Alenka Fikfak, Saja Kosanović, Miha Konjar and Enrico Anguillari [eds.]

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Saja Kosanović, Alenka Fikfak, Nevena Novaković and Tillmann Klein [eds.]

This thematic book series is a result of the Erasmus+ project, *Creating the Network of Knowledge Labs for Sustainable and Resilient Environments (KLABS)*. The books are dedicated to establishing a comprehensive educational platform within the second cycle of higher education across the Western Balkan region. The series comprises five volumes in the English language:

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FOR SUSTAINABLE & RESILIENT ENVIRONMENTS

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Sustainability and Resilience
Socio-Spatial Perspective

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Contents

Towards Climate Proof Cities _

Innovative Tools and Policies for Territorial Government

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ABSTRACT **Climate change is one of the most relevant issues (both political and scientific) of the twenty-first century. If every crisis has brought to light new issues, new research paths, and sometimes even new solutions, then the challenges posed by climate change offer the opportunity for spatial planning to come back and reclaim its social usefulness to solve problems by redefining objectives, fields of investigation, and methodologies.**

The purpose of the chapter is to add a further element in this field of research by reconstructing the state-of-the-art scientific research and finding the limitations and potentialities of initiatives undertaken to date, as well as to synthesise a methodological and practical proposal in order to offer to public administration and local authorities a 'practical way' to make local climate policies and plans more effective. It therefore proposes an investigation process that moves away from the urgency and need to address some initial questions: what does planning or designing low carbon or climate-proof cities and territories mean? What are the obstacles to developing this kind of planning process? What are the governance implications on a local and transnational level, and what is the relationship between these two levels?

Moving from a theoretical dimension to a more practical one involves different areas of public administration, and means developing innovative processes for the re-designing of instruments, priorities, actors, and organisational structures, thus leading to a new governance paradigm for cities and territories. This paradigm represents a new model to address the challenges of climate change towards climate proof cities.

KEYWORDS climate change, planning tools, governance, climate policies

1 Introduction

The Larsen B ice shelf collapse in Antarctica and the possible disappearance of the Kiribati islands due to sea-level rise are both dramatic examples of the negative externalities that global society will have to deal with in the future.

While these events might look unrelated from a local perspective, thus making the future seem less pessimistic, analysing the problem and its impact from a global perspective reveals dramatic scenarios. International organisations like the World Bank, the Intergovernmental Panel on Climate Change (IPCC), the Organisation for Economic Co-operation and Development (OECD), the Food and Agriculture Organization of the United Nations (FAO), the United Nations Development Programme (UNDP), highlight that the impact of extreme rainfalls and drought that occurred in the last 50-100 years could be disastrous for some areas of the planet, forcing millions of people to migrate. Cities will bear the highest cost in terms of economic and human loss (Biesbroek, Swart & van der Knaap, 2009; Bulkeley & Betsill, 2005; Van der Veen, Spaans, Putters, & Janssen-Jansen, 2010).

As most of the dramatic events that occurred over the last few years demonstrate - from New Orleans to New York, passing by Genoa and Hamburg - the consequences of bad urban settlement choices, made without taking due consideration of risk factors, are being paid for by the cities, and these damages are inevitably bound to increase in a scenario of global temperature rise (IPCC, 2014; Swart & Raes, 2007; Un-Habitat, 2011a, 2011b). Being primarily artificial settings, cities are characterised by low resilience and a low capability to react or adapt to sudden changes.

This aspect makes all levels of the administration aware of the unseen consequences that have been produced, and continue to be produced, by anthropic activities, population increase, and urbanisation, to the detriment of natural resources and the atmosphere.

For some time, scientists and climate experts have agreed upon the necessity to react, not only as an emergency response, but also as preventive adaptation towards a climate that has already changed, and continues to do so. This means maintaining ongoing actions for the reduction of greenhouse gases in the atmosphere, decreasing and eradicating fossil fuel consumption and, in the meantime, preparing cities and territories to face a changed climate scenario (Bulkeley & Betsill, 2005; Musco, 2008, 2010; Musco & Magni, 2014). Analysing the impacts of extreme weather phenomena (cyclones, storms, heat waves, etc.) and downscaling to a local level have therefore become essential fields of research for those dealing with city planning and urban politics.

