

TeMA

Journal of
Land Use, Mobility and Environment

Cities need to modify and/or adapt their urban form, the distribution and location of services and learn how to handle the increasing complexity to face the most pressing challenges of this century. The scientific community is working in order to minimise negative effects on the environment, social and economic issues and people's health. The three issues of the 14th volume will collect articles concerning the topics addressed in 2020 and also the effects on the urban areas related to the spread Covid-19 pandemic.

TeMA is the Journal of Land Use, Mobility and Environment and offers papers with a unified approach to planning, mobility and environmental sustainability. With ANVUR resolution of April 2020, TeMA journal and the articles published from 2016 are included in the A category of scientific journals. From 2015, the articles published on TeMA are included in the Core Collection of Web of Science. It is included in Sparc Europe Seal of Open Access Journals, and the Directory of Open Access Journals.



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

TeMA

Journal of
Land Use, Mobility and Environment

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

2 (2021)

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 | online ISSN 1970-9870
Licence: Cancelleria del Tribunale di Napoli, n° 6 of 29/01/2008

Editorial correspondence

Laboratory of Land Use Mobility and Environment
DICEA - Department of Civil, Architectural and Environmental Engineering
University of Naples "Federico II"
Piazzale Tecchio, 80
80125 Naples
web: www.tema.unina.it
e-mail: redazione.tema@unina.it

The cover image is a train passes a rail road crossing that is surrounded by flooding caused by rain and melting snow in Nidderau near Frankfurt, Germany, Wednesday, Feb. 3, 2021. (AP Photo/Michael Probst)

TeMA. Journal of Land Use, Mobility and Environment offers researches, applications and contributions with a unified approach to planning and mobility and publishes original inter-disciplinary papers on the interaction of transport, land use and environment. Domains include: engineering, planning, modeling, behavior, economics, geography, regional science, sociology, architecture and design, network science and complex systems.

With ANVUR resolution of April 2020, TeMA Journal and the articles published from 2016 are included in A category of scientific journals. From 2015, the articles published on TeMA are included in the Core Collection of Web of Science. TeMA Journal has also received the *Sparc Europe Seal* for Open Access Journals released by *Scholarly Publishing and Academic Resources Coalition* (SPARC Europe) and the *Directory of Open Access Journals* (DOAJ). TeMA is published under a Creative Commons Attribution 4.0 License and is blind peer reviewed at least by two referees selected among high-profile scientists. TeMA has been published since 2007 and is indexed in the main bibliographical databases and it is present in the catalogues of hundreds of academic and research libraries worldwide.

EDITOR IN-CHIEF

Rocco Papa, University of Naples Federico II, Italy

EDITORIAL ADVISORY BOARD

Mir Ali, University of Illinois, USA

Luca Bertolini, University of Amsterdam, Netherlands

Luuk Boelens, Ghent University, Belgium

Dino Borri, Polytechnic University of Bari, Italy

Enrique Calderon, Polytechnic University of Madrid, Spain

Roberto Camagni, Polytechnic University of Milan, Italy

Pierluigi Coppola, Politecnico di Milano, Italy

Derrick De Kerckhove, University of Toronto, Canada

Mark Deakin, Edinburgh Napier University, Scotland

Carmela Gargiulo, University of Naples Federico II, Italy

Aharon Kellerman, University of Haifa, Israel

Nicos Komninos, Aristotle University of Thessaloniki, Greece

David Matthew Levinson, University of Minnesota, USA

Paolo Malanima, Magna Graecia University of Catanzaro, Italy

Agostino Nuzzolo, Tor Vergata University of Rome, Italy

Rocco Papa, University of Naples Federico II, Italy

Serge Salat, Urban Morphology and Complex Systems Institute, France

Mattheos Santamouris, National Kapodistrian University of Athens, Greece

Ali Soltani, Shiraz University, Iran

ASSOCIATE EDITORS

Rosaria Battarra, National Research Council, Institute of Mediterranean studies, Italy

Gerardo Carpentieri, University of Naples Federico II, Italy

Luigi dell'Olio, University of Cantabria, Spain

Isidoro Fasolino, University of Salerno, Italy

Romano Fistola, University of Sannio, Italy

Thomas Hartmann, Utrecht University, Netherlands

Markus Hesse, University of Luxembourg, Luxembourg

Seda Kundak, Technical University of Istanbul, Turkey

Rosa Anna La Rocca, University of Naples Federico II, Italy

Houshmand Ebrahimpour Masoumi, Technical University of Berlin, Germany

Giuseppe Mazzeo, National Research Council, Institute of Mediterranean studies, Italy

Nicola Morelli, Aalborg University, Denmark

Enrica Papa, University of Westminster, United Kingdom

Dorina Pojani, University of Queensland, Australia

Floriana Zucaro, University of Naples Federico II, Italy

EDITORIAL STAFF

Gennaro Angiello, Ph.D. at University of Naples Federico II, Italy

Stefano Franco, Ph.D. student at Luiss University Rome, Italy

Federica Gaglione, Ph.D. student at University of Naples Federico II, Italy

Carmen Guida, Ph.D. student at University of Naples Federico II, Italy

Sabrina Sgambati, Ph.D. student at University of Naples Federico II, Italy

TeMA

Journal of
Land Use, Mobility and Environment

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

2 (2021)

Contents

121 EDITORIAL PREFACE
Rocco Papa

FOCUS

125 **Metropolitan Cities supporting local adaptation processes. The case of the Metropolitan City of Venice**
Filippo Magni, Giovanni Litt, Giovanni Carraretto

145 The article “The application of green and blue infrastructure impact of city borders and ecosystem edges impact”, pages 145-160, was withdrawn for the authors’ request.

LUME (Land Use, Mobility and Environment)

161 **Territorial disparities in Tuscan industrial assets: a model to assess agglomeration and exposure patterns**
Diego Altafini, Valerio Cutini

177 **Estimation of the future land cover using CORINE Land Cover data**
Gizem Dinç, Atila Gül

189 **Quantifying the urban built environment for travel behaviour studies**
Ndidi Felix Nkeki, Monday Ohi Asikhia

Covid-19 vs City-21

211 Covid-19 pandemic and activity patterns in Milan. Wi-Fi sensors and location-based data

Andrea Gorrini, Federico Messa, Giulia Ceccarelli, Rawad Choubassi

227 Former military sites and post-Covid-19 city in Italy. May their reuse mitigate the pandemic impacts?

Federico Camerin

245 Investigation of the effects of urban density on pandemic

Yelda Mert

EVERGREEN

261 Chaos and chaos: the city as a complex phenomenon

Carmela Gargiulo, Rocco Papa

REVIEW NOTES

271 Ecological transition: perspectives from U.S. and European cities

Carmen Guida, Jorge Ugan

279 Resilience as an urban strategy: the role of green interventions in recovery plans

Federica Gaglione, David Ania Ayiine-Etogo

285 Toward greener and pandemic-proof cities: policy responses to Covid-19 outbreak in four global cities

Gennaro Angiello

293 Environmental, social and economic sustainability in urban areas: a cool materials' perspective

Federica Rosso, Stefano Franco

TeMA 2 (2021) 125-144

print ISSN 1970-9889, e-ISSN 1970-9870

DOI: 10.6092/1970-9870/7948

Received 2nd April 2021, Accepted 27th June 2021, Available online 31st August 2021

Licensed under the Creative Commons Attribution – Non Commercial License 4.0
www.tema.unina.it

Metropolitan Cities supporting local adaptation processes. The case of the Metropolitan City of Venice

Filippo Magni ^a, Giovanni Litt ^{b*}, Giovanni Carraretto ^c

^a Department of Architecture and Arts
University Iuav of Venice, Venice, Italy
e-mail: filippo.magni@iuav.it
ORCID: <https://orcid.org/0000-0002-1399-1080>

^b Department of Architecture and Arts
University Iuav of Venice, Venice, Italy
e-mail: giovanni.litt@iuav.it
ORCID: <https://orcid.org/0000-0003-0837-005X>
* Corresponding author

^c Department of Architecture and Arts
University Iuav of Venice, Venice, Italy
e-mail: giovanni.carraretto@iuav.it
ORCID: <https://orcid.org/0000-0002-4679-0285>

Abstract

Cities have a fundamental role in the adaptation and mitigation process to climate change. Even though cities will be the main subject of climate change impacts, they can propose solutions and build alternative scenarios. The difficulties that municipalities may encounter in their adaptation processes concern the lack of planning skills, technical knowledge, and human resources. To face these challenges Italian Metropolitan Cities can play a fundamental role in helping municipalities to plan and coordinate their efforts. The process in the Venetian territory has lasted many years and it has led to the awareness that local adaptation policies need to be addressed with broader support. The Metropolitan City of Venice has constructed a methodology for the planning of climatic adaptation. This methodology has been developed thanks to various plans and projects. These projects acted to increase the coordination between bodies, to define a broad area vision, to help municipalities to implement local actions. The role played by CMVe intends to direct public policies towards adaptation and mitigation in a structural way and with broad area governance. The process activated could be replicable in other Italian Metropolitan Cities in the approach and the result even if adapted to local needs.

Keywords

Climate-proof planning; Metropolitan city; Broad area governance; Climate change.

