as the adaptation, resilience, green and water management plans.

These are "voluntary" planning tools that the various administrations independently draw up.

Among the most interesting experiments, the plans of the European cities of Barcelona, Rotterdam and Copenhagen must certainly be mentioned.

The adaptation plans of these cities are presented as some of the most interesting cases also from the point of view of the redesign of urban space. The three plans focus on various factors relating to climate change, but particularly on the theme of water management.

In the case of Barcelona, thanks have been designed which are capable of containing considerable quantities of water. In Copenhagen the urban spaces of the San Kjeld district have been redesigned making it the first resilient urban district in the world. Specifically, green spaces have been designed to increase the lamination of rainwater. Finally, the Rotterdam Climate Proof aims to make the city more resilient by intervening on soil permeability.

Interest in the issue of climate change has grown since, in the last decade, its effects have led to an increase in extreme weather events and greater economic and human life losses.

The increase in impact of climate change is presented by the international disaster database, which highlights the increase in floods, droughts, fires and extreme water events.

The World Economic Forum (WEF) assessed climate risk among the top five global risk in order of importance, according to the OECD, global warming could lead to a sharp drop in world GDP by 2050, a drop of about 7,5%.

It is also evident that the increase in disaster caused by climate change lead to a greater loss of life, this vision is confirmed by the Climate Impact Lab, a collaboration of over thirty climate scientists, economist, researchers, analysts and students of some of the major US research institutes.

Climate Impact Lab says that deaths caused by anthropogenic climate change could amount to 1.5 million annually.

The seriousness of this damage has led to a creation of policies to fight the climate change in all levels of government of the territory.

The Intergovernmental Panel on Climate Change (IPCC) is the body that mostly addresses the issue globally. It takes care of the development of recurring reports that monitor the impacts of the climate on the cities.

At European level, the Adaptation to Climate Change Strategy was prepared in 2009, it indicates the measures to be taken to face the new climate challenges.

The European strategy has delegated to the member states, the preparation of national strategies that will guide local authorities to draw up ad hoc plans.

The policies of the supranational, European and global levels identify, indeed, local authorities as those responsible for dealing with this problem.

The importance of local authorities was recognized for the first time in 2009 through the Copenhagen agreements. Until 2009 they had never been identified as a determining component in the fight against climate change. (de Guisasola, 2009).

The 2014 IPCC report confirms the importance of the local level by dedicating part of the periodic report to Urban Areas. Indeed, the role and function of cities in the fight against climate change are defined (IPCC, 2014).

The Italian situation appears complex although a national climate change strategy (SNAC) has been drawn up, as well as a national plan (PNACC), which, however, is not yet in force at the moment.

Both the strategy and the national plan entrust local authorities with the implementation of effective actions that can truly reduce the effects of global warming.

However, the experiments carried out by local authorities are few: among the virtuous cases we recognize the plans of the municipalities of Bologna, Padua and Ancona.

Filomena Pietrapertosa (2019), researcher Imaa-Cnr, explain that: "Only Bologna and Ancona, however, have developed an adaptation plan in the context of European projects (respectively Life Blueap and Life Act) even if other cities have started a process of planning to identify the climatic vulnerabilities of their territories" (pp. 91-105).

In the recent years, the municipality of Padua has also completed the drafting of a local adaptation plan through the European projects "Covenant of Mayors" and "Life Laks". Padua, with the help of IUAV, University of Venice, developed, in 2016, the adaptation guidelines named "Padua Resiliente", in which a technical approach was developed for the drafting of mitigation and adaptation measures.

As these tools are voluntary, a standard methodology to guide the drafting of such plans was neither foreseen nor developed. On the other hand, supranational entities are in charge of drafting guidelines for the establishment of adaptation plans.

Among the most effective experiments we must certainly mention the European Master Adapt project, co-financed by the Life project of the European Commission in 2016. It aims, precisely, the drafting of guidelines to develop a common, operational and integrated methodology to allow regions, metropolitan cities and municipalities including adaptation to climate change in their plans and programs.

According to the Master Adapt, cities must play a fundamental role in reducing the effects of global warming. The metropolitan cities currently involved in this project are those of Cagliari, Milan and Venice.

As regards the Milanese case, the Master Adapt project refers to unions of municipalities belonging to the Metropolitan City of Milan. In this case, the analyzes show that the greatest vulnerability of metropolitan areas consist in "Losses and damage due to extreme weather events". In the case of Metropolitan City of Venice, on the other hand, it emerges that the most critical vulnerability to be countered, beyond that deriving from management of both surface and costal water, is certainly linked to the urban heat islands. Finally, the same analysis conducted on the entire Metropolitan city of Cagliari shows how, in this case, the greatest vulnerability is due to drought.

Furthermore, considering Italy's national policies, the PNACC suggests the creation of a new level of planning that can deal with this issue. In fact, traditional urban development planning and programming tools are inadequate to manage the complex issues related to climate change (CMCC, 2017).

In the light of so much uncertainty towards the issue of climate change in the urban development planning, it is right to raise some questions: Are the local authorities really suitable for dealing with this issue? And, if so, which is the most suitable level in the local government?

In 2014, with the Delrio law n. 56, metropolitan cities were introduced as ac vast area local body. Since these are still in the definition phase, both from the point of view of competences and with regard to the tools, a

question that arose spontaneously is that if the new metropolitan entities are the best suited to face the climatic challenges. In fact, could they integrate the forms of adaptation into the tools still being defined?
Another question to be answered urgently concerns the role of planning in governing the effects of climate change. In light of these issues, it was decided to carry out an investigation to assess if metropolitan entities could respond effectively to the issue of climate change.

1.2 Methodological approach

The research question arises from the need to understand whether, in Italy, the level of government of the metropolitan area could be the one suitable for dealing with problems relating to
climate change. The analyzes were carried out according to the desk research methodology, which is based on the research, evaluation and re-elaboration of information already collected. Different types of material were taken into consideration for the analysis. Both international and Italian scientific literature was examined, taking into consideration both texts and articles that have territorial planning and climate change as central themes. Documents belonging to different levels of territorial government have been studied, from supra-national directives to documents drawn up by the local level. For supranational levels, the directives of global level bodies, such as the IPCC, and directives and books produced by the European community such as the White Paper and the Green Paper on climate change or the European Strategy for adaptation to climate changes. For the national levels, in addition to the documents, the territorial and urban planning tools were analyzed, paying particular attention to the tools of the metropolitan level.
The analyzes carried out on metropolitan planning tools are to be considered fundamental, all the plans and strategic documents of the fourteen metropolitan cities have been studied, focusing first on the issue of climate change, identifying the objectives and strategies proposed by the various metropolitan entities. In a second step, these objectives were compared with the eight macro objectives of the Bologna map.
Thanks to the analysis, it was possible to elaborate different matrices thanks to which the final considerations were produced which then led to the elaboration of the article.

1.3 Mitigation, Adaptation and Resilience in the Planning debate

IPCC defines mitigation and adaptation, about mitigation the IPCC (2014) states: "mitigation is a human intervention to reduce the sources or enhance the sinks of greenhouse gases" (p. 4); also IPCC (2007) affirm: "adaptation is adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities" (p. 6). According to the IPCC, the purpose of mitigation is to counteract the long-term effects of climate change, instead adaptation would deal with reducing the short and medium-term effects. From the analysis of the literature on climate change, mitigation and adaptation policies would seem closely related. Davoudi (2009) states, indeed, that these policies are not only closely connected, but that they have exactly the same purpose, that is to reduce the negative effects of climate change. Initially although the two policies were joint, they were treated separately, leaving greater importance to mitigation policies. Over the years, the two policies have been dealt with together, leading to the promotion of strong integration between the two.
Still Davoudi (2009), affirm that one task of spatial planning is "to promote greater integration between these two types of policies" (pp. 3-7).
Today therefore, mitigation and adaptation are on equal importance. This vision is confirmed by Gerundo (2018), who states that: "If mitigation is, therefore, indispensable to contain the increase in the planet's temperature and the climatic impacts connected to it, adaptation is equally necessary given that, part of climate change is inevitable for the moment and the related effects are already underway." (p. 33).
Stern (2007) says that together with mitigation measures, adaptation policies are a fundamental element for the control of climate change.