The aim of the chapter is to add a further piece to this field of investigation. The objective is, firstly, to reconstruct a state-of-the-art discipline regarding the relationship between climate change issues and spatial planning, and to identify theoretical and cultural prerequisites,

directions, and modalities that have emerged in the disciplinary debate. Research also aims to provide some examples focused on territorial governance processes that face climate issues in a proactive way, that is, by considering safety and development needs as opportunities to start climate proofing processes. New York, Stockholm, Copenhagen, Barcelona, Seattle, and, again, Rotterdam, London, Bologna, Padua, are just a few of the cities that, with increasing coherence, have shaped their policies towards climate innovation by integrating mitigation and adaptation targets.

With these best practices in mind, this chapter identifies a methodology to effectively configure regional and local strategies towards the reduction of greenhouse gas emissions and the adaptation to climate events. The necessity of moving from a theoretical to an operational dimension involves the public administrations in different areas. Moreover, it requires innovation within the processes of tool designing, priority identification, and stakeholder involvement, which will lead to a new paradigm of city and territorial governance. This paradigm represents a new model for facing and managing climate change challenges, moving towards a climate proof city.

2 Planning and Climate Change: Between Consolidated Certainties and Innovation

The increasing impact of extreme weather phenomena on different areas of the planet over the past few years has brought climate change to the attention of the scientific community, especially considering the empirical evidence of actual and potential future damages. Up until now, the issue of adapting to climate change has been addressed by national and international research, through the analysis of phenomena already underway (UNFCCC, 2011; UNISDR, 2010) – from deforestation and desertification to the melting of polar ice and mountain glaciers; from the rise in sea level affecting the most vulnerable coasts, to the possible damage caused to tourist activities, farming, water resources, and public health.

Since the highest social costs of global warming are registered in cities, large urban areas, and territorial systems (Folke et al., 2011), these are gaining importance within the research on spatial planning, highlighting the need for increased attention to be placed on adaptation strategies.

Urban areas are mostly artificial settings characterised by low resilience, so their adaptation capacity is related to a punctual action, in many cases still consisting of engineering systems and hard infrastructures (Solecki, Leichenko, & O'Brien, 2011). This aspect has become important for urban planning, which entails complex analyses, phenomenon assessment and interpretation, citizen education and involvement, target and action selection, and coordination on different institutional levels (MATTM, 2014). In such a rapidly-changing scenario, architecture, urban planning, and policies must transform deeply and

define new priorities and targets. These targets include contributing to greenhouse gas reduction, the requalification of public areas, cities and transport infrastructures, and the reduction of energy consumption and related climate-altering emissions (mitigation actions). Today, urban projects should respond to the demand of climate safety with increasing urgency, not only through emergency management, but also through new *ex ante* and structural mitigation and adaptation strategies.

To make urban planning useful for mitigation and adaptation targets, it is therefore necessary to revise knowledge at the root, and carry out a substantial renovation of planning systems at all levels (Biesbroek, Swart, & van der Knaap, 2009). The increasing attention to these processes has not yet led to adequate political responses: it is clear, now more than ever, that 'climate protection' is still rather diverse – there are cases in which adaptation plans and strategies have been introduced, versus cases in which risks and impacts are still being underestimated despite the relevance of the actual phenomena. The main reasons can be found in the lack of a public and shared awareness on climate variability and its territorial repercussions, in the slow response to climate disasters due to the lack of skill, public resources and policies, and urban and territorial planning regulations for climate change management. (Musco & Magni, 2014).

The achievement of climate-proof cities and territories will be an inevitable field of action and research over the next few years, and everyone will have to identify the most adequate measures to accomplish a few essential targets. This comprises, firstly, of the protection of the population, infrastructures, and economic systems. Moreover, it is fundamental that local contexts (counties and cities in particular) rethink and redefine their administration instruments to adapt their territory to new scenarios thus becoming safer, more resilient, and attractive.

