TeMA

Journal of
Land Use, Mobility and Environment

The special issue collects the proceedings of the Session "Smart and Resilient Cities: Ideas and Practices from the South of Europe" of the European Conference On Climate Adaptation (ECCA), held in Copenhagen in May 2015. The contributions shed light on the relationships between the emerging paradigms of Smart City and Resilient City, providing hints for developing integrated strategies in the face of climate change.

TeMA Journal of Land Use, Mobility and Environment offers papers with a unified approach to planning and mobility. TeMA has also received the Sparc Europe Seal of Open Access Journals released by Scholarly Publishing and Academic Resources Coalition (SPARC Europe) and the Directory of Open Access Journals (DOAJ).

SMART AND RESILIENT CITIES

IDEAS AND PRACTICES FROM THE SOUTH OF EUROPE

SPECIAL ISSUE ECCA 2015

ECCA
2nd European Climate Change Adaptation conference (ECCA)

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

TeMA Journal of Land Use, Mobility and Environment

Special Issue ECCA (2015)

SMART AND RESILIENT CITIES

IDEAS AND PRACTICES FROM THE SOUTH OF EUROPE

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
Lycence: 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

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.

The Italian *National Agency for the Evaluation of Universities and Research Institutes* (ANVUR) classified TeMA as scientific journal in the Area 08. TeMA 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 3.0 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.

TeMA Journal of Land Use, Mobility and Environment

Special Issue ECCA (2015)

SMART AND RESILIENT CITIES
IDEAS AND PRACTICES FROM THE SOUTH OF EUROPE

Contents

TeMA
Journal of
Land Use, Mobility and Environment

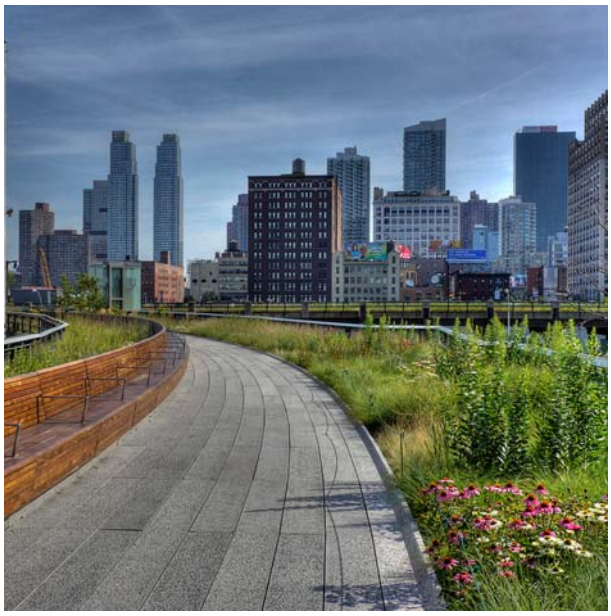
TeMA ECCA 2015 | SPECIAL ISSUE | 63-80
print ISSN 1970-9889, e- ISSN 1970-9870
DOI: 10.6092/1970-9870/3658

review paper received 22 September 2015, accepted 7 October 2015

European Climate Change Adaptation Conference (ECCA) 2015

Copenhagen, 12-14 May 2015

How to cite item in APA format:
Papa, R., Galderisi A., Vigo Majelllo, M.C., Saretta, E.. (2015). European cities dealing with climate issues. Ideas and tools for a better framing of current practices. *Tema. Journal of Land Use, Mobility and Environment*, 8 (Special Issue ECCA 2015), 63-80. doi: http://dx.doi.org/10.6092/1970-9870/3658



EUROPEAN CITIES DEALING WITH CLIMATE ISSUES

IDEAS AND TOOLS FOR A BETTER FRAMING OF CURRENT PRACTICES

R. PAPA[a], A. GALDERISI[b], M. C. VIGO MAJELLO[c], E. SARETTA[d]

[a, b, c, d] Department of Civil, Architectural and Environmental Engineering (DICEA) – University of Naples Federico II
e-mail: [a] rpapa@unina.it; [b] galderis@unina.it;
[c] majellomcr@gmail.com; [d] erika.saretta@gmail.com
URL: http://dicea.dip.unina.it/

ABSTRACT

Contemporary cities have to deal with numerous challenges, from the growth and aging of urban populations to the scarcity of resources; from environmental degradation to climate change. Climate-related impacts on urban areas are becoming one of the most urgent challenges for urban development: cities are the main contributors to energy consumption and GHG emissions, paying also the highest price for the climate impacts. Thus, climate issues have gained increasing importance in the last decades, both in terms of the metaphors coined by scholars (low-carbon cities, transition cities, smart cities, resilient cities, etc.) and in terms of the initiatives undertaken on different institutional levels. Unfortunately, mitigation and adaptation are generally regarded as two different approaches, neglecting the potential synergies and trade-offs between the related strategies. Hence, based on the growing awareness of the need for mainstreaming mitigation and adaptation policies at city level, this study will provide an overview of the state of the art of the mitigation and adaptation initiatives in Italian metropolitan cities. Then, focusing on the concepts of the "smart" and the "resilient" city – as key concepts for reducing CO_2 emissions and improving the ability of cities to respond to climate impacts – and with reference to a conceptual framework for building up a smart and resilient urban system carried out in previous research works (Papa et al., 2015), the study will examine case studies of Rotterdam and Barcelona, highlighting how this framework may improve our understanding and contribute to better integration of the fragmented on-going strategies and initiatives.

KEYWORDS:
climate change, urban adaptation, integrated climate strategy

1 CITIES AND CLIMATE CHANGE

Contemporary cities have to deal with numerous challenges, ranging from the growth and aging of urban population to environmental degradation, from the scarcity of resources (from energy to water or land) to the impacts of climate change (Batty et al., 2012). Among these multiple and often interconnected challenges (Galderisi, 2014a), climate change seems to currently represent the main threat to urban development in the near future: cities are indeed the main contributors to energy consumption and GHG emissions paying, at the same time, the highest price for increasing climate impacts. Numerous scholars highlight that CO2 emissions, mainly due to urban activities, represent about 80% of GHG emissions, which are, in turn, the main cause of the increased climate-related hazards currently threatening urban populations and assets throughout the world (Revi et al., 2014).

Considering that urban areas nowadays host more than half of the world's population and most of its strategic assets and economic activities, the urgent need clearly arises to develop both short term strategies - capable of improving the ability of cities to face already significant climate impacts (adaptation) by reducing urban vulnerability to climate-related hazards - and long term strategies - able to reduce CO_2 emissions (mitigation), by sustaining the transition of cities towards a low carbon development model.

So far, mitigation and adaptation have often been regarded by scholars, and even more so by policy makers, as two different ways "to deal with the same problem" (Biesbroek et al., 2009), neglecting the potential synergies and trade-offs between the related strategies.

In Europe for example – which is considered one of the world leaders in global mitigation policies – ambitious objectives to mitigate climate change have been established by the EU 20-20-20 Strategy since 2007. In 2011, the "2050 Energy Roadmap" set new long-term targets, aiming to achieve a further reduction of GHG emissions by 2050 (the 80-95% compared to 1990 consumptions). On the other hand, adaptation issues have only recently gained some importance: the EU Strategy on adaptation was adopted in 2013 and the Mayors Adapt Initiative, aiming to involve European cities in climate adaptation, was set up in March 2014. A similar fragmentation can be noticed when looking at the numerous and heterogeneous "labels" recently brought into the planners' language and concerned with the future of cities from the point of view of climate related issues (smart cities, resilient cities, transition cities, low-carbon cities, etc.). The different terms and approaches have led to a proliferation of initiatives and tools, often scarcely coordinated among themselves and scarcely integrated into ordinary urban planning processes. The most common labels, i.e., Smart City and Resilient City – whereby numerous initiatives to counterbalance climate change have recently been undertaken – refer, for example, to two different pathways addressing climate issues, being "smart" initiatives and projects mainly focusing on climate change mitigation, by reducing energy consumption and greenhouse gas emissions through a widespread use of ICTs (EIP, 2013), and "resilient" initiatives mainly addressed to adapting cities to climate-related impacts, reducing urban vulnerability (Hordijk, Baud, 2011). Studies and practices relating to the Smart City concept devote large room to the efficient use of energy resources and the reduction of current levels of consumption (Karnouskos et al., 2013, Kramers et al., 2014), emphasizing the potential for ICTs to improve urban energy performance (Mosannenzadeh, Vettorato, 2014). On the other hand, studies and practices relating to the Resilient City concept are mainly addressed to improving cities' abilities to react quickly and effectively to existing and future climate impacts in an equitable and efficient way (The World Bank, 2011).