The task of promoting a strong integration between mitigation and adaptation policies is entrusted to territorial planning. Davoudi et al. (2009) declare that spatial planning processes can provide key-context where it would be possible to design integrated approaches between adaptation and mitigation (p. 15). It is therefore essential to encourage this integration in order to reduce the effects of climate change in the short to medium term.
It is therefore possible to state, in light of what has been stated, that adaptation and mitigation policies are closely related and have the aim of reducing the negative effects of climate change.
Carraro (2009) further confirms this vision, declaring that in order to mitigate the inevitable adverse effects of climate change, in the short and long term, adequate policies would be required as well as mitigation and adaptation (pp. 9-18).
Also Rafael Pizarro (2009), affirm "the urgent need to create synergies between adaptation and mitigation." (p. 33). It is possible to note how not only adaptation and mitigation policies are closely connected, but how these are also connected to the concept of resilience.
Resilience is identified as the ability of a system to respond to certain shocks and quickly return to a normal condition. Graziano, (2014) affirm: "Resilience, i.e. the ability of any organism, individual or organization to face and recover from the effect of an unsettling action, is opposed to vulnerability, i.e. those elements that favour the likelihood that a system suffers from damage" (pp. 3-4).
Promoting adaptation and mitigation in planning tools also means making the territories more resilient, precisely by increasing their adaptability.
This vision is presented by Brunetta and Caldarice (2017) who affirm that "The metaphor of resilience entered the field of urban and territorial planning at the end of the last century, as a concept to activate policies for sustainable and inclusive cities to face the growing number of natural and anthropic risks".
In the light of what has been analyzed, it is possible to deduce what are the roles of planning in the environmental challenges of climate change.
Previously it has been stated that one of the tasks of planning is to promote the integration between adaptation and mitigation policies. Another planning task is to promote multi-scalar approaches, according to Brunetta and Caldarice guaranteeing a "greater coordination and greater negotiation both between the levels of government of the territory and between the large number of actors involved, providing for the rethinking of the past approaches and providing new ones, in order to create new responses to climate challenges " (pp. 135-139).
Therefore, planning has the task of promoting multi-scalar and flexible approaches in order to ensure governance that can make the climate change planning process more open. It must also encourage more the development of bottom up approaches and must involve the contextual knowledge of the communities. This latter action would not only increase the participation of private citizens, but would also increase their specific sensitivity towards the issue of the impacts of climate change and how to fight them through the territorial planning.
It is clear that planning plays a role of utmost importance in the topic of climate change. At the same time, however, it is clear that planning cannot be successful on its own, Brunetta and Caldarice affirms that: "must be part and engine of the adaptation process for resilience-oriented territories" (pp. 135-139).
In the light of what emerges from the debate, it is therefore believed that promoting a strong integration between mitigation and adaptation policies is crucial. Encouraging the integration of these policies within the territorial and urban planning tools would make the territories more resilient and therefore more adaptive to the negative effects of the ongoing climate changes. Analyzing the local and regional planning tools, which are well defined as they have already been institutionalized for some time, it is more complex to introduce the themes of adaptation and mitigation within them.

Thus was born the need to find an administrative level of planning that can better respond to current climate changes. Thus was born the hypothesis that metropolitan cities could optimally integrate these policies within their planning tools as they are not yet well defined and in the planning phase.
The following paragraphs will analyze the new Italian metropolitan entities, paying attention to the legislation, the territorial differences, the planning tools introduced with the Delrio law.
Through the analysis of metropolitan planning tools, it will be possible to understand even if metropolitan cities already deal with the issue of climate change and how.

2 Metropolitan Cities in Italy

In Italy, precisely in 2014, metropolitan cities were established with Law No. 56. The law, better known as the Delrio Law, defines the new vast area bodies, endowing them with specific planning jurisdiction, the Delrio law establishes fourteen metropolitan cities, ten for ordinary statute regions and four for special statute regions.
The Delrio law entrusts the creation of new metropolitan entities to regions with special statutes. The Sicily region and the reason Sardinia have already provided for the establishment of metropolitan cities in their territories. Instead, in Friuli-Venezia Giulia no phase of institution has been started but the region has delegated this process to the autonomy of the capital city.
At the end of the establishment process, the cities of Bari, Bologna, Cagliari, Catania, Florence, Genoa, Messina, Milan, Naples, Palermo, Reggio Calabria, Rome, Turin and Venice are metropolitan cities.

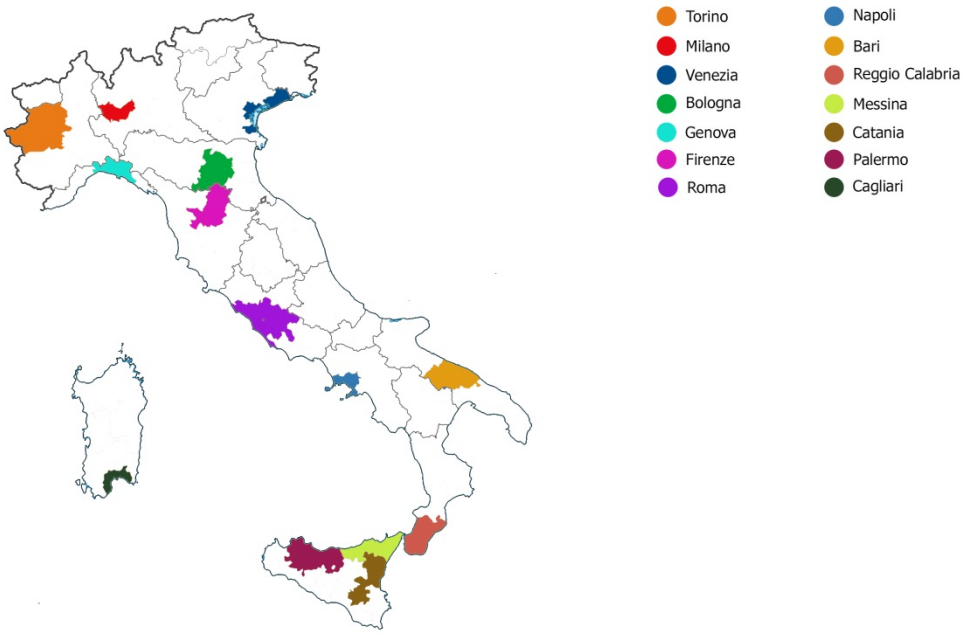

Fig. 1 Metropolitan Cities in Italy

The main functions concern the strategic development of the metropolitan area and general territorial planning. In this regard, the law provides for the creation of two new instruments: the metropolitan strategic plan and the general territorial plan.
To date, however, only strategic plans and programs are drawn up. In fact, as regards general territorial planning, the new bodies have kept in force the old provincial territorial coordination plans. Only the metropolitan city of Milan has drawn up a document of guidelines for the drafting of the general territorial plan. This happened because Law 56/2014 confers greater importance to strategic planning.

According to the Delrio law, the metropolitan strategic plan turns out to be the fundamental document for new metropolitan entities. In Article. 1 paragraph 44 the first function of the Metropolitan City is to adopt and update the metropolitan strategic plan annually. Within the metropolitan strategic plan, general, sectoral and cross-cutting objectives are defined for the development of the entire metropolitan area. This importance given to the metropolitan strategic plan seems to overshadow the metropolitan territorial plan, making it appear almost subordinate to the metropolitan strategic plan. This vision is presented by De Luca and Moccia (2017), who say that "we must not complain if the PTM is subordinate to the PSM" (pp.17-18).

Analyzing the two new metropolitan instruments, we can notice how the metropolitan strategic plan can be recognized as an operational tool. It indicates the general, sectoral and transversal objectives for the development of the entire metropolitan area. This characteristic configures the strategic plan as a performance plan. On the contrary, the general territorial plan is outlined as a tool with a structural plan value (Gastaldi & Zarino, 2015), which indicates and configures the fundamental structure of the metropolitan territory.

Although the law n.56 / 2014 proposes a single planning system for the metropolitan bodies, we can affirm that metropolitan cities present substantial differences between them from different points of view. The first difference is represented by the territorial dimension.

The Delrio law establishes that the territory of metropolitan cities coincides with that of the former provinces. But the question of the perimeter is a problem on which we have been debating since the time of the law n. 142/1990 concerning the establishment of the Metropolitan Areas, in fact never implemented. By making the metropolitan territory coincide with the provincial one, Law 56 does not solve the perimeter problem at all. According to De Luca and Moccia (2017), an approach that would guarantee greater flexibility in the choice of the territorial dimension of each metropolitan city, would have been desirable.

Another big difference between the bodies, concerns the demographic dimension. Analyzing the data on the population, it can be seen how have 431,037 inhabitants of the metropolitan city of Cagliari and 4,348,736 of those of Rome.

Not only territorial and demographic differences, but also economic and employment ones mark the strong distance between metropolitan cities.

Analyzing the data on taxable income, the differences are accentuated: the richest metropolitan city is Milan with € 17,802 of taxable income per capita; the city with the lowest data is that of Catania with € 7,441.

Through this analysis, it emerges that six metropolitan cities, namely Naples, Reggio Calabria, Palermo, Bari and Cagliari, are below the Italian average.

According to Battarra et al. (2018), the analysed indicators "reveal a non-homogeneous image for the different geographical areas of the country" (pp. 83-107).

Despite these substantial differences, the Delrio law acknowledges to metropolitan cities the strategic role of driving the economic recovery of the country, this vision is presented by De Luca and Moccia (2017).

Metropolitan bodies are in fact considered the pivot of national economic development, capable of establishing relationships even beyond the national border to attract investments in their territories. Sbetti (2017) affirms that: "For this reason, they must not work in a competitive perspective, but in cooperation, by creating networks of local and international relationships, improving them more and more." (pp. 269- 270).

Because of metropolitan cities are intermediate level entities, these are also the most suitable for carrying out this task. According to this vision, therefore, the Italian metropolitan cities are not in competition with each other, but them must work with a view to cooperation, thus guaranteeing the development of the entire national territory. With this in mind, the INU has developed the "Country Project". It aims to break down the differences and competition between the various territories. It also reasons on a polycentric vision of metropolitan cities, where each territory contributes to the growth of the nation according to its resources and specificities.