How to cite item in APA format

Magni, F., Litt, G. & Carraretto, G. (2021). Metropolitan Cities supporting local adaptation processes. *Tema. Journal of Land Use, Mobility and Environment*, 14(2), 125-144. <http://dx.doi.org/10.6092/1970-9870/7948>

1. Introduction

Municipalities have, both in Italy and in Europe, fundamental importance in planning the process of adaptation and mitigation to climate change (CC) (Gaudioso et al., 2014). The Covenant of Mayors (CoM) is the main initiative that engages municipalities in the fight against CC (Pablo-Romero et al., 2018). The Covenant identifies cities as the key institutions for achieving the objectives set in the commitment to climate and energy towards a sustainable future. Starting from 2008, on the initiative of the European Commission, the Covenant has been addressing cities and city networks towards climate change projects in a coordinated manner. The CoM was set up to achieve the European target of a 40% reduction in carbon dioxide emissions by 2030 and to adopt a joint approach to mitigation and adaptation actions.

In 2050, 67.2% of the Earth's inhabitants are expected to live in the city (United Nations, Department of Economic and Social Affairs, Population Division, 2019). Cities and their activities are responsible for about 75% of global CO₂ emissions (REN21 Secretariat, 2021). Even though cities are and will be the subject of the main impacts of climate change, they can propose solutions and build alternative scenarios (Gaudioso et al., 2014). The urban dimension can facilitate the adoption of innovative and virtuous, sharing and cooperation practices (Urban Agenda for the EU, 2016; Musco & Zanchini, 2014). This also because of the density of population, the concentration of services and infrastructure, the socio-cultural context, the ability to innovate and prefigure behaviors and spaces.

These qualities help to adapt to challenges, political and civic participation in democratic life, social interrelation, the cultural and academic ferment (Mercalli, 2011; Musco et al., 2020). The difficulties that municipalities may encounter in their processes of adaptation to climate change concern the lack of planning skills, technical knowledge, and human resources (Magni et al., 2020a). These obstacles are related either to the size of the municipality or to its financial and technical capacities. Moreover, the municipalities belonging to the CoM also report operational limits (Adami et al., 2020). Despite being guaranteed administrative and promotional assistance by the Office of the Covenant of Mayors (Como), these support instruments have not always been sufficient to produce concrete results. Members of the Sustainable Energy Action Plan (SEAP) have not always led to positive responses regarding the commitment of administrations to the environmental challenge.

In Italy, 4736 Municipalities signed the pact, but the resulting Action Plans are only 3304 (69.76% of those expected) and the results monitored are only 1022 (only 21.58%)¹. To face these challenges, Regions and, most of all, Italian Metropolitan Cities (MC) can play a fundamental role (Boggero, 2016) in helping municipalities to plan, coordinate and evaluate their efforts (Piperata, 2018; Marson, 2006). In particular, the MC can have a key role in supporting the process of adaptation to the CC of both Municipalities and Groups of Municipalities (GoM). Operating on an intermediate level of planning and land management, MC can be fundamental in the strategy of a large area (Musco et al., 2018). This technical approach can overcome the gaps between institutional knowledge, technical knowledge, coordination between actors, and resource management.

This paper, starting from the specific case of the Metropolitan City of Venice (CMVe), reconstructs the possibilities that a governing body of an intermediate territory such as MC can activate to support the climate transition and the sustainability of its territory. These possibilities will be analyzed starting from the analysis of the critical issues that slow down the process of climate transition. It will be proposed a methodology, activated by CMCVe, to support the process of MCs in leading the territorial transition.

¹ www.pattodeisindaci.eu

1.1 Italian Metropolitan Cities towards mainstreaming of adaptation to climate change

The MCs in Italy were born on April 8, 2014², to replace the provinces as large entities in the Italian Constitution. In Italy, the MCs are 15: Bari, Bologna, Cagliari, Catania, Florence, Genoa, Messina, Milan, Naples, Palermo, Reggio Calabria, Rome, Turin, Venice. Each of these has different qualities to be MC. The transition from Province to MC (Crivello & Staricco, 2017) added other key functions to provincial functions (such as provincial spatial planning coordination, protection, and enhancement of the environment, planning of transport services, collection, and processing of data for technical and administrative assistance to local authorities). In detail, in territorial-environmental-climate, the Metropolitan City:

- adopts (and annually updates) a three-year strategic plan of the metropolitan territory which constitutes an act of guidance for the institution and the exercise of the functions of municipalities;
- deals with general spatial planning by setting constraints and objectives to the activity and exercise of the functions of the municipalities included in the metropolitan territory;
- structures coordinated systems of management of public services;
- deals with mobility and practicability, also ensuring the compatibility and coherence of urban planning in the metropolitan area;
- promotes and coordinates economic and social development;
- promotes and coordinates systems of computerization and digitization in the metropolitan area.

The competencies of the MCs – as shown in Fig.1 – can have direct interrelations with the effects and causes of climate change (Molinaro, 2019). These are numerous, both in terms of adaptation and mitigation, and it is for this reason that the choice of encouraging mainstreaming of adaptation and mitigation in MCs and emphasizing their role of coordination and facilitation of adaptation processes at the municipal level is today particularly strategic. Mainstreaming adaptation plays a key role in supporting governance processes, proposing integration of spatial development dynamics (Magni et al., 2020b) so that adaptation to climate change and mitigation can become sustainable and applicable on a large scale, incorporating them into the political apparatus of local governments and so becoming mainstream (Bockel, 2009).

In addition, MC can be a central body in the process of transition toward climate-proof territories. A renewed and necessary attention must support greater awareness of climate problems in local transformations to reduce the ecological footprint of cities in the future policies of urban metropolitan cities in Italy and Europe. The role of MC in this process can be fundamental: for the possibilities of mainstreaming within their governance instruments and for the multilevel process of mainstreaming (Rauken et al., 2014). This process can be done by encouraging the implementation of the vertical process in the hierarchy of the Government of the Territory between over-ordered entities – regional, national, European – and Municipalities (Magni et al., 2020c).

2. Materials and method

Internationally agreed methodologies have led the United Nations Framework Convention on Climate Change (UNFCCC) to the development of a theoretical adaptation framework (UNFCCC, 2008a; UNFCCC, 2008b; Keskitalo, 2010; Fritzsche et al., 2014; Romero Lankao & Zwickel, 2014) as a practical and specific guide to support structured decision-making bodies in several stages that governments, both local, regional and national can undertake. These strong theoretical bases indicate several passages. These passages do not necessarily have a strict order, some may occur in parallel with others. In all cases, the steps should be viewed as a cycle (Jabareen, 2013).

² Law n. 56 of April 7, 2014. Disposizioni sulle città metropolitane, sulle province, sulle unioni e fusioni di comuni. (14G00069) (GU n.81 del 07-04-2014). <https://www.gazzettaufficiale.it/eli/id/2014/4/7/14G00069/sg>

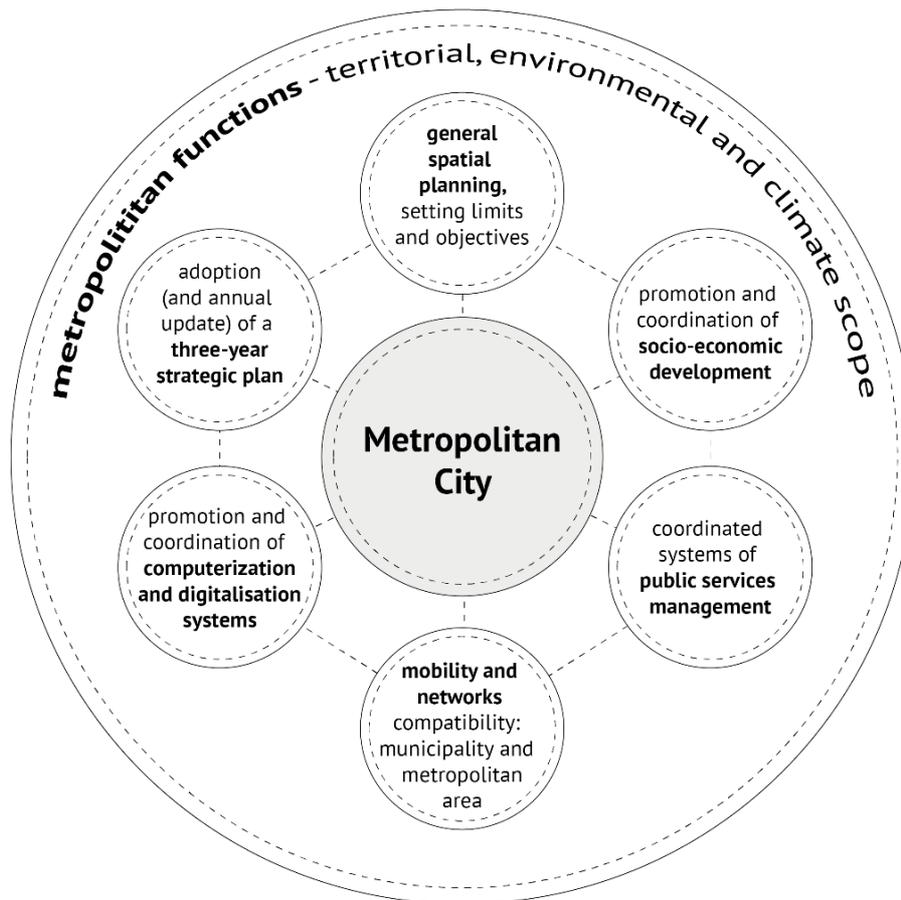


Fig. 1 The functions of the Metropolitan Cities

The macro-steps are (Magni et al, 2020a):

- building a knowledge base for adaptation;
- assess the macro and micro impacts of climate change;
- assess vulnerability and its capacity to adapt;
- to identify possible adaptation options (design of adaptation measures);
- the implementation of the measures;
- monitoring and evaluation of effectiveness.