Obviously, mitigation and adaptation strategies are characterized by different objectives as well as by different temporal and spatial scales of reference (Galderisi, 2014b). The former, aimed at reducing GHG emissions, generally result from international agreements, albeit implemented at national or local levels, and refer to a long-term perspective. Adaptation strategies, aiming to adjusting natural or human systems in response to actual or expected climatic stimuli or their effects (UNISDR, 2009), generally comprise short to

mid-term measures, identified and implemented at local level, and tailored to the specific site and providing local benefits (Bulkeley et al., 2009; Walsh et al., 2011). Nevertheless, over the last decade, numerous scholars and institutions have pointed out the need to carry out an overall response to climate change, able to mainstream mitigation and adaptation into the broader perspective of sustainable urban development (Dang et al., 2003; Biesbroek et al., 2009) by combining long-term policies to reduce GHG emissions, with short-medium term strategies to reduce the impacts of climate-related events (Klein et al., 2005; Jones et al., 2007). The World Bank has recently emphasized that mitigation and adaptation are both essential and complementary for "maximizing the benefits of actions taken and ensuring that any action taken in pursuit of one goal does not undermine progress toward the other" (The World Bank, 2015).

Furthermore, urban planning has been recognized by some scholars as "one of the policy areas with leverage in both mitigation of and adaptation to climate change" (Davoudi, 2009), and the potential offered by urban planning to support an integrated approach, capable of amplifying the potential synergies, avoiding likely conflicts by framing mitigation and adaptation measures into the broader perspective of sustainable development, has been widely remarked (UN, 2012; Kelman et al. 2015).

Thus, over the last few years, awareness that mitigation and adaptation policies at city level should be better integrated and that urban planning might play a crucial role in achieving such a goal is growing rapidly, and it is taking root among scholars and in some pioneering practices. Nevertheless, a robust theoretical framework able to support the development of integrated and multi-objective initiatives is still missing.

Therefore, based on the awareness that an integrated climate strategy is not only desirable but also necessary in an era of limited resources, in what follows we will firstly outline the state of the art of the mitigation and adaptation initiatives so far undertaken in the Italian metropolitan cities; then we shall analyze, with reference to a conceptual framework for building up a smart and resilient urban system carried out in previous research works (Papa et al., 2015), two case studies, i.e., Rotterdam and Barcelona, which are far ahead of the Italian Metropolitan Cities on the path towards a comprehensive climate strategy, in order to highlight how this conceptual framework may allow us to better understand the on-going practices and, above all, to better guide them towards an integrated climate policy, overcoming the current fragmentation of mitigation and adaptation strategies and initiatives.

2 MITIGATION AND ADAPTATION PRACTICES IN THE ITALIAN METROPOLITAN CITIES

Among the European Member States, the Covenant of Mayors initiative, set up in 2008, was very successful in terms of the number of signatory cities in Italy. In order to meet the European Union target of a 20% CO_2 reduction by 2020, the initiative was geared to increase energy efficiency and the use of renewable energy sources at local level through the implementation of the Sustainable Energy Action Plans (SEAP). Nevertheless, even though most Italian cities have adopted the SEAP, few have started an effective mitigation process and even fewer are working on monitoring the results achieved. As regards adaptation, it should be outlined that the parallel initiative, the Covenant of Mayors Initiative on Climate Change Adaptation, only began in 2014. The initiative aimed to strengthen cities' resilience to the expected impacts of climate change, by developing a comprehensive local adaptation strategy, or integrating adaptation into relevant existing plans. Although more than half of the 100 signatory cities are represented by Italian Local Authorities, at the moment, very few Italian Cities have started an adaptation process and only one has approved an Adaptation Plan.

Beyond the specific Plans adopted in response to the initiative launched by the European Union, numerous, but fragmented, projects and initiatives to counterbalance climate change have also been undertaken in Italy. We will thus focus here on all the initiatives concerning climate issues recently promoted by the ten

Italian Metropolitan cities established under National Law 56/2014, i.e., Turin, Milan, Venice, Genoa, Bologna, Florence, Bari, Naples and Reggio Calabria (fig. 1) – in which the majority of people, strategic assets and economic activities are located. According to the Italian Constitution, these cities are autonomous entities with their own statutes, powers and functions, and they have crucial responsibilities, such as the strategic development of their territory. Therefore, on the one hand, they urgently require effective strategies to increase their ability to function in the face of climate-related impacts and on the other hand, given their crucial role, they represent the engine for starting and testing new development processes, promoting transition towards low carbon development models by reducing energy consumption and related GHG emissions.

Analysis of on-going practices has been carried out using the documents freely available on the web and has taken into account the approved mitigation and adaptation plans or those still being developed, as well as initiatives and projects promoted under the Smart City and Resilient City "labels".

Despite the lack of universally shared definitions of these increasingly widespread urban labels, most of the Italian Metropolitan cities have recently launched research projects and initiatives under the Smart City flag, ranging from the promotion of renewable energy sources (e.g. for transport and urban mobility) to the reduction of energy consumptions by improving energy efficiency at different scales (from building to city level). On the other hand, very few Italian Metropolitan cities have undertaken specific initiatives under the Resilient City flag, through participation in campaigns promoted by large international organizations (UNISDR, Rockefeller Foundation, etc.).

The time window 2008-2015 has been chosen as a reference for our analysis; the starting point has been set in 2008 as this was the year that the "Covenant of Mayors" was launched. It is also worth recalling that numerous mitigation initiatives have been undertaken since 2009, following the establishment of the Strategic Energy Technology Plan (SET Plan) by the European Commission. The SET Plan, whose main goal was the reduction of CO_2 emissions, identified Smart Cities as one of the seven investment priorities for the transition towards a low carbon future. Adaptation issues gained relevance from 2012 - after the launch of the second phase of the "Making Cities Resilient" campaign, begun by the UNISDR in 2010 – becoming more and more widespread after the adoption of the EU Adaptation Strategy in 2013.

However, it is important to recall that the Italian National Strategy for Adaptation to Climate Change (SNACC) – which identifies urban settlements as one of the strategic areas to promote adaptation actions - was only set out in July 2014.

The graph in fig. 2 provides an overview of the mitigation and adaptation initiatives for dealing with climate change adopted by the Italian metropolitan cities. According to the collected data, 9 out of 10 metropolitan cities are committed to reducing CO_2 emissions through mitigation plans and/or mitigation initiatives promoted as part of the Smart City projects at city level. On the other hand, only 4 out of 10 cities (Bologna, Venice, Rome and Milan) have started the process of outlining an adaptation plan or have joined an international initiative to enhance urban resilience.

It is worth noting that the most active cities in promoting mitigation and/or adaptation initiatives are involved in European research projects allowing participants to access funds. From the "GELSO" (ISPRA, 2014) Italian database of best practices for local sustainability, Bologna carried out some mitigation and adaptation initiatives through funds received by the Research and Technological Development Framework Programme, the Central Europe Programme and the Intelligent Energy Europe Project, to a total of 22 million euro. Also, some Southern cities (Naples and Bari) financed part of the mitigation initiative thanks to the Research and Competitiveness 2007-2013 National Operational Programme (PON) or the "POR FESR AXIS VII".