2.1 Between Decarbonising and Climate Proofing: The Role of Spatial Planning

Despite considerable uncertainties, it seems clear that the knowledge about the causes and impacts of climate change has significantly improved. It is now recognised that the spatial configuration of cities, and the way in which the soil is used, have significant implications both on the adaptation to climate change, and on the reduction of the emissions that cause the change in the first place (Agrawala & Fankhauser, 2008; Jha, Miner, & Stanton-Geddes, 2013; UNDP, 2010). The various types of settlement, their impact on natural resources, and their related emission levels are all influenced by many complex factors such as available technologies, buildings typologies, investment strategies of public and private institutions, public policies (relating mainly to housing, transport and environmental systems), institutional traditions, social regulations, culture, and the behaviour of each individual. Territorial planning interventions, therefore, become a decisive factor when shaping sustainable settlements and considering

site-specific actions and interventions, based on 'critical thinking on spaces and places' (RTPI, 2003). In actual fact, the recognition of the complexity, uncertainty, and irreversibility of climate by climate sciences is changing the nature and overview of territorial planning, favouring the leading role of mitigation and adaptation actions within urban systems (Solecki et al., 2011).

Developing climate-proof solutions within urban and territorial planning doesn't mean decreasing the risk of sudden and variable climate phenomena to zero. The idea behind the concept of climate-proof planning is to reduce possible risks to a quantifiable level acceptable for society and, above all, for the economic system (Baltzar, Varbova, & Zhechkov, 2009). Risk reduction is promoted by the integrated and combined use of infrastructures, and management and planning measures, which can include 'adaptation portfolios', insurance packages focused on local impacts, alert and evacuation systems as well as pre-consolidated civil protection capabilities (Desouza & Flanery, 2013; Rosenzweig et al., 2015). Civil protection approaches themselves need a deep revision to guarantee that 'protective' actions are effective not only after calamitous events, but are actually integrated *ex ante* in planning and designing (Musco, 2014).

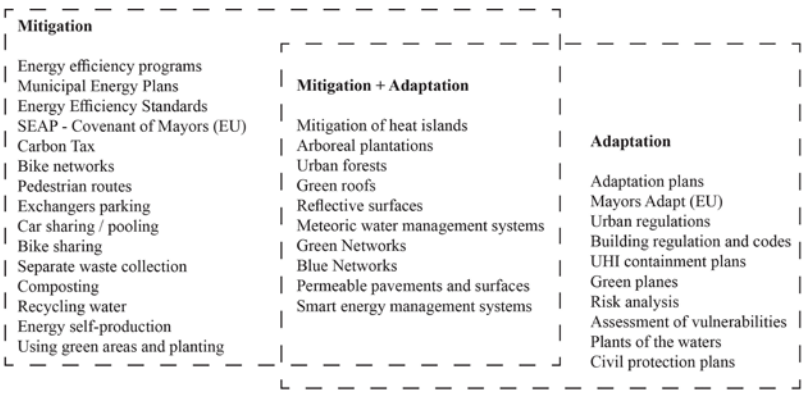

FIG. 2.1 Integration between mitigation and adaptation measures on an urban scale *(Image by Musco, 2012)*

Bearing this in mind, the protection of urban systems from extreme climate variabilities means safeguarding the population and realising that the frequency and intensity of natural dangers will increase, or have already increased. For example, heat waves and extreme droughts were, up to now, considered secondary or only partly relevant events (EC, 2013), but they may happen with more frequency in the future, meaning that the actions to be undertaken as part of planning processes must be evaluated according to the spatial dimension of the events and their geographical distribution (UFPP, 2009). The search for decarbonised and climate-proof urban planning should be considered as an opportunity of technological and institutional innovation for society as a whole, rather than being purely moved by the fear of the negative effects of climate change. Admittedly, the transposition of these objectives into policies and ordinary territorial management processes is not always so smooth (save in specific trials) (Biesbroek, Swart & Capela Lourenco, 2014; Bulkeley & Betsill, 2005; Musco, 2008, 2010; Musco & Magni, 2014).

The reduction of emissions and adaptation targets are complementary in many situations (Fig. 2.1), but they may also be in conflict.