Municipalities often find it difficult to build their climate change adaptation pathways. These difficulties are due to three main gaps (Musco et al., 2020):

- the lack of a coherent and up-to-date policy and knowledge framework;
- policies of adaptation and mitigation only municipal, when instead of the impacts of climate change often involve a wider territorial context than the municipal, so the answers to these problems should be planned on an equally large scale.
- sectoral and non-global solution approach: adaptation and mitigation are relegated to specific plans and not able to dialogue with cogent planning.

This paper shows how CMVe has supported municipalities in the climate transition process by working to fill these three gaps and how the same process could fit in the other MCs (Fig.2).

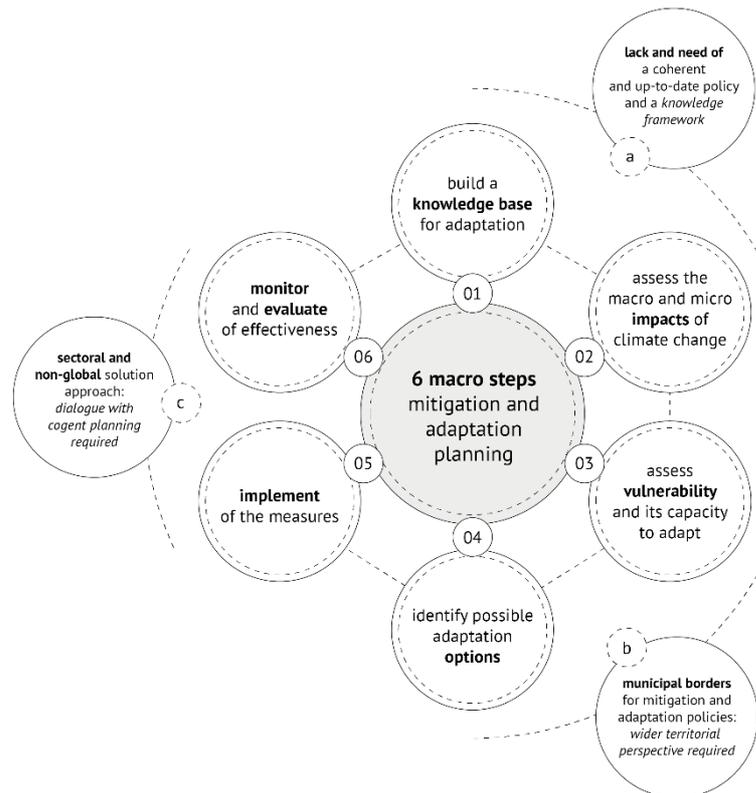


Fig.2 Link between steps and gaps

2.1 Mitigation and adaptation in the Venetian area: the evolution of processes between Province and Metropolitan City

The Metropolitan City of Venice, which replaces the Province of Venice, has always worked on sustainability and CC, both in terms of mitigation and, in more recent times, in terms of adaptation. This effort is dictated by well-known territorial needs (Magni, 2019). The geomorphological (Sistema Nazionale per la Protezione dell’Ambiente, 2019) and hydraulic condition of the Venice Lagoon and the surrounding territories has always been critical: a fragile balance between environment and man-made settlement (Guerzoni & Tagliapietra, 2006; Maragno et al., 2021). For the previous reasons, the spatial configuration is extremely vulnerable to the impacts of climate change. The report of the European Environment Agency (2016) and the most recent climate scenarios for Italy (CMCC, 2021)³, confirm a critical picture, characterized by the intensification of phenomena of urban flooding, floods, tides, and high waters, heat waves, etc.

The first step of the path towards sustainability – started by the second half of the last decade by the Province of Venice to promote a more sustainable and attentive to the peculiarities of the territory model of development – was the publication in 2008 of the Territorial Plan of Provincial Coordination⁴ (PTCP) which introduced the obligation for municipalities to acquire a Municipal Water Plan⁵. The Province has defined the guidelines for the elaboration and has contributed directly to the financing of their preparation, constantly monitoring their development. To date, all 44 municipalities have adopted, or are in the process of adopting, their hydraulic management tool).

³ www.cmcc.it/it/scenari-climatici-per-litalia

⁴ The PTCP is the instrument of urban and territorial planning through which the Province exercises and coordinates its action of government of the territory, outlining its objectives and fundamental elements of planning.

⁵ Including land reclamation agencies, private owners of agricultural funds, integrated water supply agencies, etc.

In September 2010, the awareness acquired in the field of sustainability and climate led the Province to adhere, as a coordination and support structure, to the Covenant of Mayors. The Province of Venice has considered the "Covenant of Mayors and its potential effects extremely positive and for this reason, has decided to provide support to the municipalities to accompany them in the path of accession and assumption of commitments arising from the signing". Then, it has launched "a program of accompanying and support to assist municipalities in the path of the Covenant of Mayors, promoting a stable and constant system of territorial coordination, aimed primarily at the preparation of Sustainable Energy Action Plans at the municipal level, seeking opportunities and related financial resources and promoting the Pact" (Venice Province, 2011).

As a matter of fact, the Province undertook to accompany the Municipalities in joining the Covenant of Mayors and to assist them in the implementation of commitments, providing the scientific-technical support necessary to prepare emission balances, SEAP, and creating stable coordination between the signatories of the pact and the Province of Venice. This support has made it possible to carry out monitoring plans, based on substantial cognitive analyses. The Province has been responsible for researching and proposing financial support, providing technical support for the organization of public events, and following the implementation of the action plans and monitoring of the activities carried out by the municipalities. Finally, it has facilitated the networking of experiences and the connection with the services of the European Commission. On the other hand, the municipalities have shared the accompanying program for the Covenant of Mayors with the Province, providing information on the developments of the SEAP and their implementation. The individual municipalities have also helped to identify and implement energy planning paths. They have also contributed to spread and communicate to citizens the contents of the Covenant of Mayors, in synergy with the Province. The Covenant of Mayors was oriented to the reduction of greenhouse gas emissions. Since the beginning the Province has tried to guide municipalities towards adaptation, aiming at the construction and adoption of specific actions. This awareness has not yielded the expected results, as adaptation actions were only introduced by a minority of the submitted SEAPs. The causes of this lack of integration have been identified in the unawareness of the urgency of adaptation actions to CC, in the absence of a simple methodological framework, a comprehensive analysis of the vulnerabilities of the territory, and in the approach strongly oriented to the mitigation of the same Covenant of Mayors. Throughout 2012, the coordination and support activities for municipalities have been reflected in: the definition of guidelines for the implementation of SEAP at the local level; the establishment of a single database for the management of all the information necessary for the definition of emission inventories (BEI) and action plans of municipalities; the training for municipal technicians for the definition of the consumption of municipal structures and the use of the single database; the determination of the basic inventory of emissions for macro sectors for all municipalities of the Province.

The process in the Venetian territory continued with the project SEAP_Alps⁶, which allowed the path of adaptation of the new CMVe to derive indications of governance. The methodological approach of this experiment has shown that the cognitive process conducted throughout the theoretical research phase has itself become an act of social adaptation (Lewin, 1946), when municipal technicians, policy-makers, citizens, and other local stakeholders were involved. The project has constructed a common methodology between the partners for the management of the process of planning previewed from the initiative Covenant of Mayors (energy analysis, scenario development, identification of objectives and actions, monitoring of the implementation of plans), integrating it with the concept of adaptation to climate change. The research-action phase started with the adaptation of the construction methodology of a SEAP to the local regulatory environment and then moved to a moment of accompanying and support with continuous training of the partners and local authorities involved. Mentoring has been conducted in a training way, using the

⁶ www.seap-alps.eu/

methodology and the tools associated with it. The outcome of this path started in 2014 laid the foundations for the construction and implementation of new generation SEAP and a simplified upgrade of those already adopted.

Thanks to the activities developed within the project LIFE Master Adapt⁷, CMVe was able to develop and adopt tools to facilitate the optimization of the relationships between levels of planning, to increase and coordinate municipal planning capacity and facilitate public-private collaboration. In addition to these activities, the process of mainstreaming for the design and implementation of adaptation strategies has been developed through coordination between the different levels of government of the territory (State, Regions and Local Authorities) and horizontal coordination between different policies (territorial, landscape, agricultural, environmental, civil protection, etc.). The LIFE Master Adapt project has allowed starting an innovative and detailed climate analysis and a vulnerability assessment at the metropolitan level, aimed at identifying impacts, risks, and vulnerabilities (Maragno, 2017), climate change for key CMVe sectors.

Based on the analysis and evaluation of national and international adaptation practices, targets for supra-local adaptation have been defined, following a vertical and horizontal mainstreaming process, standardizing and aligning adaptation policies at different levels. Technical processes and dialogue with the territories have allowed the development of an effective method for the integration and governance of shared adaptation objectives. This process has allowed defining a strategy of adaptation, and the measures identified, at the intermediate administrative level: both for specific groups of municipalities and the entire Metropolitan City of Venice. The LIFE Master Adapt project has been crucial in the long programming process of the CMVe described. It has allowed the creation of a system of information and skills sedimented over the years, building a common knowledge base and an inventory of vulnerabilities and risks related to climate change through the implementation of the methodologies developed. Particularly, a common knowledge base has been provided and the operational guidelines and common objectives have been defined with a transcalar logic to allow the municipalities of the CMVe to program independently or on the network. Without this support, individual municipalities would hardly be able to engage in the climate challenge and integration with the tools of spatial planning.