Fig. 1 The Italian metropolitan cities

Summing up, this analysis highlights a significant imbalance between mitigation and adaptation initiatives, pointing out that to date, most of the efforts have been addressed to developing mitigation strategies. All the cities considered have approved, or are going to approve, the SEAP, and most of them are involved in research projects focusing on energy efficiency, smart grid development, or promotion of the use of renewable energy sources, with the sole exception of the city of Reggio Calabria.

On the other hand, adaptation is at a very early stage. Although cities are considered pivotal to both mitigation and adaptation issues, only two cities are currently developing an Adaptation Plan, and only one of them (Venice) has joined the UNISDR "Making Cities Resilient" campaign as a "Role Model" city, since the city had already promoted good practices and innovation in disaster resilience, and two of them (Rome and Milan) have recently joined the "100 Resilient Cities" initiative promoted by the Rockefeller Foundation with a view to building up a roadmap for improving resilience in the face of the numerous challenges that cities have to deal with (physical, social, economic, etc.), including extreme events due to climate change.

It is worth noting that all the cities dealing with adaptation issues are located in the North of Italy. The southern cities have neither plans nor adaptation initiatives geared to increasing urban resilience.

Moreover, according to the overview provided, it is evident that none of the cities analyzed have undertaken a move towards developing an integrated strategy to counterbalance climate change, overcoming the traditional approach to mitigation and adaptation goals.

A more in-depth analysis of the plans and initiatives undertaken by the Italian metropolitan cities provides the opportunity for some further consideration. Despite the lack of a comprehensive urban climate strategy in the cities analyzed, some preliminary signals of an increasing awareness that a cross-sectoral approach to climate change is becoming more urgent are emerging. For example, in the case of Venice, the SEAP (2012) clearly outlines the need for an adaptation strategy capable of integrating the mitigation policy already embarked upon. Also in the case of Bologna, the SEAP (2012) outlines that a climate change strategy at city level needs to be developed taking into consideration both energy efficiency and adaptation issues. Even more explicitly, the Action Plan for Sustainable Energy and Climate approved by the city of Milan in 2014 remarks that mitigation and adaptation strategies share the same policy levers, requiring shared tools in order to implement them (e.g. urban planning, building regulations, etc.).

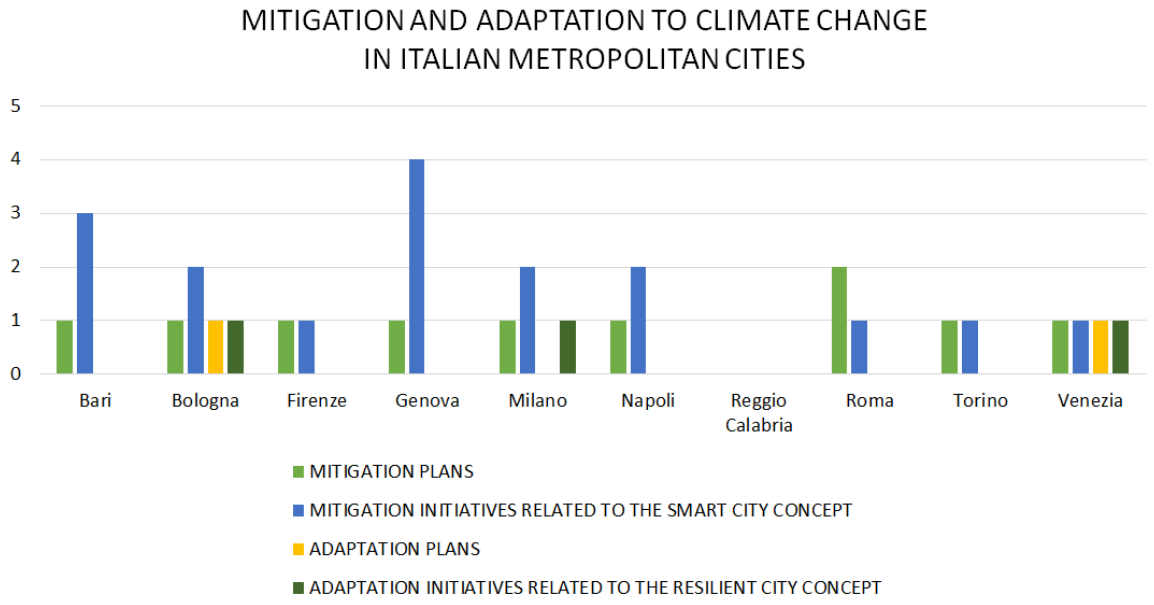


Fig. 2 Recap of mitigation and adaptation measures in the ten Italian metropolitan cities

Thus, available documents underline that - although effective tools for developing integrated strategies and measures to counterbalance climate change are still missing - some preliminary steps towards cross-sectoral approaches to climate change have been undertaken, although they have so far mainly been restricted to mere will statements. To reverse current trends and save the more and more limited economic and financial resources, more effective steps along this path are required, such as a closer cooperation between the various city departments, which generally act independently, as well as the "adaptation" of the ordinary urban planning processes (Moccia, 2010) and their tools to better frame the fragmented climate strategies.

3 A CONCEPTUAL TOOL FOR ANALYZING AND DRIVING SMART AND RESILIENT INITIATIVES IN THE FACE OF CLIMATE CHANGE

As stated above, despite the growing awareness that an integrated strategy to counterbalance climate change is increasingly necessary, a robust theoretical framework capable of guiding the development of an integrated and multi-objective climate strategy is still missing.

On the one hand, mitigation and adaptation strategies have been developed separately and at different times at European level, resulting in fragmentation of the relative tools at city level and a significant delay in the start of adaptation plans. On the other hand, the two concepts of Smart City and Resilient City - which have increasingly drawn the attention of decision-makers and scholars involved in climate studies over the last few years, as witnessed by the numerous mitigation and adaptation initiatives promoted under these labels – have generally been developed and conceptualized separately.

Nevertheless, some authors have recently emphasized the increasing overlap between these concepts: despite smart initiatives having so far essentially focused on energy sector, indeed, the most recent approaches to smart cities clearly show the need to drive these initiatives to better cope with global pressures (climate change, poverty, natural hazards, etc.) as a key to improve the quality of life of the citizens (Greco, Bencardino, 2015). Moreover, the goal of enhancing urban resilience in the face of the most urgent challenges affecting urban development is becoming more frequent among the Smart Cities' objectives and, as remarked by Kunzmann (2014), smart initiatives are often designed to allow cities to "become more livable and resilient and, hence, able to respond quicker to new challenges". From this perspective, some international organizations and networks are promoting integrated strategies to build up

smarter and more resilient cities, as a key step to effectively counterbalancing the challenge of climate change, as well as pursuing better integration between mitigation and adaptation strategies (Klein et al., 2005). The American Planning Association (APA), for example, has created a Smart Cities and Sustainability Task Force, whose mission is to exploit advances in technology and innovation to build up smarter, more resilient and sustainable cities; the Asian Cities Climate Change Resilience Network (ACCCRN), funded by the Rockefeller Foundation, is striving to develop smarter and more resilient cities in India.

Nevertheless, as mentioned above, an effective theoretical framework to drive urban strategies towards building up smart and resilient urban system in the face of climate change is still lacking: current literature provides some conceptual frameworks aimed at better framing smart initiatives (Chourabi et al., 2012; Neirotti, 2014) or enhancing urban resilience in the face of different pressures (Tyler and Moench, 2012; Galderisi and Ferrara, 2012; Desouza and Flanery, 2013), neglecting the potential synergies between these concepts. To fill this gap, a conceptual framework capable of framing the characteristics of a smart and resilient urban system throughout the different temporal phases that characterize cities' responses to climate change, and with the aim of guiding planners and decision-makers in developing a comprehensive climate strategy, has been outlined in a recent research work (Papa et al., 2015).