Climate proofing (verb): Waterproof, weatherproof.
Proof (adjective): proof, safe from, anti-. – Includes methods, tools and procedures to ensure that plans, programs and strategies are available for the adverse effects of climate change (Olhoff & Schaer, 2009) – For urban development is a methodological approach aimed at integrating climate change issues into development planning. (Fröde & Hahn, 2010). – A process to ensure that climate change risks are reduced to acceptable levels through lasting, environmentally-friendly, economically and socially acceptable sustainable change (Baltzar, Varbova, & Zhechkov, 2009) – The set of activities aimed at ensuring the sustainability of investments throughout their lives, while explicitly taking into account a changing climate (EC Green Paper, 2007)
Climate proof cities: cities that have adopted strategies, processes, measures and spatial devices to accommodate the risks arising from the impacts of climate change (adaptation measures to climate change). (EC Green Paper, 2013)

TABLE 2.1 What is meant by Climate Proof?

3 City, Climate and Urban Policies

On a global perspective, state-of-the-art climate change issues, and climate protection planning in particular, are tackled in a very diverse manner.

An overall reading of European policies about mitigation and adaptation to climate change (Fig. 3.1) reveals an uneven perspective, characterised by very different institutional systems and cultural-territorial features (Musco & Magni, 2014; Wilson & Piper, 2010). Each country has its own national orientation (mitigation and/or adaptation plans and strategies, if any) and local initiatives such as climate planning, tools or local organisation networks.

The condition of the latter varies considerably case by case, and only a few local organisations have introduced integrated strategies of adaptation, mitigation, and energy efficiency into the existing territorial planning system (Musco & Patassini, 2012). Although effects are recurrent to a specific area, every urban context is subject to different ones depending on different combinations of climate change exposure and specific dimensional, localisation, social, and productive features (which can be more or less sensitive to climate change). Downscaling forecast and climate analyses is key (current climate models mainly work on a larger scale and therefore provide inadequate indications for planning on a local scale). However, in order to understand local impacts and vulnerabilities, climate resiliency studies are fundamental support tools to identify strategies, priorities, and action plans suitable for the actual needs of every settlement (Ombuen & Filpa, 2014). Even though scientific overviews (Andonova, Betsill & Bulkeley, 2009; Biesbroek et al., 2009, Biesbroek et al., 2014; Bulkeley & Betsill, 2005; van Staden & Musco, 2010) and international reports (EEA, 2012b, 2013; IPCC

2007, 2013) consider territorial planning an essential paradigm to face both climate change causes and consequences, its transposition into policy and ordinary territory management processes is not always so straightforward (Musco & Magni, 2014; Musco & Patassini, 2012). In Italy, just like in other European countries, some aspects concerning the realisation of a better urban energy output and 'climate protection' policies, albeit more rarely, have gradually started to be introduced into the regulation systems (urban plans and building codes). But results still remain very restricted or based on voluntary experiences, and are definitely not in line with expectations on the reduction of energy consumption and greenhouse gases.