As claimed by Viviani (2017) Metropolitan cities can therefore be considered as "pins of a reorganization" (pp. 269-270) in different areas of planning: economic, environmental and services management.
However, since metropolitan territories are plagued by major administrative, legislative and financial problems, the implementation of this vision is complicated. The financial problem is the most decisive one, since often the financial resources available to metropolitan bodies are too scarce.
Despite the differences and problems presented, metropolitan cities represent a great opportunity for the growth of the entire nation. It is therefore essential to encourage their development that is such as to make the visions described concrete.

2.1 The role of Italian metropolitan cities in fighting climate change

The supranational territorial government policies and treaties (and the national adaptation strategy itself), identify the municipal level as the most suitable to combat climate change. Cities are considered as the most prominent actors in any strategy against climate change, Zanchini et al. (2019) presented this vision in the report for Legambiente (pp. 11-13).
Also, at the European level, metropolitan cities are recognized as driver of adaptation strategies. In the last years a large number of projects are developed for Metropolitan level. Italian metropolitan cities joined to different project as showed in the table below.

Metropolitan Cities	Project	Adaptation	Mitigation	Integrated approach
M.C. Bari	Chance for change		x	
	Covenant of Mayors			x
	Biodiversity, resilience and climate change	x		
M.C. Bologna	BlueAP	x		
	Covenant of Mayors			x
M.C. Cagliari	Master Adapt			x
	Covenant of Mayors			x
M.C. Catania	Interreg GreenIT		x	
	Covenant of Mayors			x
M.C. Firenze	Covenant of Mayors			x
M.C. Genova	Covenant of Mayors			x
M.C. Messina	LIFE Call 2016			x
	Covenant of Mayors			x
M.C. Milano	Master Adapt			x
	Life Metro Adapt	x		
	Covenant of Mayors			x
M.C. Napoli	Covenant of Mayors			x
M.C. Palermo	Covenant of Mayors			x
M.C. Reggio Calabria	Covenant of Mayors			x
M.C. Roma	ENERJ		x	
	Covenant of Mayors			x
M.C. Torino	Seap Alps		x	
	Covenant of Mayors			x
M.C. Venezia	Master Adapt			x
	Veneto Adapt			x
	Seap Alps		x	x
	Covenant of Mayors			x

Tab. 1 European projects and climate change policies approach

As Tab. 1 shows, all metropolitan cities signed the "Covenant of Mayors", an important European cooperation agreement. This agreement aims to edit a voluntary Plan that can increase energy efficiency and the use of renewable energy.

These are voluntary agreements signed between the mayors and the EU to increase the de-carbonization processes and the levels of urban resilience. This occurs through the drafting of the so-called PAESs and PAESCs (Action Plans for Sustainable Energy, and Action Plans for Sustainable Energy and Climate).

The report of ARUP, Smart Actions in Italian metropolitan cities (2013) affirm that thanks to the signature of Covenant of Mayors "the metropolitan cities, are the local authorities that can make the difference in the pursuit to reduce GHG emissions" (p. 20). In addition to the Covenant of Mayors there are other European projects to which metropolitan cities adhere.

In June 2017, metropolitan cities signed an important document - the Bologna Charter - which is the first to place the metropolitan level as the protagonist of environmental protection, sustainable development and the fight against climate change consequently.

Each metropolitan city undertakes to achieve the eight macro-objectives of sustainability contained in the Bologna Charter to respond to the 2030 Agenda, implementing different actions and strategies based on its territorial context.

The macro objectives of Bologna Charter are: 1) Circular economy; 2) Sustainable use of the soil, solutions based on natural processes; 3) Adaptation to climate change and reduction of the risk of disasters; 4) Energy transition; 5) Air quality; 6) Air quality; 7) Ecosystems, urban greenery and biodiversity protection; 8) Sustainable mobility.

Actions and strategies are identified in the metropolitan strategic plans and in strategic documents that the various metropolitan entities have drawn up.

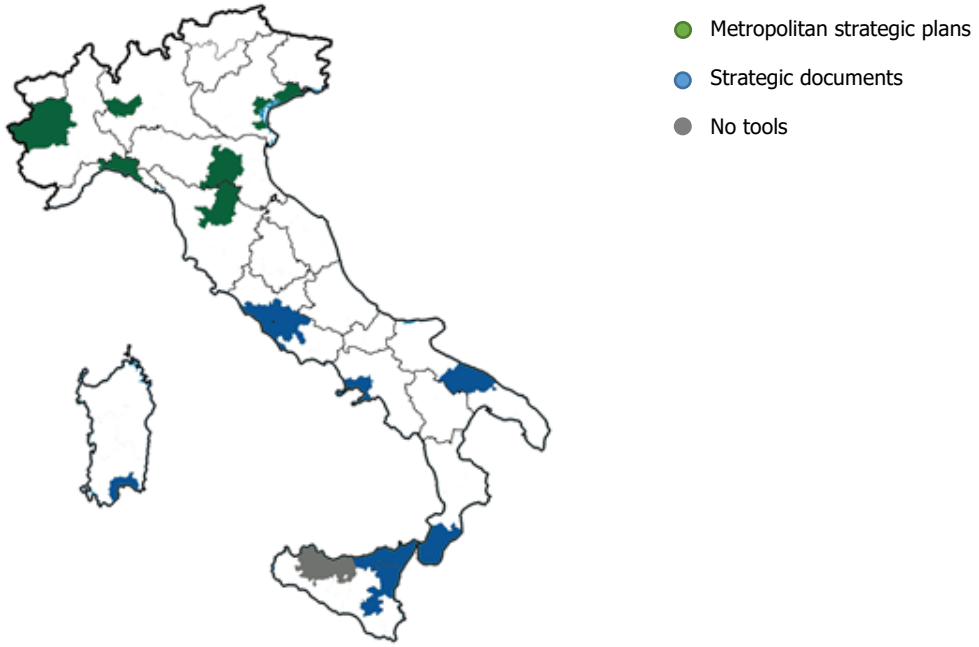

Fig. 2 Metropolitan strategic plans and strategic document

By analyzing the metropolitan strategic planning tools, it was possible to identify those put in place by each body to respond to the demands placed on climate change policies.

The table below shows objectives and actions present in metropolitan strategic planning tools.

It is noted that the objectives, actions and strategies of metropolitan bodies often coincide, even if each metropolitan city will have to contextually address the specific problems that afflict its territory.

The goals of the strategic plans deal with different problems concerning climate change, including: sustainable mobility, energy efficiency, various types of risk triggered by climate change, urban greenery and safeguarding biodiversity. These are just some of the objectives in common between the different tools; each one then focuses on specific goals in relation to the territorial context, which may concern for example: combating heat islands, creating sustainable tourism, increasing metropolitan greenery.

Metropolitan Cities	Bologna Charter	Metropolitan strategic planning tools	Objectives	Actions
M.C. Bari	Joined	Pact for the development of the Metropolitan City	Natural heritage conservation, Safeguard landscape-flora-fauna, Safeguarding biodiversity	Soil defense, Remediation, Pollution Prevention/Control, Reduction of atmospheric and noise emissions, Protection of water resources, Waste disposal, Alternative energy
M.C. Bologna	Signed	Strategic Plan	Modification of the urban fabric, Respond to climate change, Damage reduction, Sustainable mobility, Objective transposition in local plans	Water management, Permeability increase, Multi-objective interventions, Hydrographic network
M.C. Cagliari	Joined	Pact for the development of the Metropolitan City	Hydrogeological risk mitigation, Safeguarding biodiversity Landscape enhancement, Integrated / sustainable tourism Accessibility of environmental interest areas, Cycle-pedestrian paths Green infrastructure	-
M.C. Catania	Signed	Strategic planning document Metropolitan City	Seismic risk, Hydrogeological risk, Radon risk, Water protection	Territorial security, Environmental monitoring, Mapping, Sensitization, Rational exploitation, Risk protection
M.C. Firenze	Signed	Strategic Plan	Safeguard / enhancement of the agro system, Green / blue infrastructure, Metropolitan forest	Metropolitan Agricultural Parks, Identification / Promotion of green-blue, infrastructures, Metropolitan forest,
M.C. Genova	Joined	Strategic Plan	Resilience	-
M.C. Messina	Joined	Strategic Document	Climate challenges, Climate rise, Reduce emissions	Environmental monitoring, Congestion reduction, Alternative energy, Participation
M.C. Milano	Signed	Strategic Plan	Energy efficiency, Sustainable mobility, Resilience, CO_2 reduction, Waste management, Urban greening Air quality	Vehicle traffic reduction, Technological innovation Sensitization, Air quality improvement, Pollution abatement