In referring to this research for a detailed description of the steps leading to the definition of the conceptual framework and of the meanings, roles and interconnections of the various characteristics, it is important to recall here that the structure of the model (fig. 3) is that of a cyclical process developing over the different time spans (short, medium and long term) that characterize the response of a complex urban system in the face of climate change (Salat and Bourdic, 2012). The cyclical process is grounded in continual learning (Cutter, 2008; Davoudi, 2012) and is characterized by the "dynamic interplay of persistence, adaptability and transformability" (Folke et al., 2010), allowing urban systems to extend their focus beyond resistance to shock, through the inclusion of adaptive responses, as well as long-term transformation in response to future or unforeseen threats (Galderisi, 2014a).

In more detail, learning capacity, persistence, adaptability and transformability are classified as the key properties of a smart and resilient urban system, the main goals to which strategies and measures have to be geared in order to improve cities' responses in the face of climate change. The cyclical structure of the process is also characterized by three different stages (strategy definition, implementation and management), connected by a feedback loop: such a structure emphasizes that a smart and resilient urban system does not represent a "fixed state" (Davoudi, 2012), but is the result of a dynamic and continuous development process.

Learning capacity, which is at the core of the process, allows the system to start, revise or change the strategies to achieve the key characteristics of a smart and resilient city. Based on ICTs and according to the uncertainties of climate scenarios, learning capacity can support the development of climate strategies (Linkov et al., 2006) that can be continuously updated in the light of variable conditions and information.

Despite the dynamic interplay of the selected characteristics through both time and space, it is worth noting that each of them gains prominence along a different time span. In the short term, strategies are generally adopted with a view to improving cities' ability to withstand the expected (or the most likely) climate-related impacts, by increasing the persistence of a system. In the medium term, strategies aim to enhance a city's capacity to cope with unexpected impacts by improving a system's adaptability. In the long term, strategies to improve a city's transformability should drive urban transition towards new an original development models, capable of reducing the energy footprint of the city and, in so doing, prevent future climate-related impacts. All the selected characteristics have been placed in a hierarchy within a given model, and related to one or more of the key characteristics identified on the basis of their meaning and relevance.

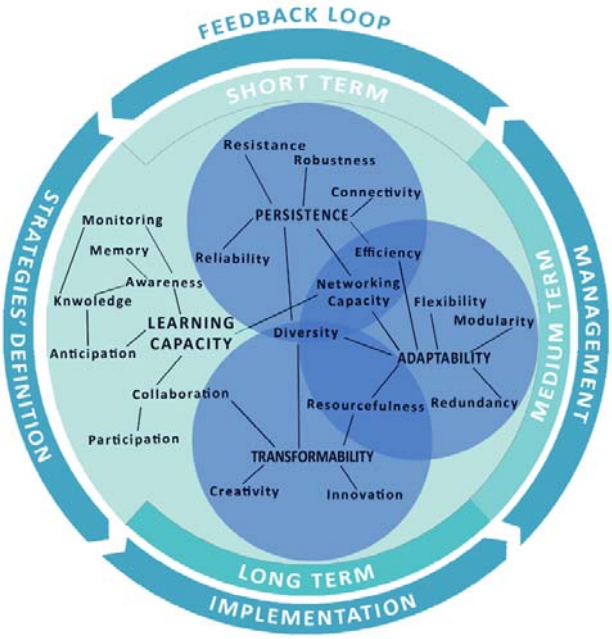


Fig. 3 Framing roles and linkages among the characteristics of a Smart and Resilient Urban System in the face of climate change

4 ARE EUROPEAN CITIES ON THE WAY TO AN INTEGRATED CLIMATE STRATEGY? TWO CASE STUDIES

Based on this framework, we can examine two case studies of cities striving to promote smart and resilient initiatives as a key step in the progress towards an integrated climate strategy. We focus on the smart and resilient initiatives undertaken by two European cities – Rotterdam in the north, and Barcelona in the south of Europe – in order to better understand which of the primary and secondary selected characteristics are taken into consideration in the on-going practices.

The choice of the two cities, both of them outside Italy, was dictated by the significant imbalance between mitigation and adaptation initiatives that characterizes Italian cities. As can clearly be seen from the state of the art in the Italian Metropolitan cities as portrayed above, except for a few cases still, however, at a very early stage, mitigation and adaptation plans are developed as sectoral tools, and effective linkage among smart and resilient initiatives is still lacking. Current strategies are strongly focused on mitigation issues, with limited attention to urban adaptation, even though some of the analyzed documents emphasize the need to promote cross-sectoral and multi-objective strategies capable of reducing GHG emissions by improving, in the meantime, urban safety in the face of climate impact.

On the other hand, the city of Rotterdam, which has a long history of water management, adopted a smart strategy specifically addressed to improving urban resilience after two major flood events during the twentieth century. Such a strategy earned the city an award in 2014 - The New Economy Smart Cities Award – for its efforts in tackling climate issues and promoting its image as the most sustainable port in the world. Similarly, the city of Barcelona, after a number of infrastructures failures in 2007, including a power outage that left over 300,000 users without electricity for 3 days, developed strategies to improve the resilience of urban services through smart urban design (Chelleri et al., 2013). The two selected case studies significantly differ in demographic size, broader economic weight, environmental features, and expected climate-related impacts. Nevertheless, they have some similarities: they share the idea that resilience may represent one of the key vectors for moving towards the smart city, and both of them have promoted a Public-Private

Partnership to implement, promote and manage an integrated climate strategy (The Rotterdam Climate Initiative and the Barcelona Resilience Group).

Our study of the strategies and measures adopted by the two cities is based on the documents and reports available on dedicated web platforms (Rotterdam Climate Initiative and Barcelona Smart City). The available documents were used to carry out a screening of the main strategies and related measures undertaken on the national and local level and the crucial factors determining current policies. Then, taking the conceptual framework briefly presented above as a reference, the current strategies and measures were analyzed in order to assess if and how they contribute to improve the different characteristics of a smart and resilient urban system and, in so doing, to promote an integrated approach to climate issues.

4.1 THE ROTTERDAM CLIMATE STRATEGIES

In the last decade, Rotterdam has undertaken a sustainable development policy aiming to integrate smart and resilient initiatives in the face of climate change. The city has always dealt with water issues, since 1953 when a significant flood killed almost 2000 people. Thus, to better understand current policy, three main factors have to be considered: the morphological features of Rotterdam itself, the size and role of the city, and the importance of establishing a public-private partnership for dealing with climate change. Rotterdam is a river town with 80% of the urbanized area below sea level: this particular morphology has always forced Rotterdam to find strategies to cope with flood issues (Lu, Stead, 2013). As regards the second factor, it is worth noting that Rotterdam city – the second city in the Netherlands, covering an area of 319,35 km² and counting about 610,386 inhabitants – is part of the "Randstad" metropolitan area which covers an area of about 542 ha, with about 1,003,088 inhabitants, and its port area plays a crucial role on both national and European level. Concerning the third factor, it must be underlined that a Public-Private Partnership – the Rotterdam Climate Initiative (RCI) – has been running since 2006. It comprises the Municipality of Rotterdam, the Rijnmond Environmental Protection Agency (DCMR), the Port Authority and the Deltalinqs (Group of Industrial and Logistic societies in the Port of Rotterdam) to promote and implement smart initiatives in order to increase urban and regional capacity to cope with climate change impacts in view of the 2050 scenario forecasts.