Placed the priorities of climate adaptation within the broader framework of metropolitan environmental policies thanks to Seap_alps, with the European project LIFE Veneto Adapt, CMVe wanted to improve, at the multi-scale level (from regional to local), the capacity to respond to climate change, especially those related to hydrogeological risk. The initiatives proposed by the project have been developed since 2017 within the vast area of central Veneto, involving different levels of government of the territory, from the metropolitan one of the City of Venice to the local one of the cities of other provincial capital cities such as Padua, Vicenza, and Treviso, up to the micro-scale one, such as the Union of Municipalities of the Middle Brenta.

This has led CMVe Municipalities to implement actions relating to adaptation directly in existing Seaps or the transition from SEAP to Sustainable Energy and Climate Action Plan (SECAP) towards the reduction of emissions of at least 40% to 2030.

If LIFE Master Adapt and LIFE Veneto Adapt have provided the strategic bases to guide the work in the Metropolitan City of Venice, the next step has been entrusted to two projects still in the development phase: the Interreg SECAP and the Desk project.

⁷ The project, coordinated by Regione Sardegna, with the support of a partnership composed of Ambiente Italia, Università IUAV di Venezia, Fondazione Lombardia per l'Ambiente, Regione Lombardia Coordinamento Agende 21 Locali Italiane, ISPRA, Università degli Studi di Sassari - (<https://masteradapt.eu/>), aimed to provide a common methodology to support Regions (Region of Sardinia, Region of Lombardy), Metropolitan Cities (CM of Venice, CM of Cagliari) and Groups of Municipalities (Metropolitana del Nord Sardegna, Unione dei Comuni del Nord Salento and Aggregazione di Città a Nord di Milano), to identify the main vulnerabilities to climate change, the priorities of intervention and, specifically, to develop strategies for the governance of adaptation.

The first one, the Interreg Italy-Slovenia SECAP - Support for Energy and Climate Adaptation Policies⁸, has the objective of encouraging sustainable development of the territory by promoting strategies for low carbon emissions creating relevant adaptation and mitigation measures thanks to the transition of the SEAP to the SECAP for the municipalities of CMVe. The project will promote sustainable development models of the Covenant of Mayors with improved quality of life and resilience to climate change. Thanks to the creation of an inventory of strategies, measures and projects to increase resilience, practical support to the municipalities in the partner area will be provided for the implementation of sustainable energy and climate adaptation policies, to improve energy planning by municipalities, focusing on energy saving, renewable energy, reducing CO₂ emissions.

The project Desk - Consultation, participation and Decision support system to Support territorial Knowledge⁹, finally, in collaboration between the Metropolitan Cities of Venice (leader), Milan, Genoa, and the Province of Taranto, supported by the Territorial Cohesion Agency and funded by the PON "Governance and Institutional Capacity Programme 2014-2020", aims to build smart, sustainable and inclusive territories. The project, starting from the best practice of CMVe, will allow to computerize and digitize the knowledge tools of the territory. A set of web services will allow sharing in real-time geo-referenced information and aggregate innovation services on a supra-municipal scale. Thus various stakeholders will actively participate in the construction of territorial support indicators to the management, contributing to the definition of in-depth thematic analyses.

In the programmatic chronology of CMVe (and, before, of the Province), the contents and goals of the projects described are part of a path focused on sustainable development and resilience. This path began with environmental protection plans (Water Plans and SEAPs), followed by energy sustainability projects and mitigation of the causes of the greenhouse effect, up to the most recent integration of adaptation policies to climate change. The synergic experiences gained in recent years, between local administrations and the local authority, with the technical-scientific support of universities and other research centers, indicate one of the possible ways, replicable in other contexts, for local adaptation. To achieve these results, it was essential to:

- increase awareness of territorial vulnerabilities to the CC in every sector of public administration to understand the potential effects;
- reorganize public structures, making widespread and uniform use of Information and Communications Technology - ICT tools;
- draft of appropriate technical guidelines to facilitate knowledge sharing;
- define a unique vocabulary for the study and application of the most innovative climate-proof processes, which can be traced back to the virtuous cycle of analysis of needs, planning of interventions, measuring the effects of the processes implemented, calibration of new interventions;
- develop a land approach that is sensitive to evidence of climate change;
- extend the comparison and complexity of the CC discussion to other areas of broad area planning, such as land consumption, mobility, energy, health, and safety.

The path described so far shows how local contexts are currently more likely to undertake a path of adaptation, where higher support bodies such as the Metropolitan Cities can provide a framework to support the development of adaptation capabilities and the exchange of information about existing good practices. (Musco et al., 2015; Musco and Magni, 2014). With the support and the coordination of an over-ordered entity, cities – both in-network and in autonomy – demonstrated greater commitment and effectiveness in producing decarbonized and climate-proofed development strategies.

⁸ www.ita-slo.eu/it/secap

⁹ www.progettodesk.it

3. Results

The results obtained from the described path are many and differentiated by specific thematic and scientific areas. Concerning spatial planning for adaptation to climate change, in addition to specific legacies of individual projects, the most relevant results of the path of the Metropolitan City of Venice, as shown in Fig.3, can be summarized in:

- development of a common knowledge framework and identification of impacts and assessment of territorial vulnerabilities;
- active support to the process that led to the definition of metropolitan adaptation objectives and strategies;
- integration of adaptation actions into local plans and programs.

These results are fundamental for having equipped the CMVe with tools to address the metropolitan-integrated strategic vision. The construction of a well-defined and common methodology in the metropolitan area has allowed and will allow, to move from a planning “per projects” to a “ per processes” (Musco et al, 2019), increasing the capacity of adaptation, administrative resilience, decision-making, and operational processes, building a system capable of facing change in a virtuous and innovative way.

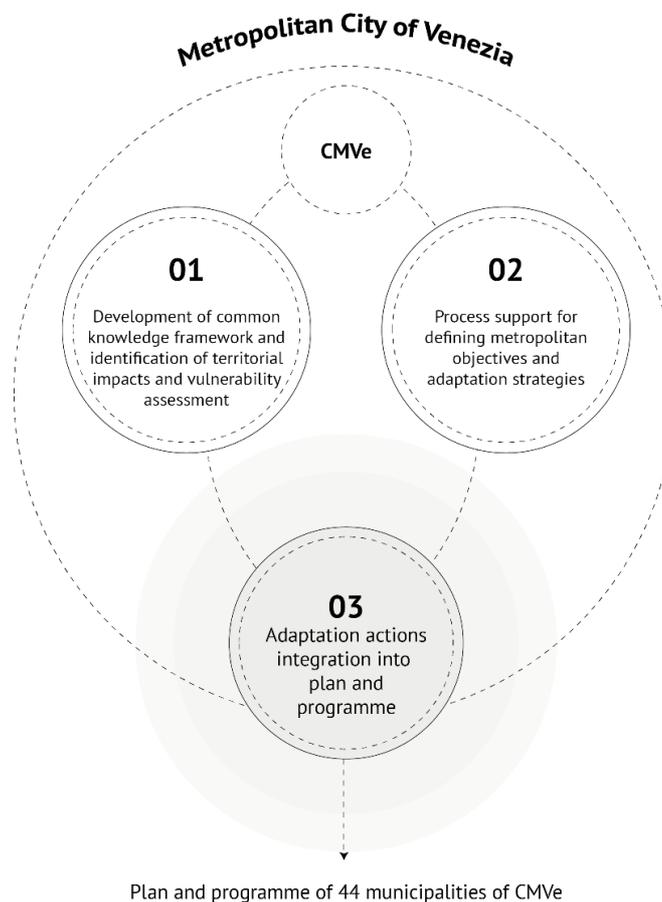


Fig.3 Results of the adaptation planning process of CMVe

3.1 Development of the common metropolitan knowledge framework: identification of impacts and assessment of territorial vulnerabilities

Adaptation has the primary need to know in-depth the study areas and the impacts they are subject to, to cope with specific impacts resulting from CC. The definition of the framework for CMVe has been implemented with the definition of the impacts of climate change, understood as the threats felt in the specific territory, the

outcome of the relationship between climate, urban fabric, and urban functions. Climate change impacts selected through the participatory process for the CMVe are urban flooding and the urban heat island. The analysis phase for the assessment of vulnerability to urban flooding and urban heat islands (Shmelev, 2019) was based on a quantitative-qualitative of surface runoff of rainwater, soil permeability, temperatures, and vegetation indices. The analysis showed how and to what extent soil sealing negatively affects the area's hydraulic performance and perceived urban temperatures. The elaboration has been useful to construct an updated cognitive picture of the whole metropolitan territory, to orient the policies and the strategies of development to avoid the exceed specific critical thresholds. The results obtained indicate those areas in which the priority is to intervene with blue, green, and grey solutions to adapt to the territory. The aforementioned process is summarized in Fig.4.