Metropolitan Cities	Bologna Charter	Metropolitan strategic planning tools	Objectives	Actions
M.C. Napoli	Joined	Urban development strategy Metropolitan City	Sustainable mobility, Energy efficiency, CO_2 emissions reduction	Low impact transport, Mobility sharing, Reduction of energy consumption, Renewable energies. Reduction of emission
M.C. Palermo	Joined	-	-	-
M.C. R. Calabria	Joined	Strategic document for sustainable urban development	Addressing climate challenges	Photovoltaic systems Energy saving, Public lighting, Susble mobility
M.C. Roma	Joined	Guidance document to the 2016 strategic plan	Green infrastructure, Energy efficiency, Heat islands, Rain collection	Green infrastructure, Biodiversity conservation, Mitigation Recovery of green areas, Adaptation / Mitigation / Resilience of Climate change
M.C. Torino	Signed	Strategic Plan	Environmental resilience / sustainability, Risk / Vulnerability, Energy consumption	Integrated photovoltaic systems on public roofs, Public lighting improvement works through the use of technologies, incentives for ecological public transport.
M.C. Venezia	Joined	Strategic Plan	Hydrogeological instability, Urban heat islands, Landscape quality, Sustainable tourism, Energy saving, Susble mobility	Monitoring, Participation, Energy Performance

Tab. 2 Objectives /actions in metropolitan strategic planning tools

Through a more thorough investigation of the strategic plans, it was possible to derive the actions undertaken by each Metropolitan City to achieve the objectives set by the plan. Before analyzing specifically some of the most recurrent actions, it is necessary to report their absence both for the CM of Palermo, which does not have any metropolitan planning tool, and by the CM of Cagliari, which is not equipped with Strategic Metropolitan Plan (PSM) but possesses the "Document for the development of the Metropolitan City ", in which only the objectives are indicated.

The most recurrent actions are therefore monitoring actions and actions that aim at greater participation and awareness of the population. Similarly, actions for sustainable mobility, in the different forms, are widely explained: they aim to reduce vehicular traffic, to achieve a new integrated approach model between tickets and single fares, to the development of soft mobility and car sharing and Finally, to the promotion of greater use of ecological public transport.

Attention to policies regarding sustainable traffic is constantly increasing; efforts are being made to develop approaches based on the correct use of resources to reduce energy consumption and polluting emissions. Fistola and La Rocca (2018) state that: "The rising attention of urban policies towards sustainable mobility is strongly linked to the need to affirm a model of development based on the correct use of resources (including water, energy and soil) to face environmental exigencies and to reduce energy consumption and the emission of pollutants produced by vehicles" (pp. 301-322).

Further actions also concern the issue of energy efficiency, such as, for example, energy efficiency measures or activities to promote savings and the conscious use of energy.

Furthermore, most of the Metropolitan Cities aim at an increasing use of alternative energy sources. Considering the theme of green, MCs organize actions aimed at the creation of metropolitan parks, as at the implementation of green and blue infrastructures and the development of the metropolitan ecological network. An interesting case is that of the MC of Florence, which also promotes the development of particular metropolitan-level agricultural parks. Another important issue dealt with in the metropolitan strategic planning tools concerns the adaptation to climate change through actions aimed at reducing risk, increasing resilience and territorial security and managing surface waters. Thanks to the analysis of the actions, it was possible to identify some best practices implemented by the metropolitan cities most involved in achieving the listed goals. The strategies and actions identified in strategic metropolitan tools have been compared with the eight macro-objectives of Bologna Charter.

The table 3 illustrating the comparison of the objectives of the strategic plans with the eight fundamental points of the Bologna Charter.

The result of comparison shows that the most active metropolitan cities in fighting climate change are Bologna, Milan and Venice. The great effort of the metropolitan city of Bari should also be mentioned.

The other metropolitan cities are on average involved in dealing with climate change issues, with the exception, however, of the metropolitan cities of Cagliari and Palermo which are completely inactive in this regard.

The points of the Bologna Charter most dealt with in the strategic planning tools are:

- Sustainable use of the soil;
- Adaptation to climate change;
- Energy transition;
- Metropolitan green;
- Sustainable mobility.

Each Metropolitan City aims to achieve these objectives by implementing different actions and strategies based on its territorial context. The analyzes carried out show, however, that some actions are recurrent in multiple metropolitan territories, such as the integrated management of waste, the integrated water service and transport system. In relation to the issue of climate change, which corresponds to point three of the Bologna charter, it can be said that all metropolitan entities aim to reduce risk and vulnerability and increase the resilience of their territories.

Also with regard to the issue of the energy transition, point two of the Bologna charter, it is possible to find similar objectives for some Metropolitan Cities including Bari, Messina, Milan, Naples, Rome, Turin and Venice; in fact, they all have energy efficiency objectives for both civil and production buildings.

Metropolis greenery is another theme widely dealt with in metropolitan strategic plans, especially through actions aimed at greater development of green / blue infrastructures and the management and creation of parks on a metropolitan scale.

The creation of ecological networks through the development of green infrastructures is also of great importance. They connect the various green areas present in the metropolitan territories so as to create a real green system of metropolitan scale. The points of the Bologna Charter least dealt with in the metropolitan strategic plans are those relating to the issue of waste, soil protection and air quality.

The lack of attention from many metropolitan entities highlights the work of the Metropolitan Cities of Bologna, Milan and Venice even more. In fact, in relation to the theme of waste, they propose integrated management on a metropolitan scale. As far as the issue of soil protection is concerned, the three metropolitan cities have different objectives. However, their application to this theme must also be pointed out, especially of the Metropolitan City of Bologna. The topic of air quality is not dealt satisfactorily within the metropolitan strategic tools, except for the Metropolitan Cities of Bari, Milan, Naples, Venice and Bologna.

Finally, also as regards the theme of water quality, the Metropolitan Cities of Bologna, Milan and Venice are to be taken as good examples; in this case too, they aim for integrated management on a metropolitan scale.

2.2 The study of strategic metropolitan plan of Bologna

In the Metropolitan Strategic Plan of Bologna 2.0 it is stated that "*the commitment to sustainability is crucial for the improvement of environmental quality, the social well-being of individuals, economic and employment opportunities*". It does not just assume the objectives of the Bologna Charter, but it declines them differently by adapting them to its own objectives.

Metropolitan cities	**M.C. Bari**	**M.C. Bologna**	**M.C. Cagliari**	**M.C. Catania**
Sustainable land use	Soil defense	Perm., Urban margins, Territorial structure Urban regeneration, Different use	-	Mapping
Waste	Waste control	Integrated mgmt.	-	-
Adaptation CC	Environmental Planning, Environmental Education	Hydrographic network Drainage Lamination	-	Territorial security, Environmental Monitoring, Awareness, Risk protection
Energy transition	Alternative energy, Concessions for power lines	Energy efficiency	-	-
Air quality	Prevention, Control pollution, Emission reduction	Prevention measures, Emergencies measures, Ecological Sundays	-	-
Water quality	Water protection Waste Purifiers Monitoring	New water mgmt.. model	-	Rational water exploitation, Prevention of degradation risk
Urban green	Safeg. Biodiversity Parks, Woods reserves	Green areas increase, Green infra. Enhance ecosystem. serv	-	-
Sustainable mobility	-	Public transport, Private transport, Cycle mobility	-	-

Tab. 3a Comparison of the objectives of the strategic tools with the eight fundamental points of the Bologna Charter

Metropolitan cities	**M.C. Firenze**	**M.C. Genova**	**M.C. Messina**	**M.C. Milano**
Sustainable land use	-	-	-	Free soil protection Reuse policies
Waste	-	-	-	Integrated mgmt.
Adaptation CC	Hydrographic network protection	Integrated Approach, Participation, Monitoring	Environmental Monitoring, Participation	Sensitization Drainage River works
Energy transition	-	-	System integration Participation	Energy efficiency, Innovation Sensitization
Air quality	-	-	-	Air quality improvement Felling pollution

Metropolitan cities	M.C. Firenze	M.C. Genova	M.C. Messina	M.C. Milano
Water quality	Water protection	-	-	Integrated mgmt.
Urban green	Metropolitan agricultural parks Green and blue infrastructure Metropolitan forest	-	-	Integrated mgmt.
Sustainable mobility	-	-	System integration Participation	Traffic reduction, Sustainable mobility

Tab. 3b Comparison of the objectives of the strategic tools with the eight fundamental points of the Bologna Charter

Metropolitan cities	M.C. Napoli	M.C. Palermo	M.C. R Calabria	M.C. Roma
Sustainable land use	-	-	-	-
Waste	-	-	-	-
Adaptation CC	Overheating Adaptation Impact reduction	-	-	Adaptation Mitigation Resilience
Energy transition	Reduction of civil/industrial consuption Renewal energies	-	Photovoltaic systems Energy saving Advertising lighting	Energy efficiency
Air quality	Reduction of emissions	-	-	Air quality improvement Felling pollution
Water quality	-	-	-	-
Urban green	-	-	-	Green infra. Biodiversity Mitigation Green areas increse
Sustainable mobility	Sustainable mobility, Sharing mobility	-	Sustainable mobility	-

Tab. 3c Comparison of the objectives of the strategic tools with the eight fundamental points of the Bologna Charter

Metropolitan cities	M.C. Torino	M.C. Venezia
Sustainable land use	-	Monitoring
Waste	-	Integrated mgmt. Alternative energy
Adaptation CC	-	Hydrogeological risk Coastal erosion Monitoring Participation

Metropolitan cities	M.C. Torino	M.C. Venezia
Energy transition	Photovoltaic systems Energy saving Advertising lighting	Energy efficiency
Air quality	-	Civil/Industrial emissions reduction
Water quality	-	Integrated mgmt..
Urban green	-	Ecological networks Green infra. Lagoon-marine ecosystem Biodiversity
Sustainable mobility	Sustainable mobility	Sustainable mobility

Tab. 3d Comparison of the objectives of the strategic tools with the eight fundamental points of the Bologna Charter

With reference to the first point, that is: "Sustainable use of the soil and solutions based on natural processes", the issue of soil consumption is addressed, which is often linked to the theme of urban regeneration and redevelopment. The metropolitan strategic plan deals with the issue of land use as one of the fundamental elements for planning choices for the metropolitan area. In fact, the aim is to reduce land consumption within the territory by 20% by 2020, by means of policies regarding both new expansions and already consolidated fabrics.