Smart and Resilient initiatives are part of a well-established and interconnected framework of mitigation and adaptation strategies carried out on different (national and local) geographical scales and mostly developed between 2007 and 2010. In detail, on the national level, the National Adaptation Strategy (NAS) and the Delta Programme represent the main points of reference for Water Plan 2 and the Rotterdam Climate Change Adaptation Strategy (RCCAS), both of which are carried out at the local level. Furthermore, at national level, great attention has also been devoted to the question of mitigation, as witnessed by the Energy Agreement for Sustainable Growth and the Climate Agenda (2013), whereas at local level, the most interesting initiative is the Rotterdam Energy Approach and Planning (REAP), carried out in 2009 and supported by the Rotterdam Climate Initiative in order to develop a methodology for the effective integration of CO_2 emissions and energy issues in urban planning processes.

The NAS – *Make Space for Climate* (2007) – referring to the 2050 scenario forecasts and based on an analysis of past events, provides a comprehensive picture of the expected vulnerabilities and risks in the Netherlands and promotes an adaptation policy mainly focusing on the impact of climate on the social and economic sectors. The Delta Programme (2014) is a strategic plan aiming to improve the safety of the Netherlands from flooding, by ensuring water safety and a sustainable and resistant freshwater supply by 2050. Started in 2010, the Programme is currently in its fifth edition. The measures promoted by the Delta Programme mainly focus on disaster prevention and articulated on five axes: three of them refer to thematic

measures (Water Safety, Freshwater Supply, Spatial Adaptation), and the others to specific geographical areas (the Rhine-Meuse and the Ijsselmeer Region).

As regards local adaptation strategies, Water Plan 2 (2007) focuses on water management over the 2007-2030 time span and frames the projects that have to be primarily undertaken in the next years, grouping them into four main sectors (protection, clean water, attractive city, sewers). The RCCAS (2008) aims to transform water from being a threatening factor into an opportunity for city development, and to make Rotterdam a climate-proof city by 2025. The strategy comprises five axes of intervention (Hydraulic Safety of the Delta of Rotterdam; Accessibility of the Port for Freights and Passengers; Adaptive Buildings; Urban Water System; Climate City improving Urban Environment and Quality of Life) and is based on three pillars: knowledge, marketing communication, and actions.

Shifting to the mitigation strategies and focusing on the local level, it is worth mentioning the Rotterdam Energy Approach and Planning (REAP) methodology (2009) aiming to support a 50% reduction in CO_2 emissions in the Rotterdam region (city and port) by 2025, compared with the 1990 emissions (Tillie et al, 2009). Based on these briefly described strategies, current measures have been analyzed in depth in order to assess how they contribute to improving the key properties of a smart and resilient city and their related characteristics as sketched in the conceptual model presented above (Fig. 3) and, in so doing, to promote an integrated approach to climate-related issues.

Learning capacity – All the strategies carried out on national and local level assign a key role to learning capacity and, above all, to the improvement and dissemination of the available knowledge. In the Delta Programme, for example, in-depth knowledge of the water safety infrastructures, as well as of their level of maintenance, is a key tool for increasing ability to prevent future flooding events. Furthermore, the RCCAS is based on the Dutch national research programme, 'Knowledge for Climate', which provides an in-depth knowledge base relating to climate effects, such as rising sea levels, the increase in cloudbursts, periods of drought and higher temperatures. Building up effective monitoring systems to continuously update the available knowledge is also considered a crucial factor in guaranteeing the review of climate strategies and actions. Besides knowledge and monitoring, much attention is given over to networking ability as a key to sharing and exchanging knowledge and best practices. To this end, the Delta Programme Knowledge Network has been established within the Delta Programme itself: it is worth recalling that Rotterdam is also part of the 'Connecting Delta Cities', which is, in turn, part of the wider C40 cities network.

Persistence – It must be underlined that both the RCCAS and Water Plan 2 are tasked with combining grey measures (structural measures) and green infrastructures to improve urban ability to cope with floods. In more detail, numerous measures aim to maintain and improve the robustness of the existing network of storm surge barriers and dikes, canals and lakes, sewers and pumping stations that have always protected the city from the water. Moreover, a network of green infrastructures has been put in place to improve the city's ability to deal with floods and heat waves, by creating benefits for the natural environment and new recreational areas for citizens.

Adaptability – The Rotterdam climate strategies include numerous measures to improve the flexibility and diversity of the urban system: adaptive buildings (e.g. Floating Pavilions) and adaptive public spaces (e.g. water plazas, the redesigning of the river Meuse, Tidal Park), green facades and green roofs.

Transformability - The Rotterdam climate strategies also include long-term measures to reduce energy consumption and CO_2 emissions, by innovating the design of the urban settlements at both structural and neighborhood levels.

Fig. 4 The Rotterdam's Solar-Powered Floating Pavilion: a "flag" project for a climate-proof urban Development.

Furthermore, the Rotterdam Climate strategies promote a new pathway to favor citizen collaboration and participation: citizens are involved in the design and maintenance of small green areas designed to improve rainwater absorption in the case of heavy rainfall, with the ultimate aim of enhancing air quality and providing other ecological benefits.

However, it is worth emphasizing that measures addressed to improving both adaptability and transformability have so far been mainly conceived as "flag" projects to be tested and then extended on a larger scale. For example, thanks to their innovative building materials, as well as innovative systems to improve internal comfort, the Floating Pavilions have been designed as pilot buildings capable of reducing CO_2 emissions.

4.2 BARCELONA SMART AND RESILIENT STRATEGIES

The city of Barcelona covers an area of about 102 Km^2 and counts 1.6 million inhabitants, while its metropolitan area covers an area of about 803 Km^2 and has 4.5 million inhabitants. The city is characterized by a great entrepreneurial spirit, significantly focused on innovation. Also thanks to this feature, the city embraced a Smart Strategy for social, economic and urban development in 2011. The Strategy is based on cross-sectoral measures to promote sustainable urban development by improving the green economy, high-speed connections between the city and its Metropolitan Area, and by pursuing an energy self-sufficient and zero-emission city policy, where nature holds a prominent role. This Strategy includes numerous projects that, by working together and integrating technology and innovation, address different issues and, above all, a more efficient management of the city's services and resources.

In 2009, in the wake of a number of incidents that occurred in 2007 and that stressed the need to increase urban resilience to guarantee the security and continuity of its services in an emergency, the Barcelona City Council launched a Resilience Strategy, guided by the Barcelona Resilience Board for Infrastructure and Services Supply (TISU) and the Barcelona Resilience Group (BRG), a public-private association established in

2008, which includes different stakeholders (Universities, large scale and local companies, local Authorities, etc.). Specifically, the BRG is in charge of coordinating different sectors of local government, private operators, infrastructure owners, and other administrations. This Strategy aimed to drive cross-sectoral projects for reducing urban vulnerability and guaranteeing the operational continuity of the city's services in the event of hazardous events. As a result of the Resilience Strategy, due to its efforts to reduce the vulnerability of critical infrastructure and to ensure the continuity of urban services, the United Nations recognized Barcelona as "a role model for urban resilience" in April 2013.

The smart and resilient strategies in Barcelona are supported by a robust framework of mitigation and adaptation strategies at national level issued in 2006-2007 (such as the Spanish Strategy of Climate Change and Clean Energy; the Strategy for Energy Saving and Efficiency in Spain; the National Plan for Adaptation to Climate Change).