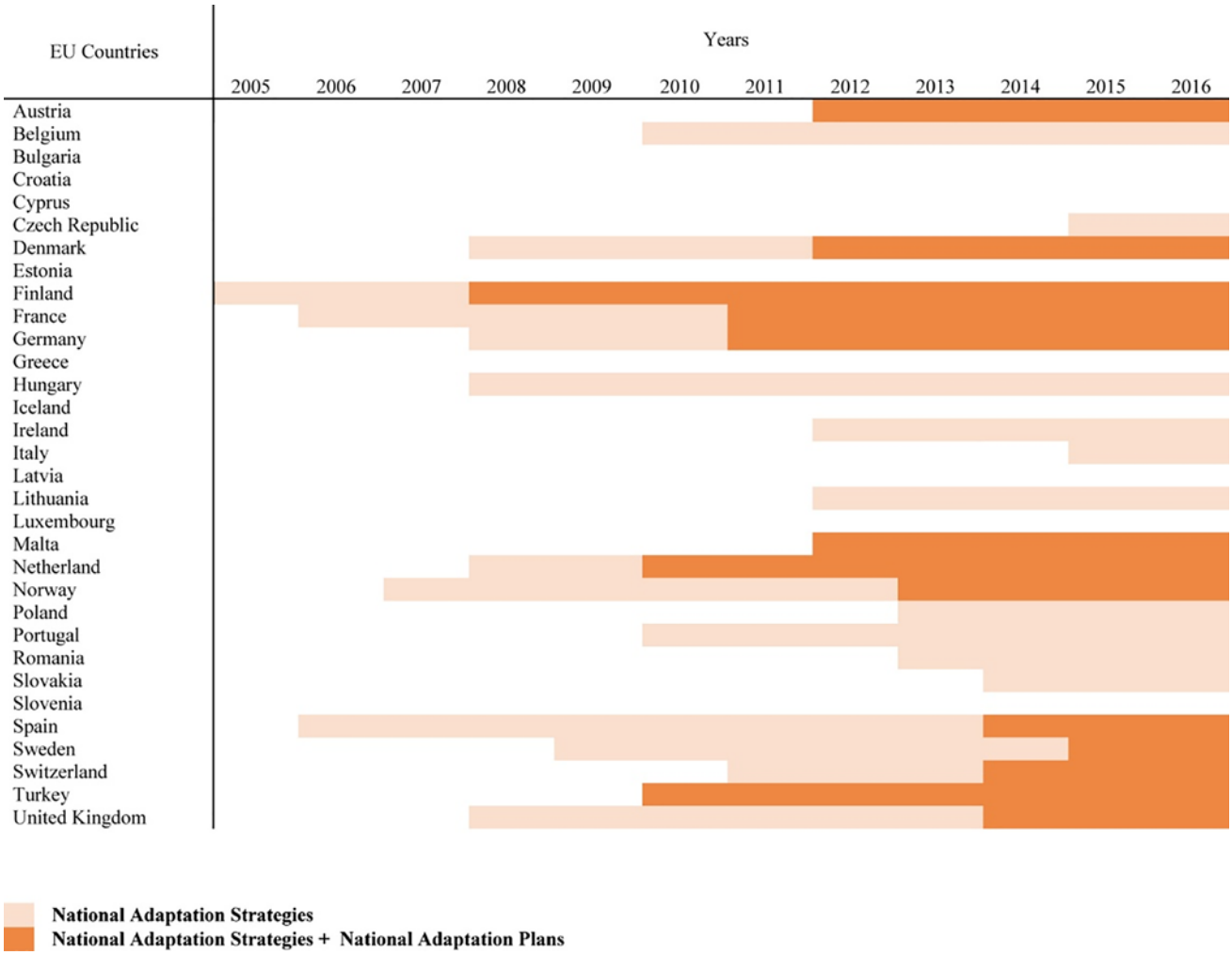

FIG. 3.1 Overview of national and sectorial adaptation strategies and plans in Europe

Even if the actualisation of policies and action plans varies according to national background and urban governance methods, an increasing quantity of experiences, programmes, and projects now directly connect local environments to the European community, possibly leading to new networks (e.g. the Covenant of Mayors; Italian network of Agenda 21) or supporting pre-consolidated associations on an international level (ICLEI - Local Governments for Sustainability; C40 Cities Climate Leadership Group; The Clinton Foundation; 100 Resilient Cities; etc.).

Based on these premises, local, regional, and sometimes national authorities have begun to define, often on an experimental basis, a series of plans and policies aimed at climate protection, which have assumed different names depending on the type and level on which they were implemented (Musco & Patassini, 2012). Regardless of the different denominations, differences in content are not substantial (van Staden & Musco, 2010) though there are different levels of attention given to mitigation and adaptation: climate strategy plans, national mitigation/adaptation strategies, sustainable energy action plans, climate action/protection plans, and climate mitigation plans. These are just few of the tools and strategies developed on a European and international level with the aim of introducing climate protection into territorial planning both on large and local scales. Generally speaking, the problem shared by all these initiatives is the fact that climate plans have quite an uneven structure, in terms of both definition and content (Musco & Magni, 2014).