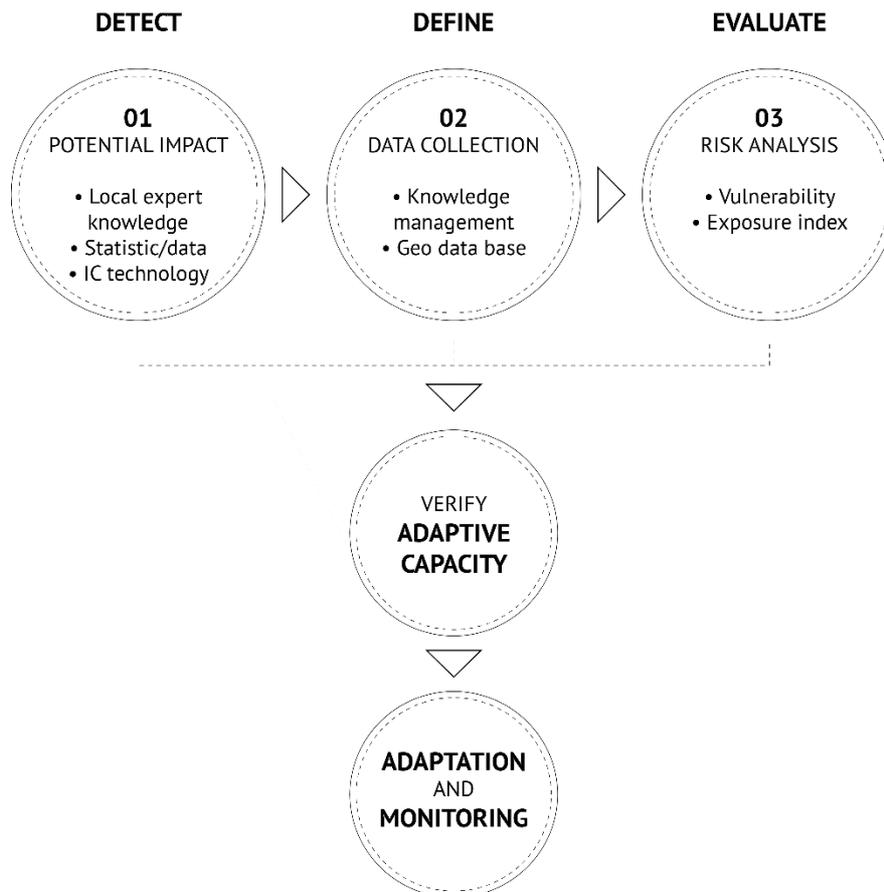


Fig.4 The phases of knowledge framework building

All the information obtained and systematized, together with the information already in the possession of the Municipalities and the CMVe, have created new information levels. These new levels gave rise to the Decision Support Tool¹⁰ (DST). The DST, built in its initial version within the pilot area of the LIFE Master Adapt project and adopted and improved by CMVe with the DESK project, is now available to policymakers and municipal technicians. The results have enabled local adaptation processes to be supported through this new CMVe Territorial Information System (SIT). The Decision Support Tool (DST) is a research site where every municipality can investigate its territory to define its vulnerability and geolocation characteristics. In this way, municipalities are supported for the strategic, political, and practical decisions: which actions to implement, what priority, in which specific area of their territory (Fig.5).

¹⁰ www.desk.cittametropolitana.ve.it:8088/superset/dashboard/10/

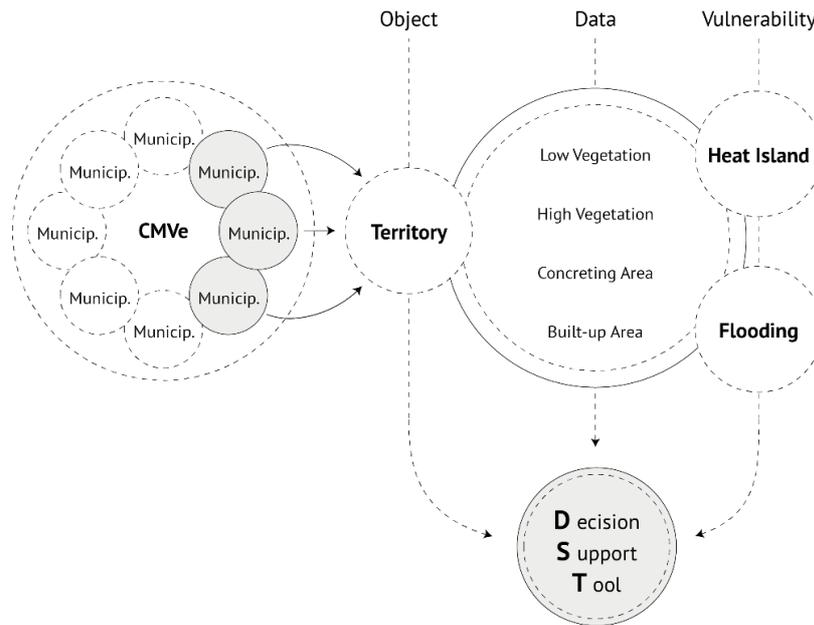


Fig.5 Decision Support Tool (DST) applied to the territories of CMVe

3.2 Support to the process that led to the definition of metropolitan adaptation goals and strategies

By referring to LIFE Master Adapt as a key part of a process that has been underway for more than a decade in CMVe, the two impacts of climate change described above – urban heat island and run-off – have been considered for the definition of adaptation goals and strategies. The technical work of scientific analysis of vulnerabilities was accompanied by an evaluation process of a participatory nature, through workshops, public meetings, and questionnaires entrusted to the Municipalities of the CMVe. The activities were carried out to assess perceptions and investigate what has already been achieved in the Venetian territory in terms of adaptation to climate change.

This phase allowed the participation and multi-level involvement of stakeholders, horizontally between the operating sectors of the Metropolitan City of Venice and vertically with the Municipalities of the CMVe. The dissemination and preliminary communication of the intentions of the process has been an important part in building trust between the citizen and the administration, between perception and effort of the metropolitan administration to make territory, networks, buildings, and communities, mostly climate-proof. The success of the adaptation process also depends on the level of awareness about the effects of CCs in the technical apparatus, in the political bodies, between stakeholders, and the population. Following the elaboration and sharing of the knowledge framework, a vision has been defined to build the orientation process. The definition of the vision has followed a method for the development of goals of adaptation that is articulated in four logical passages:

- understanding of goals or general purposes of adaptation;
- defining an overall vision for land development in climate change conditions;
- identification of general and specific objectives;
- proposal of possible options for achieving these objectives.

The goals, defined through the participatory process (Tab.1) were determined for the two impacts chosen: urban heat waves and urban floods.

Impacts	Sectors	Focus Area	Goals
Urban Heat Waves	Human health	<ul style="list-style-type: none"> Increased health risks related to heatwaves 	<ul style="list-style-type: none"> Improving knowledge of all possible effects of extreme weather events on the population and monitoring their development Adapting health infrastructure and strengthening emergency management systems Adequately disseminate the information acquired to the population and develop effective awareness-raising campaigns
	Built environment	<ul style="list-style-type: none"> Potential damage to plant structures in urban environments 	<ul style="list-style-type: none"> Updating urban green planning models and techniques Increasing knowledge of urban greenery to improve heritage management in a situation of thermal stress Raising public awareness of efficient management of private green assets Revision of urban management tools
	Energy	<ul style="list-style-type: none"> Increase in energy consumption by cooling buildings 	<ul style="list-style-type: none"> Updating urban green design models and techniques Increasing the urban green heritage to boost the provision of urban ecosystem services Raising public awareness of appropriate behavior in situations of high thermal stress
Urban Run-off	Built environment	<ul style="list-style-type: none"> Increasing knowledge of the territory, in particular of areas subject to possible flooding Updating urban planning and design models and techniques Raising public awareness of areas vulnerable to flooding Promoting integrated coordination in hydraulic risk management between the different territorial policies Greater damage to infrastructure, disruption of public services, danger to the population 	<ul style="list-style-type: none"> Increasing knowledge of the territory, in particular of areas subject to possible flooding Updating urban planning and design models and techniques Raising public awareness of areas vulnerable to flooding Promoting integrated coordination in hydraulic risk management between the different territorial policies

Tab.1 Goals and Options for Heat Waves and Urban Flooding for CMVe

3.3 Support for the integration of adaptation actions into municipal plans and programs

On the one hand, the actions in the existing instruments of territorial governance (voluntary and/or mandatory) have been modified with an adaptive perspective; on the other hand, new adaptation actions have been inserted. Metropolitan City planning is already very structured by tools and plans that already contain adaptation and mitigation actions. The CMVe Municipalities were offered a questionnaire to verify, within their territorial policies, the presence or absence of adaptation actions (Table 2), to avoid the frustration of what already produced in the territories by public bodies or other actors (waste cycle, water, and wastewater management, mobility, reclamation agencies, ATO, etc.).

This is a very important basis for proper integration/construction of adaptation actions into existing or newly drafted plans and programs.

N	Question
01	Are you aware of what area potentially affected by climate change is currently covered by adaptation measures?
02	If so, what is the surface?
03	Are adaptation measures planned or will be implemented at the end of the project?
04	If so, what area will be affected by these adaptation measures?
05	Are adaptation measures planned or will be implemented five years after the end of the project?
06	If so, what area will be affected by these adaptation measures?
07	Are you aware of particularly vulnerable areas in your area of expertise?
08	If so, what is the surface area of these particularly vulnerable areas?
09	Do you anticipate that at the end of the project the particularly vulnerable areas will disappear?
10	If so, by how much?
11	Do you anticipate that five years after the end of the project, particularly vulnerable areas will change?
12	If so, by how much?

Tab.2 Structure of the survey submitted to the municipalities of the CMVe

For this specific phase, the role of CMVe has been fundamental over the years for having provided technical guidelines that facilitate knowledge sharing and a unique vocabulary for the study and application of the most innovative climate-proof processes. A large body such as CMVe has, in this case, helped to rethink the organization and policies of individual municipalities bringing them progressively towards the interdisciplinary and systemic approach that modern problems require, triggering the virtuous cycle of analysis of needs, planning of interventions, measuring the effects of the processes implemented and possible calibration of new interventions.