As regards the new expansions, particular attention is paid to the design of the urban margins. The aim is also to consolidate the existing territorial structure to avoid the creation of new residential neighborhoods in contexts without services, accessibility and connections with the transport network. The policies regarding consolidated urban fabrics aim at urban regeneration and requalification; in fact, they provide for an increase in urban and environmental quality through the development and expansion of the services already present within them.

As regards the second point of the Bologna Charter, "development of the circular economy in relation to the topic of waste", the metropolitan strategic plan does not provide objectives in line with those of the analyzed document. However, it aims to make the Metropolitan City of Bologna a regional hub for waste management, aiming to achieve high standards of ecological and environmental quality.

The metropolitan strategic plan, moreover, in relation to the third point of the Bologna Charter, i.e. objectives regarding adaptation to climate change and risk reduction, entrusts metropolitan territorial plan with the role of coordinator in the development of the different local plans, for the creation of an integrated planning that aim to increase territorial security.

The energy transition, on the other hand, does not seem to be dealt thoroughly by the metropolitan strategic plan. This could be explained by recalling that all the Metropolitan Cities have signed the Covenant of Mayors, through which they, including therefore the Metropolitan City of Bologna, undertake to increase the energy efficiency of the metropolitan area and to use an increasing number of renewable energy sources. Indeed, it is precisely through this pact that Action Plans for sustainable energy are developed.

Moving on to the fifth objective, Air Quality, we read how the variation of the metropolitan strategic plan in this case conforms to the measures indicated by the Regional Air Plan, which provides for two types of actions: prevention and emergency.

The prevention measures, applied throughout the metropolitan area, limit the circulation of the most polluting vehicles and also provide for the creation of "ecological Sundays".

Emergency measures, on the other hand, are adopted when the limit imposed by the Pm10 law is exceeded; therefore, they include more restrictive policies such as the 1°C reduction in space heating or a ban on the use of wood biomass heat generators.
On the other hand, policies regarding water quality and the water service system do not appear within the Metropolitan Strategic Plan.
A point on which the Metropolitan Strategic Plan focuses largely is, instead, point seven of the Bologna Charter, within which the objectives regarding the protection of ecosystems, urban green areas and the protection of biodiversity are discussed. The first theme, namely that of safeguarding ecosystems, defines actions aimed at increasing safety and enhancing eco-systemic services, such as the increase in green infrastructure. These objectives are then declined by the PTM in relation to each municipality in the metropolitan area.
As regards the issue of urban green, the Metropolitan City undertakes to increase the green endowment by 2030, raising the standard to 45 m^2/inhabitant.
The last goal of the Bologna charter focuses on sustainable mobility; fundamental theme for Metropolitan Cities and their development. In fact, more and more attention is paid to the issue of transport. The Metropolitan City of Bologna has developed the "Integrated Mobility Plan", which focuses not only on travel but also on increasing the quality of life throughout the metropolitan area. The aim of the plan is to achieve a 'virtuous balance that knows how to "balance the efficiency and effectiveness of the mobility system"
In the mobility plan are identified as strategies:

- moving on foot as a first choice;
- the bicycle as a competitive mobility choice;
- better dissemination, consistency, usability and frequency of public transport;
- reduced and sustainable private mobility;
- promotion and coordination of quality and low impact logistics.

The reduction of private traffic by favoring the use and development of public transport will only be possible if public transport can provide a real alternative to medium-long distance travel and with a high standard of reliability, efficacy and efficiency. In this context, a fundamental role is played by the Metropolitan Railway Service. One of the most effective strategies is to create an integrated service between the Metropolitan Railway Service, the suburban bus service and the tram and city bus system.
In order to pursue this strategy, the PSM identifies as an action the establishment of an integrated ticket that covers all daily journeys with the same travel document, regardless of the company providing the service. It is therefore important that the network of extra-urban buses increases the capillarity of the service, while as regards transport in urban air, the tramway line is recognized as the main connection, therefore it will be necessary to respond to the growing demand for the service with technologically advanced solutions.
Another solution that aims to a technological advancement in the transport sector is the introduction of a "control room" which will take care of planning all the public transport services, in order to coordinate the different modes, develop and introduce an integrated tariff system, strengthen the policies of intermodal nodes and define their quality standards and their monitoring.
As previously mentioned, the Urban Plan for Sustainable Mobility provides for the reduction of private mobility by road, promoting the development of infrastructural solutions for pedestrian and cycling mobility. In order to do that, it proposes actions that aim to make moving on foot easy and safe, providing pedestrians with quality spaces and also promoting forms of pedestrian tourism. The purpose is also to develop the network of cycle paths in an optimal way, so as to achieve higher levels of use (nowadays they are around 5%, given in line with that of the other Metropolitan Cities).
In conclusion, it can be said that the Metropolitan Strategic Plan of the Metropolitan City of Bologna optimally integrates many of the points of the Bologna Charter. There is a high degree of attention also towards other issues, with the exception of shortcomings regarding the strategies on water quality and management and the

safeguarding of biodiversity. The Metropolitan City of Bologna can, therefore, be considered a good example of development both as a second-level body and as regards the approach used towards climate change issues. In fact, in addition to being involved from different points of view in contrasting the effects of climate change, the body also uses a planning paradigm that aims at integrated planning between different sectors.
In summary, the policies regarding this topic, undertaken by the metropolitan body, aim above all at:

- Waste management;
- Energy saving;
- Reduction of emissions;
- Smart mobility;
- Water management.

As highlighted, the Metropolitan City also participates in community-level projects. This indicates a multi-scalar vision of policies for climate change that aims to increase the participation of individuals in projects relating to climate adaptations, so as to intervene on the forms of partnership.
The tables 4 and 5 highlight the objectives and strategies of the metropolitan strategic plan in relation to the eight points of the Bologna Charter.

Metropolitan City of Bologna	Objectives	Strategies
Sustainable land use	New expansions, Consolidated fabrics, Reduction of soil consumption	Urban redevelopment, Strengthen the territorial structure existing 20% reduction of soil consuptiom Urban Regeneration Urban/Envirnomental quality
Waste	Integrated service	
Adaptation CC	Integrated risk planning	Hydrogeological/earthquake Safety, Integrated local adaptation plan
Energy transition	Energy efficiency	Energy saving
Air quality	Prevention Measures Emergency Measures	Traffic Limitation, Ecological Sundays, urban heat reduction, Don't use Biodiversitymass generators
Water quality	New mgmt. model	Rainwater purification
Urban green	Green areas increase, Territorial security, Enhance ecosystem serv.	Urban green area increase, Green infra., Enhance ecosystem serv
Sustainable mobility	Integrated plan Public transport, Private transport, Cycle transport, Sharing mobility	Integrated tickets, installation of control room, Alternative transport Awareness campaign, Cycle path development

Tab. 4 Objectives/Strategies comparison matrix PSM C.M. of Bologna - Bologna Charter

2.3 The case of the metropolitan city of Milan

The Metropolitan Strategic Plan, the main document of the metropolitan body, takes into account all the points of the Bologna map in detail. In relation to the first point of the Bologna Charter, that is "Sustainable use of the soil and solutions based on natural processes", the objectives of the PSM aim at limiting the consumption of soil through policies that aim at encouraging urban regeneration processes. Other important strategies employed are both the clearing of the buildings on "free grounds" and that relating to the reuse of the building heritage. The former is promoted through tax measures which make it more convenient to invest in already built ground; for the second strategy, on the other hand, policies are envisaged for the recovery of existing urban fabrics and situations of degradation, always with a view to reducing soil consumption.

With regard to the development of a circular economy connected to the issue of waste, the Metropolitan City of Milan, through the Metropolitan Strategic Plan, aims to build an integrated approach in the management of this service through the establishment of the ATO (Optimal Territorial Area) and the identification of the managing body that will deal with the preparation of the waste management plan. The Metropolitan Strategic Plan also provides policies to raise awareness among the population in relation to this issue.
In the case of the Metropolitan City of Milan, the issues of energy and air quality are often treated in an integrated way for the issue of reducing emissions, both for civil and production buildings.
In relation to the issue of air quality, the institution aims to establish a metropolitan working group with the goal to undertake actions aimed at:

- measures to contain vehicular traffic by promoting and encouraging public transport and other more sustainable forms of mobility;
- support for technological innovation for green economy companies;
- support to municipalities for the submission to state and regional European Calls;
- awareness of the population towards environmentally friendly behaviors in relation to travel, renewable resources, reduction of emissions, containment of waste production.