Therefore, how can a correct climate plan that is actually focused on city and territory be defined? How can climate issues be integrated into ordinary territorial management tools? How can mitigation and adaptation be combined?

3.1 The City is Changing Climate: What is the Role of Local Authorities?

The relevance of local action in promoting and guaranteeing sustainable development on a global level was highlighted for the first time in 1987 by the Brundtland Report, and later, more firmly reiterated at the United Nations Conference on Environment in Rio de Janeiro in 1992 (and reiterated on its 20th anniversary in June 2012 at the Rio+20 Conference). On that occasion, the Rio Declaration launched the Agenda 21 process (UNCED, 1992), which was then spread all over the world for more than two decades, thanks also to the affirmation of a new political trend in which multi-level governance replaced the traditional top-down approach. The Agenda 21 process crystallised during the decade of 2000-2010, moving from a pioneering spirit to a more holistic vision, according to which actions against climate change that preserve biodiversity, activate adaptation policies, etc. are essential to achieve sustainable development (Davoudi, Crawford, & Mehmood, 2009).

The sustainability concept itself, which was originally based on three pillars - economic, social, and environmental (Murphy, 2012) – grew to include the same key themes of Rio+20: green economy, mainstreaming, and a new institutional framework with multi-level governance (Andonova & Hoffmann, 2012).

Local authorities were fully recognised as the main actors in the fight against climate change in 2007 with the Climate Roadmap, again in 2009 with the Covenant of Mayors and, above all, in 2011 with the commitments undertaken in the Global Cities Covenant on Climate - the Mexico City Pact 2011 and the Bonn Declaration of Mayors (ICLEI,

2013). They recognised that local administrations play a strategic role in tackling climate change due to their role in the development of plans and regulations, which can influence processes and innovative solutions for adaptation and mitigation. The Bonn declaration identifies four main features that can define the involvement of local administrations (Angel et al., 1998; Collier, 1997; DeAngelo & Harvey, 1998; Feldman & Wilt, 1993; Harvey, 1993; Lambright, Changnon & Harvey, 1996; Nijkamp & Perrels, 1994; Wilbanks & Kates, 1999):

- Firstly, cities are places that consume high levels of energy and produce a lot of waste. The influence of local authorities on these processes varies according to national circumstances, but can entail following: energy provision and management; transport supply and demand; territorial planning; building regulations; waste management and consultations offered to the local community.

- Secondly, local authorities have been committing themselves to sustainable development for almost twenty years, trying to transpose global rhetoric into local practice through the processes of local Agenda 21 (with clear implications for climate change mitigation as well).

- Thirdly, local authorities can push national governments through the development of local projects that prove, on small scale, the costs and benefits of reducing greenhouse gas emissions.

- Fourthly, local authorities have notable experience in dealing with environmental impact as part of their energy management, transport, and land use policies.

In brief, local administrations can exert pressure to encourage the reduction of greenhouse gas emissions, as they have direct impact on the national governments' capability of reaching internationally agreed targets. This led to a substantial redesigning of the local administration's involvement in climate change strategies. Moreover, local governments not only respond to national political targets, but they also represent an important place for the management of international and global issues.

Local administrations join transnational networks created by local organisations, with the aim of spreading political programs and promoting the exchange of best practices on a national and international level. The quantity and quality of these global networks reflect new, innovative cross-governance forms, with which the traditional distinction into global, national, regional, and local levels, will have to deal in the near future.

4 Problems in the Implementation of Climate Policies and Instruments

The previous section revealed the clear process of building 'correct' and efficient climate policies. However, even if integrated adaptation and mitigation policies have been recognised as necessary, their actual and mass implementation still looks problematic (IPCC, 2014; UNFCCC, 2008)