The situation of the SEAP and SECAP reported in Fig.6 is indicative of what the CMVe is doing in the environment, climate, and adaptation, both on a large scale (metropolitan), both at a local scale, through actions to support individual municipalities and local authorities.



Fig.6 Situation of the SEAPs and the SECAPs in the CMVe

CMVe is also supporting some local and supra-local projects and plans – in addition to the definition of SECAPs – thanks to the methodology described and carried on. The results obtained up to 2021 are shown in Tab.3.

Action			Municipality
Year	Project	Plan	
2018	Venezia2021: scientific research program for a “regulated” lagoon		Cavallino-Treporti, Chioggia, Dolo, Eraclea, Jesolo, Marcon, Mira, Musile Di Piave, San Donà Di Piave, Venezia
2020	AdriaClim		
2020	STREAM		
2019	Hyperion		
2020		Adaptation Plan (ongoing)	
2019	SAVEMEDCOASTS - 2		City of Venice
2017	I-STORMS		
2016	GreenerSites		
2020	Metropolitan Sustainable Urban Mobility Plan – PUMS (ongoing)		
2019		Metropolitan Strategic Plan with references to territorial resilience	
Ongoing	Capillar interventions of the Consorzio di Bonifica Acque Risorgive for ordinary management of extreme weather events		All the Municipalities of the CMVe

Tab.3 Other projects and plans in the CMVe

Obviously, the City of Venice has been able to start more projects than other municipalities, but many projects (Metropolitan Sustainable Urban Mobility Plan – PUMS, Metropolitan Strategic Plan, Venezia2021) have been started at the metropolitan level or jointly between more municipalities thanks to the intermediation of the CMVe.

4. Discussion

The processes of adaptation need to have an in-depth knowledge of the territories to become shared, effective and efficient and to cope with the specific impacts resulting from CCs (Maragno, 2018; Bezzi et al., 2015). Studying territorial specificities and making them known (Miranda Sara, & Baud, 2014) to policymakers and technical offices is the first step in knowing how to make an informed decision and which actions are the most important. Since the late 1990s, the need to address the dynamics of CC in cities has been recognized at the institutional, academic, and operational levels in urban management practices (Musco, 2008).

It is also demonstrated that an overall vision is fundamental to overcome economic and technical difficulties that municipalities often encounter in initiating processes of adaptation (Ministero dell’Ambiente e della Tutela del Territorio e del Mare, 2014; Ministero dell’Ambiente e della Tutela del Territorio e del Mare, 2017). These operations usually involve different administrations and bodies at the same time. Difficulties may arise for the different roles they can have, for the transcalarity of the actions, for the convergence of needs of more municipalities on a specific theme, and, not least, because the effects of climate change exceed administrative boundaries. Therefore, acting in a coordinated way is as efficient a choice in saving time, resources, and means as it is effective in achieving the goal.

The presence and support of an intermediary body such as MC are crucial for municipalities to facilitate the process at every stage. Indeed, it is found that the main causes of the poor implementation of adaptation

actions at the local level are the lack of awareness of the urgency of adaptation actions to CCs, the absence of a methodological framework, and the lack of analysis of the vulnerabilities of the territory.

The MC, as an intermediary between the regional and local levels, have the opportunity to acquire a leading role, no longer that of a body supporting the Covenant of Mayors, but rather that of guarantors of responsibilities and skills adequate to respond to large-scale problems going beyond the usual dichotomy between strong (rich) and weak municipality (lacking in financial and technical resources).

CMVe's adaptation process has adopted these principles, committing itself from the beginning to support the planning of wide areas. For this reason, it was necessary to increase the levels of knowledge available by making interoperable spatial information on the geomorphological and climatic specificities of the place, as well as on the adaptation practices already initiated by local communities. The process in the Venetian territory has lasted many years and has led to the awareness that climate impacts need to be addressed with a broader perspective (Magni, 2019). Also, it has emerged that the MC can be the most suitable administrative level for information and knowledge support; technical support, and scientific support. Due to this, the CMVe has constructed a method of approach to the planning of the climatic adaptation on a wide area thanks to the various plans that made the MC address the problem of the union and the coordination of strategies and actions to level metropolitan, supporting individual municipalities in defining a broad vision and common lines. As shown in Fig.7, CMVe acted to (specific results are shown in Fig.8):

- support municipalities in the processes of integration of technical knowledge into the technical apparatus and among political decision-makers. This happened thanks to the support in having Covenant of Mayors and thanks to the projects LIFE Master Adapt, LIFE Veneto Adapt, Desk and to the PTC;
- support the establishment of a free and shared metropolitan knowledge framework (DSTs and vulnerability and risk maps). This happened thanks to SEAP_ALPS, LIFE Master Adapt, Interreg Italy-Slovenia SECAP;
- to accompany with a participatory process in the definition of the vision matrix/goals/action that has allowed shared reasoning on a large scale, thanks to LIFE Master Adapt;
- organize actors and stakeholders in a strong and metropolitan way, thanks to LIFE Master Adapt and LIFE Veneto Adapt.

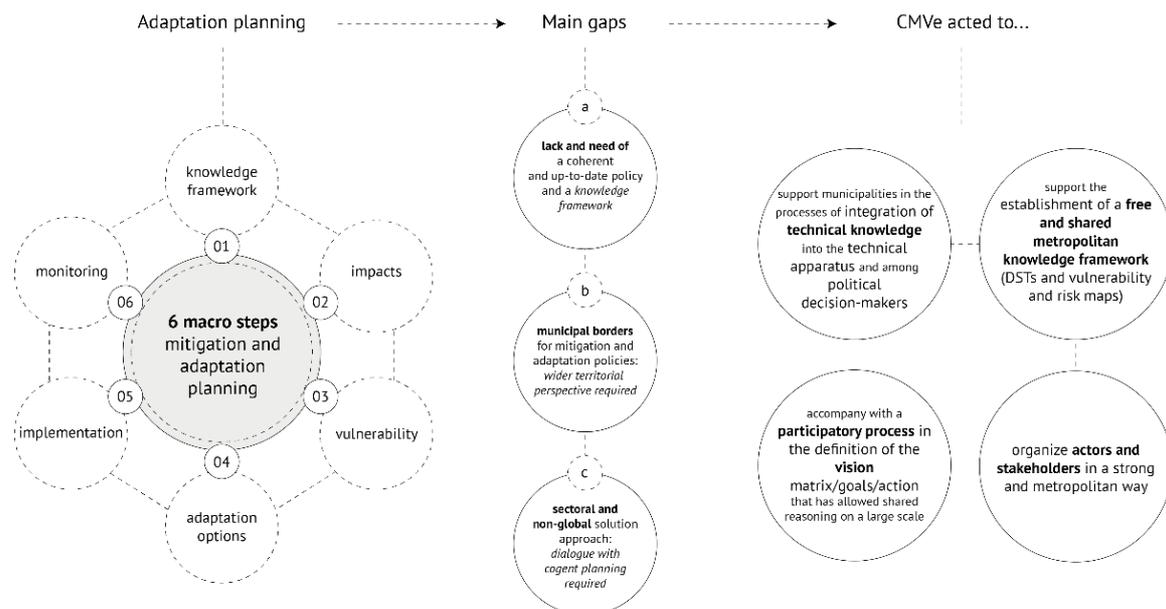


Fig.7 Connection between methodological steps, gaps, and actions in CMVe

As shown in Fig.8, the adaptation processes implemented in the CMVe have been carried out also thanks to external funding – the EU LIFE program, the special resources of the Provveditorato public works, Interreg Italy-Slovenia, Italy-Croatia CBC Programme – which CMVe has been able to direct and manage for all its 44 municipalities.

As the CMVe did, the other Italian MCs should be able to channel in specific projects and implementation in the various Municipalities/Aggregations of Municipalities concerned according to territorial needs. Also, MCs could have the opportunity, thanks to their structure and expertise, to take on the role of representativeness in raising European or national funds, coordinating projects, allocating financial resources and energy, and facilitating the work of connecting the municipal, regional and European levels. MC could also direct the process of integration of adaptation to climate change in tools and processes “ordinary” planning and territorial planning.

The narrated path can be replicable in other MC in the approach and in the result, but not necessarily in the process. Adaptation and climate transition processes, unlike mitigation processes, must be site-specific. Therefore, each MC could start a path differentiated according to starting conditions (Burton & Dredge, 2007), to the available cognitive and economic resources, to the relations between operational planning levels (Laukkonen et al., 2009; Satterthwaite, 2007).

5. Conclusions

As demonstrated above, to integrate adaptation measures into local urban agendas and in the management of cities, it is necessary a reorganization of public structures.

This should happen to make the use of ICT tools widespread and uniform, technical guidelines to facilitate the sharing of knowledge, a unique vocabulary for the study, and application of the most innovative climate-proof processes.

It would also be essential to rethink the organization of individual public administrations and gradually move them towards the interdisciplinary and systemic approach that modern problems require to guarantee the success of such an administrative practice. Another fundamental aspect is that of the now necessary obligatory nature of adaptation and mitigation practices.

The MC can access funds and economic sources through European and National partnerships that would be difficult to find and carry forward for individual municipalities, especially small and medium-sized. Compared to other types of administrative aggregations, the MCs have an autonomous form and a well-structured legal framework that can address policies of the wide area on the issues of climate change. This innovative process took place, for example, in the Venetian metropolitan area with the Territorial Plan of Provincial Coordination, which, starting from a will of the CMVe, has become a virtuous and compelling element of adaptation for each of the municipalities of the MC.