At local level, the institutional web platform - the Barcelona Smart City - comprises 122 projects, classified into 24 programs relating to 10 smart city areas (e.g. public and social services, environment, mobility, etc.). All these projects are based on innovative solutions for better management of public services and resources so as to improve quality of life. Resilience is one of these programs, and is related to the Environment Smart City Area. The Resilience Program provides measures for preventing and mitigating climate-related impacts, in order to guarantee a safer city and better quality of life. Moreover, some projects - such as Urban Platform (2013) and HAZUR (2012) - are specifically intended to enhance urban resilience by using ICTs for improving connections within the metropolitan area and allowing wider sharing of the available knowledge. Specifically, the Urban Platform represents an open and transversal platform, in which information can be collected, elaborated and shared, in order to guarantee better management of the various resources (water, public services, CO_2 emissions, etc.), and improve the response capacity of the city in case of emergency. HAZUR is a software platform that provides public authorities with a service tool able to evaluate and increase the continuity of urban services.

Like in the Rotterdam case study, current measures have been analyzed in depth in order to assess how they contribute to improving the key properties of a smart and resilient city and their relative characteristics as sketched in the conceptual model presented above (Fig. 3) and, in so doing, to promote an integrated approach to climate-related issues.

Learning capacity – The measures addressed to create networks for collecting, disseminating and sharing information and knowledge represent the core of the Barcelona Smart City Strategy. Moreover, a number of projects strongly promote the involvement of citizens, one of which is the GO (Open Government) project within the Urban Platform project, which provides services based on public information. Real time monitoring of water levels and energy consumption through sensor networks is also considered a crucial activity in all the measures in order to save energy and reduce GHG emissions. The care dedicated to building up a constantly updated and widely shared knowledge base is also important in increasing the awareness of citizens and decision-makers in the face of natural and climate-related hazards and for improving ability to anticipate future events.

Persistence – Although there are no measures to specifically strengthen resistance or the robustness of the urban system, most of the measures included in the Resilience Programme, the Urban Platform and the HAZUR project may, through improved connectivity, allow the urban system to better withstand external pressures.

Fig. 5 The Smart City Campus in Barcelona: a project that combines urban regeneration and technology innovation.

Adaptability – Most of the on-going projects aim to address the redundancy of the material and immaterial infrastructure networks and, in so doing, to guarantee the continuity of urban services in the event of emergency. Furthermore, some initiatives included in the Barcelona Smart City Strategy, such as the BUITS (Urban Space with Territorial and Social Involvement), which promotes the temporary use of abandoned areas through public-private-partnerships, may contribute to enhance the flexibility of the urban system.
Transformability – The Barcelona Smart City Strategy envisages, in a long-term perspective, an innovative path for city development, based on citizen collaboration and participation and addressed to promoting sustainable mobility, the smart use of public space for improving biodiversity, and social cohesion, in order to achieve an energy self-sufficient habitat, characterized by smart and sustainable resource management. The BIT (Barcelona Institute of Technology) and The Smart City Campus projects are two examples of this innovative vision: they promote the renovation of old factories into zero-emissions smart buildings through a public-private partnership (Cisco and Schneider Electric as industrial partners and BIT as a research partner).

4.3 DISCUSSION

The analysis of the strategies and projects carried out in the two case studies allows us to better understand which of the key properties of a Smart and Resilient Urban System are mainly considered in the on-going practices and to reshape the conceptual framework presented in the previous paragraph (Fig. 4) accordingly (Cillo, 2014). First of all, it is worth noting that whereas in the Rotterdam case study – also due to its peculiar relationship with the water issue – the smart initiatives so far undertaken have been mainly geared to enhancing urban resilience in the face of climate change, in the Barcelona case study, Resilience is only one of the sub-programmes, albeit important, of a wide set of smart initiatives geared to improving the quality of life and to better management of urban services and resources also, but not primarily, concerning climate issues. Moreover, it is worth noting that in both case studies, a Public-Private Partnership has been established that can drive and coordinate the numerous strategies, initiatives and projects.
Then, focusing on the relationships between current initiatives and the selected key characteristics required to build up a smart and resilient city, both the examined case studies confirm the key role of learning capacity (Fig. 6).

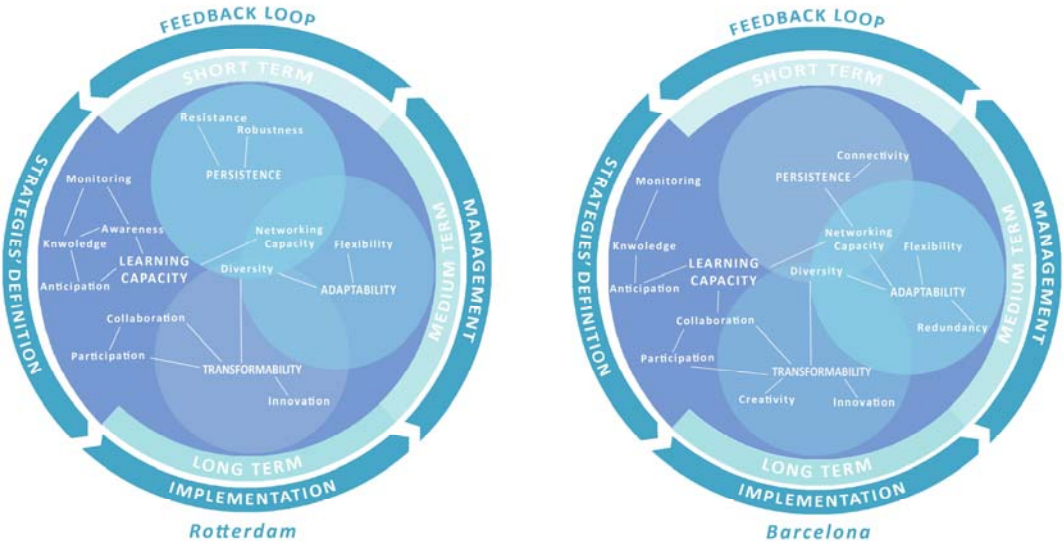


Fig. 6 The Conceptual Framework applied in the Rotterdam and Barcelona case studies

Both of them assign a key role to building up an effective and constantly updated knowledge base, also through the widespread use of ICTs that allows the strengthening of real-time monitoring capacity and, consequently, the improvement of the ability to anticipate future climate impacts and citizen awareness of energy and climate issues. In both cases, local and global networking ability plays a crucial role in disseminating and sharing knowledge and best practices, while particular attention has been devoted in the Barcelona case study to strengthening citizens participation in public life, by promoting widespread use of ICTs to enhance collaboration between citizens and public administrations.

Persistence is a crucial property in the Rotterdam case studies, where strategies and measures are primarily addressed to increasing the ability of the urban system to withstand the impacts of climate-related events by improving the robustness of the existing grey infrastructures and combining them with green infrastructures. In the Barcelona case study, despite the fact that persistence seems to play a secondary role, many of the smart initiatives so far undertaken are geared to improving connectivity, efficiency and networking capacity, in order to allow the city to guarantee the operational continuity of urban services should hazardous events occur. Adaptability also plays an important role, even though in the Barcelona case study, some of the smart initiatives are geared to increasing the redundancy of physical and telecommunication infrastructure networks, whereas Rotterdam has promoted numerous projects aiming to increase flexibility and diversity in the urban environment by introducing adaptive buildings and adaptive public spaces as well as reinforcing the green infrastructure networks that play a twofold role, contributing to adapt the city to climatic impacts (allowing better management of both floods and high temperatures in urban areas) and to mitigate climate phenomena (e.g. allowing carbon storage and sequestration).

Lastly, both cases address transformability by means of experimental projects that envisage innovative paths for city development, promoting nature-based measures to counterbalance climate impacts as well as transition towards a zero-emission urban environment. Nevertheless, up to now, these projects are limited to individual buildings or to specific neighborhoods, requiring extension and integration into the wider processes of urban development.

5 CONCLUSION

Summing up, this contribution provides some hints to better frame current practices to counterbalance climate issues undertaken by the Italian and European cities.