In fact, even if such policies are blooming, both in developing and developed countries, they often don't yield concrete results, just like 'empty shells' of pure propaganda (van Staden & Musco, 2010). The difficulty in effectively actualising concrete policies was usually explained by referring to a series of limiting factors such as: ecological factors (natural bonds), economic factors (poverty level, lack of financial resources), technological factors (insufficient knowledge, unavailable adequate technology) and institutional weakness (Clar, Prutsch & Steurer, 2012). Using these limitations as parameters to assess which countries have the highest level of implementation efficiency, it would seem almost obvious that the less developed countries would be the ones to face major difficulties, being under-equipped for the autonomous planning of successful climate policies. On the contrary, according to the OECD (Agrawala & Fankhauser, 2008), these countries are generally less susceptible to the problems related to climate policies and are able to actualise them with success. For this reason, the vision that considers only the factors above has been judged as being too simplistic and has been questioned by some scholars (Hauser & Jadin, 2012; Kerr, 2011), who demonstrated that in highly developed countries (e.g. Norway), state and public administrations aren't tackling the vulnerabilities to climate change with specific political responses in a systematic (and systemic) way. This contributes to enforcing the idea that, in addition to economic, ecological, and technological barriers, there could also be political or normative obstacles as well as institutional (e.g. inaccurate governance), and behavioural barriers.

The correct actualisation of climate policies can therefore be hindered by a single type of barrier (acting individually in a specific context), or by multiple barriers interacting simultaneously. Below (Fig. 4.1) are some of the main factors that contribute to creating barriers in the actualisation of climate policies.

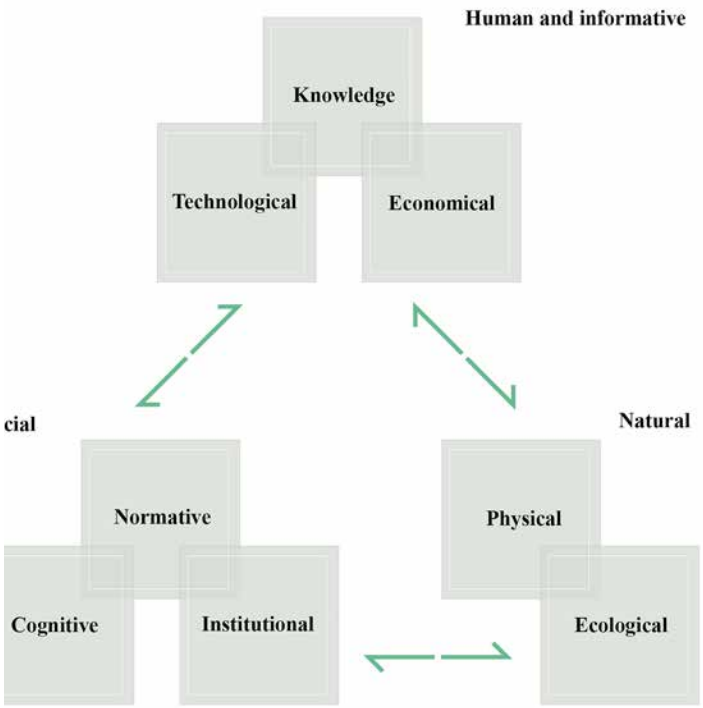

FIG. 4.1 Conceptual summary of the limitations and barriers to adaptation *(Magni & Musco, 2017)*

BARRIER TYPE	BARRIERS AT LOCAL AND REGIONAL LEVEL	BARRIERS AT NATIONAL AND LEVEL
Institutional	Lack of a subnational level mandate to address adaptation problems and coordination problems between municipalities.	Narrow interpretations of subsidiarity leave little room for flexibility.
	Institutional structures that hinder the coordination of relevant issues (vertical / horizontal).	Newness and instability of the adaptation agenda where the role of the supranational level (e.g. EU or US Congress) is still in development phase.
	Laws and national or regional regulations that lead to maladaptation and increased vulnerability.	Sectoral policies with interests already acquired.
Political	Local authorities affected by particular interests.	Level of government affected by particular interests.
	Pressure to maintain business as usual.	Preferred stakeholder and political interests emphasize business development as usual.
	Pressures from short-term electoral cycles on effective risk management	At national or supranational level, emphasis is not given to adaptation as is done for mitigation, eco-efficiency, innovation and growth.
	Lack of willingness to accept costs and changes in behavior.	Lack of willingness to accept the costs.
Economical	Lack of resources or funding to address the identified problems.	Lack of resources, including the immediate challenges of financial austerity.
	Differences between perceived and real costs and benefits.	Uncertainty about the costs of climate change. Problems in determining a sufficient level of intervention.
	Difficulties in integrating adaptation into the various budget lines.	Difficulties in implementing the mainstreaming of adaptation actions in the different lines of the budget.
	Intersectoral competition to receive funds in view of no increase in the budget.	Intersectoral competition to receive funds in view of no increase in the budget.
Technical-Scientific	Lack of technical or scientific information relevant to the local scale	Lack of up-to-date and comparable information on national, regional and local vulnerability adaptation.
	Lack of adequate understanding of climate risks.	Effective communication of the impacts of climate change.
	Scientific uncertainty; Lack of technical skills or access to know-how.	