The role played by CMVe over the years intending to direct public policies towards adaptation and mitigation in an increasingly structural way has been of considerable importance and has the value of being replicable in other Italian MC. As the DESK project provided a common approach among MC of Italy for data management, it would be interesting to replicate the approach between MC in the governance of climate-proof planning to move towards homogeneity in the approach to emerging issues regarding the Territorial Government.

The CMVe has been able to develop the described process also thanks to the large sum of funds deriving from European and other financings. In the absence of these, the process can be more difficult. The MC can however engage themselves to take action to find these financings and to modify their administrative structures to facilitate the process of territorial adaptation.

To implement with greater effectiveness and efficiency some innovations within the metropolitan administrative structure, the government could focus on:

- the creation of a team dedicated to climate change: coordination that meets periodically to update and organize the work; a team that deals structurally, within the public administration, the topic; a person who, with the assistance of representatives of other sectors, coordinate work on the subject;
- the definition of a real Metropolitan Strategy for Adaptation able to organize in a single document the goals that the entire vast area poses. Adaptation has a very wide and long-term potential that can be found in a Document and in a formal process in which it is channeled to have greater authority and continuity that formalizes and defines goals and adaptation actions. This can certainly help the effectiveness of mainstreaming and address the salient issues on which the Metropolitan City must work in collaboration with stakeholders and administrative structures, both within the Metropolitan City and the Municipalities belonging. A Metropolitan City endowed in all its local administrative declination of such climate-proof government tool addressed by a single methodological hat would allow the spread with greater speed and effectiveness of sensitivity towards an integrated approach of mitigation and adaptation.
- be aware that many important plans to tackle CC with adaptation or mitigation measures are in the hands of municipalities, which must be appropriately encouraged to do so. The MC has many limits in improving this.

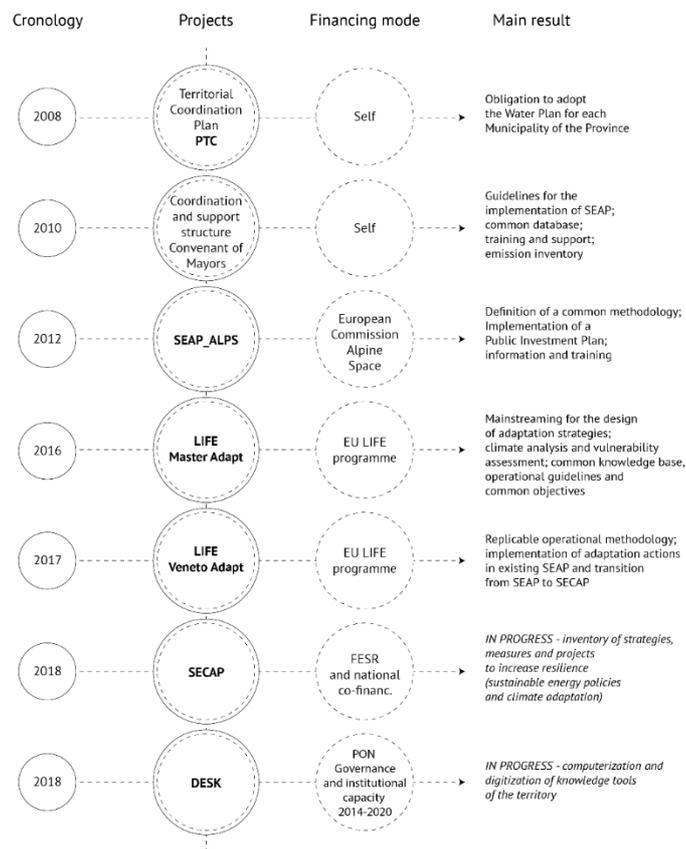


Fig.8 Projects and programs of adaptation planning in the CMVe related with main results

The difficulties of the municipalities in systematically addressing the impacts of climate change and a certain uncertainty in the definition of the direction that has the MCs in Italy can find, in the climate transition project, a renewed mutually positive alliance. The path told happened in the CMVe shows that, despite the numerous difficulties of both municipalities and MCs, the presence and support of a large area local authority can play an indispensable role in supporting climate change and territorial resilience.

References

- Adami, L., Tubino, M., Ragazzi, M., Conti, F. & Rada, E.C. (2020). Local actions for reducing global greenhouse gas footprint: 10 years of covenant of mayors initiative. *International Journal of Sustainable Development and Planning*, 15(2), 247-252. <https://doi.org/10.18280/ijstdp.150216>
- Bezzi, A., Boccali, C., Calligaris, C., Colucci, R.R., Cucchi, F., Finocchiaro, F., Fontolan G., Martinucci D., Pillon S., Turpaud P., Zavagno E., Zini, L. & Toffolon G., (Eds.). (2015). *Impatti dei cambiamenti climatici sul territorio fisico regionale. Studio sullo stato di fatto concernente la conoscenza d'insieme del territorio fisico regionale per la valutazione degli impatti dovuti ai cambiamenti climatici*. Retrieved from: http://www.regione.fvg.it/rafv/export/sites/default/RAFVG/ambiente-territorio/geologia/FOGLIA22/allegati/Impatti_dei_cambiamenti_climatici_sul_territorio_fisico_regionale.pdf
- Bockel, L. (2009). *How to Mainstream Climate Change Adaptation and Mitigation into Agriculture Policies*, FAO. Retrieved from: http://www.fao.org/fileadmin/templates/ex_act/pdf/ppt/Climate_Change_and_Agricultural_Policies_ppt.pdf
- Boggero, G. (2016). The establishment of metropolitan cities in Italy: an advance or a setback for Italian regionalism?. *Perspectives on Federalism*, 8 (3). <http://dx.doi.org/10.1515/pof-2016-0014>
- Burton, D., & Dredge, D. (2007, November). *Framing climate: Implications for local government policy response capacity*. 3rd State of Australian Cities National Conference, 28-30 November 2007, Adelaide, Australia.
- Crivello, S. & Staricco, L. (2017). Institutionalizing Metropolitan cities in Italy. Success and limits of a centralistic, simplifying approach. *Urban Research & Practice*, 10 (2), 228-238. <https://doi.org/10.1080/17535069.2017.1307001>
- Euro-Mediterranean Center on Climate Change. (2021). *Scenari climatici per l'Italia*. Retrieved from: www.cmcc.it/it/scenari-climatici-per-litalia
- European Environment Agency (2016). *Climate change, impacts and vulnerability in Europe 2016*. Retrieved from: <https://www.eea.europa.eu/publications/climate-change-impacts-and-vulnerability-2016>
- Fritzsche, K., Schneiderbauer, S., Bubeck, P., Kienberger, S., Buth, M., Zebisch, M. & Kahlenborn, W. (2014). *The Vulnerability Sourcebook: Concept and Guidelines for Standardised Vulnerability Assessments; Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH: Bonn, North Rhine-Westphalia, Germany*. Retrieved from: <https://www.adelphi.de/de/publikation/vulnerability-sourcebook-concept-and-guidelines-standardised-vulnerability-assessments>
- Gaudio D., Giordano F. & Taurino E. (Eds.) (2014). *Qualità dell'ambiente Urbano X Rapporto Edizione 2014 Focus su Le Città e la Sfida dei Cambiamenti Climatici, ISPRA – Istituto Superiore per la protezione e la ricerca ambientale*. Retrieved from: <https://www.isprambiente.gov.it/files/pubblicazioni/statoambiente/FocussulEcittelasfidadeicambiamenticlimatici.pdf>
- Guerzoni F. & Tagliapietra D. (Eds.) (2006). *Atlante della Laguna. Venezia tra Terra e Mare*. Venice: Marsilio.
- Jabareen, Y. (2013). Planning the resilient city: Concepts and strategies for coping with climate change and environmental risk. *Cities*, 31, 220-229. <https://doi.org/10.1016/j.cities.2012.05.004>
- Keskitalo, E. C. H. (2010). Introduction—adaptation to climate change in Europe: theoretical framework and study design. In *Developing adaptation policy and practice in Europe: Multi-level governance of climate change*. Springer International Publishing AG, Dordrecht, 1-38. https://doi.org/10.1007/978-90-481-9325-7_1
- Laukkonen, J., Blanco, P. K., Lenhart, J., Keiner, M., Cavric, B. & Kinuthia-Njenga, C. (2009). Combining climate change adaptation and mitigation measures at the local level. *Habitat international*, 33 (3), 287-292. <https://doi.org/10.1016/j.habitatint.2008.10.003>
- Lewin K. (1946). Action Research and Minority Problems. *Social Issues*. 2(4), 34-46. <https://doi.org/10.1111/j.1540-4560.1946.tb02295.x>
- Magni, F. (2019). *Climate Proof Planning: L'adattamento in Italia tra Sperimentazioni e Innovazioni*. Milan: Franco Angeli.
- Magni F., Litt G., Musco F. & Carraretto G. (2020a). *Guidelines for Mainstreaming in Groups of Municipalities (Action C3); LIFE Master Adapt. Italy*. Retrieved from: https://masteradapt.eu/wordpress/wp-content/uploads/2020/07/C3_LG_Unioni%20di%20Comuni.pdf
- Magni F., Litt G., Musco F., Carraretto G. & Maragno D. (2020b). *Smart Tools: Interactive Map and Common DSS (Action C3.2); LIFE Master Adapt.*. Retrieved from: <https://www.masteradapt.eu/strumenti/>
- Magni, F., Musco, F., Litt, G. & Carraretto, G. (2020c). The Mainstreaming of NBS in the SECAP of San Donà di Piave: The LIFE Master Adapt Methodology. *Sustainability*, 12 (23), 10080. <https://doi.org/10.3390/su122310080>
- Maragno, D., Musco, F. & Domenico, P. (2017). La Gestione del Rischio di Ondate di Calore e Allagamenti in Ambiente Urbano: Un Modello Applicativo. In *Atti della XX Conferenza Nazionale SIU - Società Italiana degli Urbanisti. Urbanistica e Azione Pubblica. La Responsabilità della Proposta*. 131-140.
- Maragno, D. (2018). *Ict, Resilienza e Pianificazione Urbanistica. Per Adattare le Città al Clima*. Milan: FrancoAngeli.