In greater detail, based on the awareness that an overall response to climate change requires mainstream mitigation and adaptation within the broader perspective of sustainable urban development, by combining long-term policies aiming to reduce GHG emissions with short to mid-term strategies aiming to reduce the impacts of climate-related events, the research initially outlined the state of the art in the Italian metropolitan cities. This outline clearly highlights that, despite the fact that the need to develop cross-sectorial approaches to climate change is sometimes recognized, most of the cities analyzed have developed mitigation strategies based in sectorial plans (e.g., SEAP or Municipal Energy Plan) or "smart" projects, whereas only four cities are developing an adaptation plan or have recently developed a local strategy to enhance urban resilience.

Then, based on a theoretical framework able to show the characteristics of smart and resilient cities (fig. 3), the Rotterdam and Barcelona case studies were analyzed in order to better understand the strengths and weaknesses of current smart and/or resilience initiatives aiming to counterbalance climate change. Analysis of the two case studies clearly shows that current initiatives and projects, undertaken under the flags of the "Smart" or the "Resilient" city, seem to significantly contribute to promoting cross-sectorial and multi-objective strategies to deal with climate change, paving the way for an integrated approach to climate issues. In the case studies examined, numerous measures, and above all, those related to the improvement of green infrastructures, play a twofold role, contributing to both mitigation and adaptation issues.

Moreover, the selected case studies emphasize that smart and resilience initiatives are largely tailored to their specific contexts. In the case of Rotterdam, the peculiarity of the city – where 90% of the urbanized area is below sea level – has led to considering urban resilience in the face of climate change as the key goal of most of the smart city projects. On the other hand, in the case of Barcelona, smart city projects pursue a wide range of objectives related to the improvement of the quality of life as well as to a better management of urban services and resources, also including increased urban resilience in the face of climate change.

In addition, both case studies attribute a key role in improving urban response to climate change to learning capacity, and numerous initiatives have been undertaken to enhance the related characteristics, also through widespread use of ICTs. On the other hand, initiatives to enhance transformability are still at an early stage, requiring a move on from current urban development models and the transition from current energy-consuming development models towards low-carbon ones, in order to reduce GHG emissions and, consequently, climate-related impacts on urban areas.

Nevertheless, to pursue transformability, a more crucial role should be assigned to urban planning, which may well represent a key tool in reconciling different objectives as well as different temporal and spatial perspectives and the various stakeholders and, above all, in better framing current sectorial policies, initiatives, projects and tools.

REFERENCES

Batty, M., Axhausen, K. W., Giannotti, F., Pozdnoukhov, A., Bazzani, A., Wachowicz, M., Ouzounis, G., & Portugali, Y. (2012). Smart City of the Future. *The European Physical Journal Special Topics*, 214(1), 481-518..

Biesbroek, G.R., Swart, R. J., & van der Knaap, W. G. M. (2009). The mitigation-adaptation dichotomy and the role of spatial planning. *Habitat International*, 33(3), 230-237.

Bulkeley, H, Schroeder, H., Janda, K., Zhao, J., Armstrong, A., Yi Chu, S., & Ghosh, S. (2011). The role of institutions, governance and urban planning in Hoornweg, D., Freire, M., LeePerinaz Bhada-Tata, M. J., & Yuen, B. (Eds.), *Cities and Climate Change: responding to an Urgent Agenda* (pp. 125-159). Washington DC: The World Bank.

Chelleri, L., Favaro, A., Lucchitta, B., Raventos, J., & Fernandez, M. (2013). Dall'adattamento urbano al cambiamento climatico alla resilienza urbana: il caso di Barcellona, Spagna. *Conference Proceeding Climate Changing Cities*, Venice, May 23-24.

Cillo, D. (2014). Increasing resilience reduces coastal cities vulnerability. *Atti dell'VIII Giornata di Studi INU*, December 12, 22-25.

Chourabi, H., Nam, T., Walker, S., Gil-Garcia, J. R., Mellouli, S., Nahon, K., & Scholl, H. J. (2012). Understanding Smart Cities: An Integrative Framework. *System Science (HICSS)*, 2012 45th Hawaii International IEEE Conference, 2289-2297. DOI: 10.1109/HICSS.2012.615

Dang, H. H. Michaelowa, A., & Tuan, D.D. (2003). Synergy of adaptation and mitigation strategies in the context of sustainable development: the case of Vietnam. *Climate Policy*, 3(Sup1), S81-S96.

Davoudi, S. (2009). Framing the role of spatial planning in climate change. Global Urban Research Unit, Newcastle.

Davoudi, S. (2012). Resilience: A Bridging Concept or a Dead End?. *Planning Theory and Practice*, 13(2), 299-307.

Desouza, K.C. & Flanery T.H. (2013). Designing, planning, and managing resilient cities: A conceptual framework, *Cities*, 35, 89–99. http://dx.doi.org/10.1016/j.cities.2013.06.003

EIP-European Innovation Partnership on Smart Cities and Communities. (2013). Strategic Implementation Plan. Retrieved from http://ec.europa.eu/energy/technology/initiatives/doc/2012_4701_smart_ cities_en.pdf

Folke, C., Carpenter, S.R., Walker, B., Scheffer, M., Chapin, T. & Rockstrom, J. (2010). Resilience Thinking: integrating Resilience, Adaptability and Transformability. *Ecology and Society*, 15(4), 20.

Galderisi, A., Ferrara, F.F. (2012). Enhancing urban resilience in face of climate change: a methodological approach. *Tema. Journal of Land Use, Mobility and Environment*, 5 (2) 69-87, doi: 10.6092/1970-9870/936

Galderisi, A., (2014a). Urban resilience: A framework for empowering cities in face of heterogeneous risk factors, *ITUA|Z*, 1(11), 36-58.

Galderisi, A. (2014b). Climate Change Adaptation. Challenges and Opportunities for Smart Urban Growth. *Tema. Journal of Land Use, Mobility and Environment*, 7(1), 43-67. doi: 10.6092/1970-9870/2265

Greco, I. & Bencardino, M. (2015). The Paradigm of the Modern City: SMART and SENSEable Cities for Smart, Inclusive and Sustainable Growth. In: Murgante, B., Misra, S., Rocha, A.M.A.C., Torre, C., Rocha, J.G., Falcão, M.I., Taniar, D., Apduhan, B.O., Gervasi, O. (Eds.), *Computational Science and Its Applications – ICCSA 2014* (pp. 579-597). Springer International Publishing.

Hordijk, M., & Baud, I. S. A. (2011). Inclusive Adaptation: Linking Participatory Learning and Knowledge Management to Urban Resilience. In Otto-Zimmermann, K. (Ed.), *Resilient Cities* (pp. 111-121). Springer Netherlands.

ISPRA. (2014). La banca dati sulle buone pratiche per la sostenibilità ambientale. Retrieved May 6, 2015, from http://www.sinanet.isprambiente.it/gelso.

Linkov, I., Satterstrom, F. K., Kiker, G., Batchelor, G., Bridges, T., & Ferguson, E. (2006). From comparative risk assessment to multi-criteria decision analysis and adaptive management: Recent developments and applications. *Environment International*, 32 (8), 1072–1093. doi:10.1016/j.envint.2006.06.013

Lu, P., & Stead D. (2013). Understanding the notion of resilience in spatial planning: a case study of Rotterdam, The Netherlands. *Cities*, 35, 200-212.

Jones, R. N., Dettmann, P., Park, G., Rogers, M., & White, T. (2007). The relationship between adaptation and mitigation in managing climate change risks: a regional response from North Central Victoria, Australia. *Mitigation and Adaptation Strategies for Global Change*, 12(5), 685-712.