Air quality is addressed from the point of view of the integrated water service in relation to water purification systems. The Metropolitan City of Milan aims at an integrated management of the water service, through the establishment of a single ATO (Optimal Territorial Area) for the entire Metropolitan City which therefore gives the possibility of single management on a metropolitan scale. This action brings significant economic and financial advantages, allowing the integration of networks and tariffs so as to define a plan for the metropolitan city area that overcomes the current fragmentation in relation to the issue of water use.
The seventh point of the Bologna Charter, namely the preservation of ecosystems, urban green areas and the protection of biodiversity, is elaborated with regard to the issue of protecting ecosystems, the Metropolitan City aims to improve the balance of the ecosystem but without specifying the actions and policies to be undertaken.
Much more attention is instead paid to the topic of the green areas: the Metropolitan City of Milan defines a metropolitan-scale policy for the management of green areas, both in reference to the supra-municipal and urban parks, thus building an ecological network that aims to consolidation and enhancement of the upper Milanese area. Metropolitan parks will also be connected to the urban green system through the enhancement of green infrastructure. The protection of biodiversity is instead pursued both on small portions of territory, going to rethink the parks network, and on large portions through the rethinking and strengthening of the metropolitan agriculture system.

Metropolitan City of Milan	Objectives	Strategies
Sustainable land use	Existing urban fabrics, Land use, Urban Regeneration	Tax policies Intervention on occupied soils Reuse policies
Waste	Integrated planning service, Flow mgmt.	Installation ATO, Waste mgmt. Plan, Restraint of Waste production
Adaptation C.C.	Resilience, Hydrogeological works	Intervention on river system
Energy transition	Alternative Energies Building redevelopment	Tech. Innovation, Energy efficiency, Cost restraint, Monitoring
Air quality	Reduction of emissions	Promotion of electric/low impact vehicles, Sensitization

Water quality	Integrated water service	Installation ATO, Metropolitan mgmt.. Overcoming fragmentation. Integrated rates
Urban green	Metropolitan green mgmt, Ecosystem balance, Protection of Biodiversity	Ecological. Network, Green network consolidation, Urban Park connection, Territorial recomposition Metropolitan agriculture
Sustainable mobility	Modal exchanges, Infrastucture development, Public transport, Private transport, Cycle transport, Sharing mobility	Integrated tickets Urban/Interurban services integration Road system Rationalization Road safety, Modal exchanges, Cycle paths

Tab. 5 Objectives/Strategies comparison matrix PTM C.M. of Milan - Bologna Charter

The Metropolitan Strategic Plan also deals with the issue of sustainable mobility by pursuing different strategies to improve and enhance the quality and efficiency of the different types of mobility with the infrastructure planning through interventions to complete and upgrade the existing ones, especially by intensifying the modal interconnections, paying particular attention to the movements defined "of the last mile". The actions relating to public transport aim at a reorganization of fares and a unification of travel tickets. The principle adopted by the Metropolitan City is that of freedom and facilitation to move within the entire metropolitan area, increasing the exchanges between urban and extra-urban transport; to achieve this result, an integrated management of the transport service is aimed.

The Metropolitan Strategic Plan also deals with the issues of private mobility, paying particular attention to promoting shared mobility, and pedestrian and bicycle mobility, defined as "gentle". The policies regarding private mobility will be aimed at rationalizing the road system, avoiding new infrastructures on the territory. It also aims to increase road safety for both motorists and pedestrians. As far as soft mobility is concerned, policies are undertaken that aim at maximizing intermodal exchanges by increasing the supply of services.

2.4 The case of the metropolitan city of Venice

The Metropolitan Strategic Plan of the Venetian Metropolitan City focuses on the theme of land use through actions aimed at limiting soil consumption, with intervention on the concentration and reorganization of the settlement system. In other words, the aim is to create a model based on densification that maintains a multipolar character.

Metropolitan City of Venice	Objectives	Strategies
Sustainable land use	Land use restraint, Vertical cities	High densification settlement model, Zero Soil consumption, Overbuilding reduction, Permeability, Reconversion/reuse brownfields
Waste	Integrated waste mgmt. services, Green economy, Alternative energy	Integrated waste mgmt., Circular economy, Recycling, Venice Environmental Council installation

Adaptation C.C.	Hydrogeological risk reductio, Coastal erosion risk reductio, MOSES mgmt.	Coastal erosion prevention, Urban environmental mgmt., Risk reduction, Surface water mgmt., Coordination/Control, MOSES
Energy transition	Energy efficiency	-
Air quality	Emission Reduction, Coordination local plans	Protection plan, Emission reduction
Water quality	Metropolitan mgmt.	Installation ATO, Metropolitan mgmt.
Urban green	Ecological networks, Green infrastructure Lagoon-marine ecosystem protection Lagoon-marine ecosysistem development Ecological networks, Biodiversity protection	Containment Landscape fragmentation containment, Naturalization, European projects partecipation
Sustainable mobility	Infrastructure Implementation Transports efficiency increase	Accessibility, Integrated ticket/fares, Integrated mgmt., Cycle paths implementation Pedestrian routes

Tab. 6 Objective/Strategies comparison matrix PSM C.M. of Venice - Bologna Charter

The Metropolitan City aims to drastically decrease land use, developing vertical cities and promoting the reuse of existing spaces. Other objectives concern the de-cementing and the protection of permeability. By analyzing the point relating to the circular economy in relation to waste, the Metropolitan City aims to play a central role in the issue of waste management, now in charge of the Region, defining a new ten-year strategy that aims to create an integrated service for its management in order to overcome the fragmentary nature found in the current system.

The plan therefore aims to create a green economy for the recycling and creation of thermal energy, to develop circular economies related to waste management, promoting a reduction at source, separate collection and recycling.

The issue of climate change adaptation is central to the Metropolitan Strategic Plan especially as regards risk management. The Metropolitan City concentrates its actions in contrasting various forms of risk but, in particular, the hydraulic one through the management of surface waters and the maintenance of the plants.

Another central point turns out to be the difficult issue of the MOSE (engineering work aimed at defending the city of Venice and the lagoon), the Venetian Metropolitan City acts as a central actor for the management of the issue by setting up a coordination and control table between the Metropolitan City and the municipalities concerned.

It should be remembered that the Metropolitan City of Venice, regarding the issue of the energy transition, is a signatory to the Covenant of Mayors and also addresses the issue of air quality through the preparation of the "Plan for the protection and restoration of the quality of the air" which coordinates the various local plans. The main objective is to reduce both civil and industrial emissions.

With reference to the management of water and its quality, the metropolitan body aims at an integrated management between subjects, of which it defines the organizational models.

Theme seven of the Bologna Charter, the protection of the ecosystem, urban green and biodiversity protection, is entirely taken up within the Metropolitan Strategic Plan of the Metropolitan City.
Concerning the urban green areas, the plan aims to create ecological networks and green infrastructures. In relation to the issue of safeguarding ecosystems, the objective is the protection and development of marine-lagoon ecosystems. The protection of biodiversity will instead be pursued through the development of ecological networks, the containment of landscape fragmentation and the improvement of ecological functions.
Also for this case study one of the most important topics of the Metropolitan Strategic Plan is the sustainable mobility. The objectives of the plan in relation to transport are many but they are going to conform to European ones, aiming at the development of a single European transport system. This plan has a fundamental importance in this area as it is a strong attractor of flows that the metropolitan transport system must be able to manage. For this reason, the aim is to create and strategically manage the interchange nodes, to better manage and maintain existing infrastructures and, finally, to create new roads to allow the reduction of congestion. The public transport service is therefore a fundamental point of the plan, which should become more accessible, effective and efficient through the unification of fares and travel tickets. In this direction an experiment has already been started with the creation of a single day ticket called "Metropolitan Venice 24", which allows an integration of land and water services.
The rail transport line is already well developed, with 9 railway lines; however, there are some single-track infrastructures that are no longer appropriate. Road transport, especially highway, given the particular morphology of the area, is the most difficult one to manage. For the development of new forms of mobility, the aim is to create new interchange nodes and to extend and complete cycle networks. The Metropolitan City obtains the mobility funds from the Suburban Call to which two projects were submitted, RE.MO.VE and MO.VES.
In conclusion, in light of what has been analyzed, we can reiterate the importance of water-related issues. Taking action on this characterizing element for the territory appears fundamental, especially with a perspective of reducing the risk of floods, floods or floods, Pellegrini (2017) states that: "Only a radical consideration of the topic of the water at different scales, in its various forms and in different parts of the enlarged metropolitan area, will be able to transform ever higher risks into complex and constructive opportunities. The huge investments intended to reduce the risks of flood, flooding, stagnation, reduction of water resources, including the arrangement of the Lusore basin between Porto Marghera and the still agricultural areas of Malcontenta, are among the main ones in the context of the Metropolitan City" (pp. 133-140).
The OECD has also declared the management of the river basin to be central so that functional strategies can be developed for the future of the metropolitan area. We therefore intervene both on the issue of hydraulic risk and on that of green for the activation of resilience processes that can bring greater security to the entire metropolitan area (Kamal-Chaoui & Robert, 2009).