Maragno, D., dall'Omo, C.F., Pozzer, G. & Musco, F. (2021). Multi-Risk Climate Mapping for the Adaptation of the Venice Metropolitan Area. *Sustainability*, 13, 1334. <https://doi.org/10.3390/su13031334>

Marson, A. (2006). *Il progetto di territorio nella città metropolitana*. Firenze: Alinea Editrice.

Mercalli L. (2011). *Prepariamoci*. Milan: Chiarelettere edizioni.

Miranda Sara, L. & Baud, I.S.A. (2014). Knowledge-building in adaptation management: concertación processes in transforming Lima water and climate change governance. *Environment and Urbanization*, 26 (2), 505-524. <https://doi.org/10.1177/0956247814539231>

Molinario W. (2019). *La sfida dell'adattamento nella pianificazione territoriale: Il ruolo delle Città Metropolitane. The challenge of adaptation in spatial planning: The role of the Metropolitan Cities*. [Master's Degree Thesis, Politecnico di Torino, Corso di laurea magistrale in Pianificazione Territoriale, Urbanistica E Paesaggistico-Ambientale]. Retrieved from: <https://webthesis.biblio.polito.it/11479/>

Musco, F., Maragno, D., Litt, G. & Businaro, G. (2020). Beni Comuni e città climate proof: l'approccio LUCI. *BDC. Bollettino Del Centro Calza Bini*, 20(1), 51-69. <https://doi.org/10.6092/2284-4732/7544>

Musco F., Morello E., et al. (2019). *Linee guida e proposte operative della Città metropolitana di Milano: Azioni pilota su quattro Zone Omogenee*. Retrieved from: https://www.cittametropolitana.mi.it/ambiente/Progetti_ambiente/Progetti-conclusi/cariplo1.html

Musco, F. (Eds.) (2016). *Counteracting Urban Heat Island Effects in a Global Climate Change Scenario*. Charm: Springer International Publishing AG.

Musco, F., Zanchini, E. (Eds.) (2014). *Il Clima Cambia le Città: Strategie di Adattamento e Mitigazione nella Pianificazione Urbanistica*. Milan: Franco Angeli.

Musco, F. (2008). Cambiamenti Climatici, politiche di adattamento e mitigazione: una prospettiva urbana. *Cambiamenti climatici, politiche di adattamento e mitigazione. Archivio di Studi Urbani e Regionali* 93/2008, 5-38. <https://doi.org/10.3280/ASUR2008-093001>

Ministero dell'Ambiente e della Tutela del Territorio e del Mare (2017). *PNACC — Piano Nazionale di Adattamento ai Cambiamenti Climatici*. Retrieved from: <https://www.minambiente.it/sites/default/files/archivio/allegati/clima/pnacc.pdf>

Ministero dell'Ambiente e della Tutela del Territorio e del Mare. (2014). *SNACC — Strategia Nazionale di Adattamento ai Cambiamenti Climatici*. Retrieved from: <https://www.minambiente.it/notizie/strategia-nazionale-di-adattamento-ai-cambiamenti-climatici-0>

Piperata G. (2018). La Città metropolitana nel sistema dei poteri pubblici secondo il giurista. *Urban@it - Centro nazionale di studi per le politiche urbane*. Retrieved from: <https://www.urbanit.it/wp-content/uploads/2018/07/03-la-citta-metropolitana-nel-sistema-dei-poteri-pubblici-secondo-il-giurista-piperata.pdf>

Pablo-Romero, M. D. P., Pozo-Barajas, R. & Sánchez-Braza, A. (2018). Analyzing the effects of the benchmark local initiatives of Covenant of Mayors signatories. *Journal of Cleaner Production*, 176, 159-174. <https://doi.org/10.1016/j.jclepro.2017.12.124>

Rauken T., Mydske P. K. & Winsvold M. (2015). Mainstreaming climate change adaptation at the local level. *Local Environment*, 20(4), 408-423. <https://doi.org/10.1080/13549839.2014.880412>

REN21 Secretariat (2021), *Renewables in Cities 2021 Global Status Report*. Retrieved from: https://www.ren21.net/wp-content/uploads/2019/05/REC_2021_full-report_en.pdf

Romero Lankao, P. & Zwickel, T. (2014). A conceptual framework for an urban areas typology to integrate climate change mitigation and adaptation. *Urban Clim*, 14, 116–137. <https://doi.org/10.1016/j.uclim.2015.07.001>

Satterthwaite, D. (2007). *Adapting to climate change in urban areas: the possibilities and constraints in low-and middle-income nations* (Vol. 1) (IIED working paper 10549). International Institute for Environment and Development. <https://pubs.iied.org/sites/default/files/pdfs/migrate/10549IIED.pdf>

Shmelev, S.E. (2019). *Sustainable cities reimaged: multidimensional assessment and smart solutions* (1st ed.). London: Routledge.

Sistema Nazionale per la Protezione dell'Ambiente (2019). *Rapporto "Consumo di Suolo, Dinamiche Territoriali e Servizi Ecosistemici"*. Retrieved from: <https://www.snpambiente.it/2019/09/17/consumo-di-suolo-dinamiche-territoriali-e-servizi-ecosistemici-edizione-2019/>

United Nations Department of Economic and Social Affairs, Population Division (2019). *World Urbanization Prospects: The 2018 Revision*. Retrieved from: <https://population.un.org/wup/Publications/Files/WUP2018-Report.pdf>

UNFCCC (2008a). *Compendium on methods and tools to evaluate impacts of, and vulnerability and adaptation to, climate change. Final draft report*. Retrieved from: https://unfccc.int/files/adaptation/methodologies_for/vulnerability_and_adaptation/application/pdf/200502_compendium_methods_tools_2005.pdf

UNFCCC (2008b). *Report of the Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol on its fourth session, held in Poznan from 1 to 12 December 2008, Poznan, Poland*. Retrieved from: <https://unfccc.int/sites/default/files/resource/docs/2008/cmp4/eng/11.pdf>

Urban Agenda for the EU (2016). *"Pact of Amsterdam" Agreed at the Informal Meeting of EU Ministers Responsible for Urban Matters on 30 May 2016 in Amsterdam, The Netherlands*. Retrieved from: https://ec.europa.eu/regional_policy/sources/policy/themes/urban-development/agenda/pact-of-amsterdam.pdf

Venice Province (2011). *Protocollo di Intesa tra la Provincia di Venezia e i Comuni del territorio sull'attuazione della politica energetica europea al 2020, per la riduzione delle emissioni di CO₂, l'efficienza energetica e l'utilizzo delle fonti rinnovabili*. Retrieved from: <https://www.cittametropolitana.ve.it/albo-pretorio/documenti-download.html/18666>

Image Sources

All figures are elaborated by Giovanni Carraretto.

Author's profiles

Filippo Magni

Urban planner, Phd, in Planning and Public Policies for the Territory and Master in Estudios Territorials i de la població at the Universitat Autònoma de Barcelona (UAB). Researcher (RTD-A) in Urban Planning and Technology (ICAR/20) at the Department of Culture of the Project of the IUAV University of Venice. Since 2011 he has been actively collaborating with several research groups working on issues related to territorial resilience, including Planning & Climate Change Lab, of which he is a senior member, the Young Planner Ectp-ceu network, and since September 2019, the Eni Enrico Mattei Foundation, where he is an associate researcher. His research focuses on the need to redesign urban planning policies and tools to introduce new approaches to climate adaptation, both ex-ante and structural.

Giovanni Litt

Junior Architect, Urban and Environmental Planner with attention to climate-proof and resilient planning, Phd student. Researcher at the Department of Culture of the Project of the IUAV University of Venice in the Planning & Climate Change LAB. Over the years he has developed a multi-level, metabolic, and multidisciplinary approach to planning, able to reconcile actions and strategies to adapt to Climate Change with Territorial Government and participatory policies. He is specialized in urban resilience related to climate change and social and economic crises in support of Public Administrations, analyzing and assessing shocks and stress, and finding urban and environmental innovation methods and practices with a view to prevention and spatial and community adaptation. Facilitator in participatory processes for the co-planning of interventions of regeneration of public spaces activating local contexts and actors. Assistant to the didactics in different courses of Architecture and Planning.

Giovanni Carraretto

Architect, Graduate in Architecture Construction and Conservation and Architecture and Innovation, at the University Iuav of Venice. He studied at the University of Technology in Vienna. Phd student in Architecture, City and Design, Culture of the Made in Italy Project, Research Infrastructure Integral Design Environment (IR.IDE). Researcher at the Department of Culture of the Project of the IUAV University of Venice in the Planning & Climate Change LAB. Qualified as teaching assistant (ICAR/14 and ICAR/21). He works on issues related to territorial resilience, Internal Areas, and Local Development. Qualified and registered in the Association of Architects, Planners, Paesaggisti, and Conservatories of Venice. He works as a freelancer in an architecture and engineering studio in the Province of Venice and deals with architectural and urban design in the public and private sector.