Karnouskos, S., Da Silva, P. G., & Ilic, D. (2013). Energy Services for the Smart Grid City. *Digital Ecosystems Technologies (DEST)*, 2012 6th IEEE International Conference (pp. 1-6). doi=10.1.1.310. 9384&rep=rep1&type=pdf

Kelman, I. Gaillard, J.C., & Mercer, J. (2015). Climate Change's Role in Disaster Risk Reduction's Future: Beyond Vulnerability and Resilience. *International Journal of Disaster Risk Science*, 6(1), 21-27. doi: 10.1007/s13753-015-0038-5.

Klein, R. J. T., Schipper, E. L. F., & Dessai, S. (2005). Integrating mitigation and adaptation into climate and development policy: three research questions. *Environmental Science and Policy*, 8(6), 579-588.

Kramers, A., Höjer, M., Lövehagen, N., & Wangel, J. (2014). Smart Cities and climate targets: exploring ICT solutions for reduced energy use in cities. *Environmental Modelling & Software*, 56, 52-62.

Kunzmann, K.P. (2014). Smart cities: a new paradigm of urban development. *CRIOS*, 4(1), 9-20. doi: 10.7373/77140

Mosannenzadeh, F., & Vettorato, D. (2014). Defining Smart City: a conceptual framework based on keyword analysis. Tema, Journal of Land Use, Mobility and Environment, INPUT 2014. doi: http://dx.doi.org/10.6092/1970-9870/2523, 683-694.

Moccia, D.F. (2010). Città e Cambiamento Climatico. *Urbanistica Informazioni*, 38-39.

Neirotti, A., De Marco, A., Cagliano, A.C., Mangano, G., & Scorrano, F. (2014). Current trends in Smart City initiatives: Some stylised facts. *Cities*, 38, 25-36. doi: http://dx.doi.org/10. 1016/j.cities.2013.12.010

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. doi: http://dx.doi.org/10.6092/1970-9870/2883

Revi, A., Satterthwaite, D.E., Aragón-Durand, F., Corfee-Morlot, J., Kiunsi, R.B.R., Pelling, M., Roberts, D.C., & Solecki, W. (2014). Urban areas. In Field, C.B, Barros, V. R., Dokken, D. J., Mach, K. J., Mastrandrea, M. D., Bilir, T.E., Chatterjee, M., Ebi, K. L., Estrada, Y. O., Genova, R. C., Girma, B., Kissel, E.S., Levy, A. N., MacCracken, S., Mastrandrea, P. R. & WLL (Eds.), *Climate Change*, 535-612.

Salat, S., Bourdic, L. (2012) Systemic resilience of complex urban systems. *Tema. Journal of Land Use, Mobility and Environment,* 5 (2) 55-68, doi: 10.6092/1970-9870/918

The World Bank (2011). Guide to Climate Change Adaptation in Cities. Retrieved from: http://siteresources.worldbank.org/INTURBANDEVELOPMENT/Resources/336387-1318995974 398/GuideClimChangeAdaptCities.pdf.

The World Bank (2015). Climate Change and Adaptation in Cities. Retrieved May 6, 2015 from: http://www-esd.worldbank.org/citiesccadaptation/whyadapt.html

Tyler, S., & Moench, S. (2012). A framework for urban climate resilience. *Climate and Development*, 4(4), 311–326

UN (2012). The Future We Want. *Resolution*, 66, 288.

UNISDR (2009). UNISDR Terminology on Disaster Risk Reduction. Retrieved May 6, 2015 from: http://www.unisdr.org/eng/terminology/terminology-2009-eng.html.

Walsh, C.L., Dawson, R.J., Hall, J.W., Barr, S.L., Batty, M., Bristow, A.L., Carney, S., Dagoumas, A.S., Ford, A.C., Harpham, C., Tight M., Watters, H., & Zanni, A.M. (2011). Assessment of Climate Change Mitigation and Adaptation in Cities. *Proceedings of the ICE-Urban Design and Planning*, 164(2), 75-84.

IMAGE SOURCES

Cover Image: "NYC Highline", Retrieved October 10, 2015 from: https://www.flickr.com/photos/wasabi_bob/5967508362

Fig. 4, Retrieved October 12, 2015 from: https://www.flickr.com/photos/faceme/7683429446/in/photolist-cGXzTu-9AHNU8-bvWCCk

Fig. 5, Retrieved October 12, 2015 from: http://smartcity.bcn.cat/en/smart-city-campus.html

Fig. 1, 2, 3, 6: figures are from authors.

AUTHORS' PROFILES

Rocco Papa

Full Professor of Land Use Planning at the University of Naples Federico II. Editor-in-Chief of the Scientific Journal TeMA - Land Use, Mobility and Environment since 2007. Director of the Department of Urban and Regional Planning (DiPiST) of the University Federico II of Naples, from 1999 to 2005. Chairman of the Urban Transformation Company Bagnolifutura S.p.A from 2006 to 2010. Vice-Mayor of the Municipality of Naples, from 2001 to 2006. City Councilor for Livability (appointed to Town Planning and Historical Centre) for the Naples Municipality, from 1997 to 2001. Research activity, carried out continuously since 1974, has developed according to the following four main lines: the study of the interactions between urban and mobility systems; the management and governance of metropolitan areas; the safeguard of environmental quality in highly urbanized areas; the experimentation of new protocols for urban planning tools connected with the updating of techniques, methods and models of analyses, interpretation, planning and governance of territory. As City Councilor for Livability (appointed to Town Planning and Historical Centre) for the Naples Municipality he has developed in detail the following projects: the approval and implementation of the new Master Plan of Naples; the approval and implementation of the Local Master Plan for the area of Bagnoli-Coroglio and the establishment of the Urban Transformation Company Bagnolifutura SpA, and the restoration and requalification of the "Real Albergo dei Poveri" and of the "SS. Trinità delle Monache", the implementation of the Line 1 and Line 6 of the Metropolitan Railway. He is the author of more than 100 publications.

Adriana Galderisi

Assistant Professor at the Department of Civil, Architectural and Environmental Engineering - University of Naples Federico II. Ph.D. in Urban and Regional Planning; Professor of Urban and Regional Planning at the University of Naples Federico II. Research activities are mainly focused on the urban environment requalification and namely on two issues: the relationships between land use planning, mobility and environmental issues; vulnerability and resilience of urban systems to natural and na-tech events. In respect to the latter, she has coordinated research teams within numerous National and European Projects from 2000 to 2008. From 2008 to 2011, she has been the Scientific Responsible for the European Project "ENSURE - Enhancing resilience of communities and territories facing natural and na-tech hazards" (7° Framework Programme - Theme 6 Environment - Topic 6.1.3.2.1 Frame for better vulnerability assessment). From 2012, she is the Responsible for the Training Project of the National Project "Smart Energy Master for the energy management of territory" (PON 04A2_00120 R&C Axis II). She is author of more than 80 publications (monographs, chapters in books and articles).

Maria Cristina Vigo Majello

Architect (2003), Master in Building and Environmental Design for Photovoltaics Integration (2004), PhD in Architectural Design (2007), PhD in Building and Environmental Recovery (2013) at the Department of Architecture, University of Naples Federico II. She has collaborated in the research activities of the Department of Architecture, University of Naples Federico II, with the Corited Consortium, developing skills on national and international research projects on sustainable energy related to existing built environment (2009-2011). Research activities have been focused on renewable energies, innovative technologies and integrated management models to promote energy efficiency of existing built environment. In 2014, she won a one-year grant for post-lauream education and research within the project "Smart Energy Master" at the Department of Civil Engineering, Building and Environmental Engineering, University of Naples Federico II.

Erika Saretta

Civil Engineer graduated at the University of Padua presenting a dissertation "Photovoltaics and Net Zero Energy Buildings: new concepts towards a Smart City vision", carried out in collaboration with ENEA. In 2014, she won a one-year grant for post-lauream education and research within the project "Smart Energy Master" at the Department of Civil Engineering, Building and Environmental Engineering, University of Naples Federico II.