3. Results and conclusions about the analysis of case studies

In the Italian context, therefore, there are many metropolitan cities that are increasingly committed to the different topics connected with the negative effects of climate change.
The analysis shows that Italian metropolitan cities are more active in fighting negative effect of climate change. The metropolitan cities are increasingly committed to the different themes such as sustainable mobility, energy efficiency, urban greening, safeguarding biodiversity and risk about climate change. The ones that are most involved in the new environmental challenges are those of Bologna, Milan and Venice. Especially regarding the development of a circular economy in relation to the issue of waste, sustainable mobility, the energy transition, adaptation at climate changes and urban greening. In these sectors, the three metropolitan cities

identified have implemented noteworthy actions, which could be used by other Italian metropolitan bodies as a guide.

With regard to the waste management there are clear differences between the three Metropolitan cities examined in this analysis

The theme of waste management is tackled in a virtuous way by the metropolitan cities of Milan and Venice, which deal with it in a very similar way. In fact, the two metropolitan cities will entrust waste management to a single body that will take care of the entire metropolitan area.

In the case of Milan, ATO (Optimal Territorial Area) Metropolitan City of Milan (Optimal Territorial Area) will be established, in Venice, however, it will be the Council of the Basin called "Venice Environment" to deal with the issue of waste. Therefore, it seems important to create an integrated management system for the waste management. Another common point among all the metropolitan entities analyzed is the sustainable mobility. This topic has been analyzed under all the different forms of transport present in the Metropolitan Cities, and the analysis focuses its attention in particular on public transport, on private road transport (in particular on the development of car sharing activities) and gentle mobility (pedestrian and bicycle).

As far as public transport is concerned, in all three case studies, actions are pursued that aim to create a single travel ticket and to integrate fares. Also, in this case, the development of an integrated public transport system appears fundamental.

In this way, the experiment carried out by the metropolitan city of Venice called "Metropolitan Venice 24" should be noted. This action involves the creation of a single day ticket called, in fact, "Metropolitan Venice 24", which allows an integration of ground and water transport and consequently of fares and tickets. Thanks to this, it turns out to be an excellent national model for the management of the public transport sector.

In relation to private transport, the most shared objective appears to be the reduction of home-work travel by means of private road transport, intervening on the quality and efficiency of public transport, especially rail type, which is configured as the pivot of the urban and extra-urban metropolitan mobility system, collaborates with the tram and bus system, which is particularly important for travel in the most central part of the Metropolitan Cities.

By analyzing the field of soft mobility, all Bodies aim at a greater strengthening and expansion of the cycle lane networks and modal interchange nodes, thus providing a real alternative to the use of private vehicles.

By reducing the use of private vehicles, and increasing the use of public ones, emissions would be reduced, thus causing an improvement in air quality.

In order to pursue adaptation and sustainability in the transport sector, metropolitan cities are also involved in the drafting of Urban plan for sustainable mobility (PUMS), urban plans for sustainable mobility.

By shifting attention towards the issue of energy transition, the metropolitan cities analyze the achievement of objectives in terms of larger use of renewable energy, the promotion of energy efficiency and the energy requalification of both public and private buildings. There are strategies that lead to lower energy consumption, awareness of the population to a more conscious use of the energy, the use, when possible, of alternative energy sources.

The three Metropolitan Cities also deal very actively with the issue of adaptation to climate change, point three of the Bologna Charter. From the analysis of metropolitan strategic tools, it appears that the three case studies aim to create an integrated risk planning management model, configuring itself as coordinating bodies for the preparation of an integrated metropolitan plan that can guide the work of the municipalities belonging to the metropolitan city in order to achieve a real decrease in the risks affecting the various territories. It is possible to identify different types of risk, among those most faced, the flood risk, the landslide risk, the seismic risk and the risk related to overheating are identified. It is of great importance to implement actions such as the creation of surface water storage spaces or the creation of river-banks works to reduce the risk of floods, to plan new plantings in landslide risk areas in order to prevent soil erosion, to plan the new buildings in order

not to intervene on seismic risk areas and finally, to counteract the increase in urban heat, it is useful to plan the creation of new parks and new water bodies.
For risk prevention, monitoring and risk assessment are of fundamental importance. Reducing the risk would mean making the territories safer.
Another very important sector is urban green. Metropolitan cities address the issue of green through various policies such as urban and metropolitan reforestation, the construction of green roofs to fight heat islands, the implementation of green and blue infrastructures and the development of the metropolitan ecological network. Increasing the green in metropolitan areas brings benefits from various points of view such as, for example, the reduction of urban heat, an improvement in air quality and greater involvement of the population in environmental policies. The topic of green is also closely connected to the participation of the population in environmental policies. Increasing the participation, sensitivity and awareness of the population towards climate change issues appears to be a winning move to implement a better adaptation.
In order to increase the participation and sensitivity of the population, metropolitan cities implement incentive policies and information campaigns. The population appears to be a key element for the implementation of environmental policies. The listed actions can be considered as best practices to be applied, according to a contextualization, in all metropolitan territories to practice a better adaptation. It is of fundamental importance to be able to counter the negative effects of climate change, and this will be possible by activating strategies, such as those listed above, which make the territories more resilient, capable of responding to unexpected shock in the shortest possible time. The strength of metropolitan cities appears to be the capability to develop new integrated approaches for the management of climate change, by assimilating adaptation into their strategic and territorial planning tools.

3.1 General results and conclusions about the role of Metropolitan cities in Italy

In light of the above it is possible to say that, in Italy, metropolitan cities could play an important role in the management of all those projects that refer to the vast area; such as the increase in ecosystem services on a metropolitan scale, the management of greenery, the implementation of ecological corridors and green infrastructures. In this way they could act as liaison bodies between the regional and local levels.
Metropolitan cities will therefore be shaped as coordinating bodies for the promotion of integrated policies for the management of climate change.
The level of government of the metropolitan area is, indeed, the one that can best interpret the role of coordinator. Since it is, in fact, an intermediate level, it can promote both greater integration of policies at different levels (vertical integration) and of the different sectors involved in climate challenges (horizontal integration). Cooperation and integrated policies can play a fundamental role against climate change. For instance, developing cooperation among Municipalities, Universities, Technicians and Stakeholder is indicated as one of the right way to improve projects that fight the effects of climate change (Maragno et al., 2016). Developing an integrated approach to manage climate change, could be, in the Italian context, a winning move in order to promote a real contrast to the negative effects of climate change.
As Maragno et al. (2016) states again that: "Special attention was paid during their development to favor the cooperation and integration between the tasks and actors who live in the territory" (p. 8).
The participatory dimension of the stakeholder and the population appears to be fundamental, especially for the development of bottom up actions and policies. Also, the integration between the metropolitan and local levels, appears extremely important, this integration can be favored by the role of the mayor, which turns out to be the meeting point between the two levels of government of the territory. The Delrio law establishes, in fact, that the mayors of the metropolitan bodies are the same as those of the municipal capital. Since the mayors of the provincial capitals are already aware of the issues of climate change, they could operate in the

same direction from a metropolitan point of view, promoting first the drafting of metropolitan adaptation plans and then the integration between the metropolitan and local adaptation plans.

The integration of the two planning levels is supported by the vision presented by Morello et al. (2019), they affirm that: "A new coordination role for the metropolitan city is proposed whereby the central governance supports local municipalities in the production of baselines and inventories, vulnerability maps and strategies over the different areas of the territory, recognizing local peculiarities and recurrent morphologies and providing tailored solutions; local municipalities should be responsible for local action, given the profound knowledge of local situations, capacities and capabilities."

Since, the level of government of the metropolitan area is a level that has recently been institutionalized and does not have planning tools already fully defined, it could more easily integrate the themes of adaptation and mitigation of climate change. In this way the development of an integrated approach to climate change planning appears simpler for the metropolitan level.

In conclusion, it is possible to affirm that, analyzing the tools and bodies involved in spatial planning in Italy, a key role could also be played by the metropolitan level. Although, the supranational climate change planning policies identify the local level as central to contrasting the negative effects of climate change.

The goals of the metropolitan level would be:

- Promote both vertical and horizontal coordination;
- Promote an integrated approach to climate change planning;
- Promote citizen participation and awareness;
- Modulate the new metropolitan planning tools with a view to greater adaptation and mitigation at climate change.

To date, therefore, the Italian metropolitan level is not yet central to the issue of climate change, but it could become so in the years to come. To be more central in fighting effect of climate change and make territories resilient, national governments could allocate more funding to support metropolitan areas (Kamal-Chaoui & Robert, 2009). Indeed, one of the major problems for metropolitan cities is the lack of funds to operate with a view to greater adaptation to environmental problems.

References

Arup (2013). *Smart Action in Italian metropolitan cities*. Retrieved from: https://www.arup.com/perspectives/publications/research/section/smart-actions-in-italian-metropolitan-cities

Battarra, R., Pinto F., &, Tremiterra, M. R. (2018). Indicators and Actions for the Smart and Sustainable City: A Study on Italian Metropolitan Cities. In R. Papa, R. Fistola & C. Gargiulo (Eds.), *Smart Planning: sustainability and mobility in the age of change*, 83-107, Springer International Publishing AG. https://doi.org/10.1007/978-3-319-77682-8_6

Bulkeley, H. (2009). Planning and Governance of Climate Change. In S. Davoudi, J. Crawford & A. Mehmood (Eds.), *Planning for climate change: strategies for mitigation and adaptation for spatial planners*, pp. 284-297, Earthscan.

Brunetta, G. & Caldarice, O. (2017). Cambiamento climatico e pianificazione urbanistica. Il ruolo delle aree urbane nella costruzione di strategie adattive resilienti. In M. Talia (Ed.), *Un futuro affidabile per la città. Apertura al cambiamento e rischio accettabile nel governo del territorio*. Conference Proceedings Urbanpromo XIV Edizione Progetto Paese. Planum Publisher.

Carraro, C. (2009), La Stern Review. Tra Scienza e politica dei cambiamenti climatici. In N. Stern, *Clima è vera emergenza*, 9-18, Francesco Brioschi editore.

CMCC - Centro Euro-Mediterraneo sui Cambiamenti Climatici (2017). *Piano Nazionale di Adattamento ai Cambiamenti Climatici*. Retrieved from: https://www.minambiente.it/sites/default/files/archivio_immagini/adattamenti_climatici/documento_pnacc_luglio_2017.pdf

Commissione europea (2018). *Valutazione della strategia dell'UE in materia di adattamento ai cambiamenti climatici*. Retrieved from: https://eur-lex.europa.eu/legal-content/IT/TXT/PDF/?uri=CELEX:52018DC0738&from=EN

Davoudi, S. (2009). Introduction to Part 1. In: In S. Davoudi, J. Crawford & A. Mehmood (Eds.), *Planning for climate change: strategies for mitigation and adaptation for spatial planners*, 3-7, Earthscan.

Davoudi, S., Crawford, J., Mehmood, A. (2009) Climate change and spatial planning response. In S. Davoudi, J. Crawford & A. Mehmood (Eds.), *Planning for climate change: strategies for mitigation and adaptation for spatial planners*, *15*, Earthscan.

Davoudi, S. (2012). *Climate Risk and Security: New Meanings of "the Environment" in the English Planning System*, 49-69, European Planning Studies. https://doi.org/10.1080/09654313.2011.638491

De Luca, G., Moccia, F.D. (2017). Introduzione. In G. De Luca & F.D. Moccia (Eds.), *Pianificare le città metropolitane in Italia. Interpretazioni, approcci, prospettive*, 4-24, Roma: INU Edizioni.

De Luca G. & Moccia F. D., (2017). Introduzione In: De Luca G. & Moccia F. D., *Pianificare le Città Metropolitane in Italia. Interpretazioni, approcci, prospettive*, 17-18, INU Edizioni Srl.

de Guisasola, E.B. (2009). *Cities' role in climate challenge gets EU Council recognition. Eurocities. Working Group on Climate Change and Energy*. Retrieved from: https://www.zaragoza.es/contenidos/zaragozainternacional/EUROCITIES_nov09.

Fistola, R., La Rocca, R.A., (2018). Smart Slow Mobility and Cultural Tourism Walking on History Path. In R. Papa, R. Fistola & C. Gargiulo (Eds.), *Smart Planning: sustainability and mobility in the age of change*, 301-322, Springer International Publishing AG. https://doi.org/10.1007/978-3-319-77682-8_18

Gastaldi, F. & Zarino, S. (2015). *La città metropolitana: compiti e ruoli nella pianificazione del territorio*. EyesReg, *5*(1). Reitrieved from: http://www.eyesreg.it/2015/la-citta-metropolitana-compiti-e-ruoli-nella-pianificazione-del-territorio/

Georgi, B., Isoard, S., Asquith, M., Garzillo, C., Swart, R. J., & Timmerman, J. G. (2016). *Urban adaptation to climate change in Europe 2016: Transforming cities in a changing climate*. (12 ed.) (EEA Report; No. No 12/2016). ETC CCA.

Gerundo, C. (2018). *L'adattamento delle città ai cambiamenti climatici*, *33*, FedOAPress. https://doi.org/10.6093/978-88-6887-031-7

Graziano, P. (2014). Lo schema storico. In P. Graziano, Rischio, vulnerabilità e resilienza territoriale: il caso delle provincie italiane, 3-4, XXXIV Conferenza Italiana delle scienze regionali. Retrieved from: https://www.aisre.it/images/old_papers/Graziano.pdf

IPCC (2007). *Climate Change 2007: Impacts, Adaptation and Vulnerability*. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, 6, Cambridge University Press. Rtrieved from: https://www.ipcc.ch/site/assets/uploads/2018/03/ar4_wg2_full_report.pdf

IPCC (2014). Summary for Policymakers. In O. Edenhofer, R. Pichs-Madruga, Y. Sokona, E. Farahani, S. Kadner, K. Seyboth, A. Adler, I. Baum, S. Brunner, P. Eickemeier, B. Kriemann, J. Savolainen, S. Schlömer, C. von Stechow, T. Zwickel and J.C. Minx (eds.). *Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*, 4, Cambridge University Press. Retrieved from https://www.ipcc.ch/site/assets/uploads/2018/02/ipcc_wg3_ar5_summary-for-policymakers.pdf

IPCC (2014). Urban areas. In Field, C.B., V.R. Barros, D.J. Dokken, L.L.White (eds.), *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects*. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, 535-612, Cambridge University Press. Retrieved from: https://www.ipcc.ch/site/assets/uploads/2018/02/WGIIAR5-Chap8_FINAL.pdf

Kamal-Chaoui, L., Robert, A. (Eds.) (2009). *Competitive Cities and Climate Change*, OECD Regional Development Working Papers 2, OECD publishing. Retrieved from: https://www.oecd.org/cfe/regional-policy/44232251.pdf

Maragno, D., Dalla Fontana, M., Appiotti, F., Lucertini G. (2016). *Towards the Metropolitan City: adaptation strategies to climate change using new technologies and integrated approaches for e- governance and spatial planning decision- making*. Retrieved from: https://climate-adapt.eea.europa.eu/metadata/publications/towards-the-metropolitan-city-adaptation-strategies-to-climate-change-using-new-technologies-and-integrated-approaches-for-e-governance-and-spatial-planning-decision-making/maragno_2016_towardsthemetropolitancity.pdf

Morello, E., Musco, F., Caserini, S., Messori, G. (2019). *Climate change and territory: towards the adaptation plan for the metropolitan city of Milan*. ECCA 2019, 4th European Climate Change Adaptation conference. Retrieved from: https://www.ecca2019.eu/climate-change-and-territory-towards-the-adaptation-plan-for-the-metropolitan-city-of-milan/

Papa, R., Galderisi, A., Vigo Majello, M. C., Saretta, E. (2015). *Smart and Resilient Cities. A Systemic Approach for Developing Cross-sectoral Strategies in the Face of Climate Change*, TeMA - Journal of Land Use, Mobility and Environment, *8*(1), 19-49. https://doi.org/10.6092/1970-9870/2883

Pellegrini, P. (2017). Il consolidamento dell'idea di area metropolitana centrale veneta: una storia per immagini. In G. De Luca & F.D. Moccia (Eds.), *Pianificare le Città Metropolitane in Italia. Interpretazioni, approcci, prospettive*, 133-140, Inu Edizioni.

Pietrapertosa, F., Salvia, M., De Gregorio Hurtando, S., D'Alonzo, V., Churche, J. C., Geneletti, D., Musco, F., Reckieng, D., (2019). *Urban climate change mitigation and adaptation planning: Are Italian cities ready?*, *91*, 93-105. https://doi.org/10.1016/j.cities.2018.11.009

Pizarro, R. (2009). Urban Form and Climate Change: Towards Appropriate Development Patterns to Mitigate and Adapt to Global Warming. In In S. Davoudi, J. Crawford & A. Mehmood (Eds.), *Planning for climate change: strategies for mitigation and adaptation for spatial planners*, 33, Earthscan.

Sbetti, F. (2017). *Città Metropolitane e progetti di reti, una difficile necessità. Città metropolitane territori competitivi e progetti di rete*, 012, 269- 270. Retrieved from: https://issuu.com/urbinfo/docs/dossier12

Stern, N. (2007). *The Economics of Climate Change: The Stern Review*. Cambridge: Cambridge University Press. ISBN 978-0521700801

Viviani, S. (2017). *Territori metropolitani e strategie per il Paese. Città metropolitane territori competitivi e progetti di rete*, 012, 269- 270. Retrieved from: https://issuu.com/urbinfo/docs/

Zanchini, E., Nanni, G., Minutolo, A. (2019). *Il clima è già cambiato. Rapporto 2019 dell'Osservatorio di Legambiente CittàClima*, 11-13, Legambiante. Retrieved from: https://www.legambiente.it/wp-content/uploads/2019/11/Il-Clima-e%CC%80-gia%CC%80-cambiato-2019.pdf

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