TABLE 4.1 Barriers hindering climate adaptation processes

These factors, listed in Table 4.1, generate a series of problems within the design and implementation process (CEPS, 2008) which are alternately defined as 'limits' (Moser & Ekstrom, 2010), 'obstacles' (Hulme, Neufeld, & Colyer, 2007; Moser & Ekstrom, 2010; Storbjork, 2010), or 'barriers' (Moser, 2009).

The difference between definitions is quite relevant. While 'limits' are normally considered to be physical factors that can resist any kind of change (including adaptation policies) and that can hardly be overcome (Adger et al., 2007), 'barriers' are more related to behaviour and to cultural and political factors and can therefore be overcome (Moser & Ekstrom, 2010).

Even if the terms 'barriers' and 'challenges' are often used as synonyms (Moser & Ekstrom, 2010), a distinction should be made between 'political barriers' and 'governance challenges', to better understand their features. The former can be faced with no need for deep changes in policy development (e.g. by raising the awareness of the political party responsible party for adaptation and mitigation issues). The latter are instead more related to general adaptation and mitigation features, basically calling into question the traditional forms of development and the actualisation of these sector policies.

This process requires institutional changes or governance innovations in the organisation, structure and decision-making relating to public policy as a whole (Mayntz, 2004; Schedler, 2007; Treib, Bahr & Falkner, 2007). According to what emerged from the analysis of climate policy-oriented literature (Magni, 2016), four main governance climate policy challenges (mainly adaptation) have been identified, albeit not exhaustive:

- a better horizontal integration of climate policies in every public policy sector;
- a better vertical involvement of the legal levels of territorial governance;
- increasing and integrating the decision-making expertise;
- engaging a wider range of non-state actors, who are involved in tackling climate changes, but usually lack the necessary capability to get started on their own.

5 European Reflections: Addressing the Risks and Opportunities of Climate Change

A significant number of measures, policies, and actions related to adaptation, also takes place on a local level in addition to national and regional activities. Transpositions on a local level follow the national strategies, with the definition of specific strategies for specific territories. Adaptation policies cannot be generalised and require a tailor-made definition in relation to the areas involved in their implementation (Musco, 2008).

On a city level, the issue of adaptation has been addressed in detail by the European Environment Agency report *Urban adaptation to climate change in Europe* (EEA, 2012a), which provides numerous examples of the local actions adopted in various European countries, as well as by the Climate-ADAPT platform (EU, 2016), where all European initiatives on this issue are catalogued.

There are many examples of European cities that implemented adaptation strategies and local action plans and that are now in the process of developing them. Some of these specific initiatives are part of pre-existing climate strategies, or became an integral part of them, as happens when adaptation strategies complete the mitigation ones already in place. Here are some examples: the Dublin climate change strategy (CODEMA, 2014) includes adaptation targets that modify and improve the pre-existing mitigation policies. In Finland, various municipalities and regions launched climate strategies that, even if responding mainly to the mitigation issue, integrate adaptation principles through specific sector measures. In other countries like France, Germany, Hungary, Norway, Romania, Spain and Switzerland, some cities have set up for the creation of collaboration networks to share and actualise climate change mitigation and adaptation initiatives. An example is provided by Norway, which has developed a six-year a collaboration program involving the government and 13 of the country's largest cities called *The Cities of the Future* (Mikkola & Randall 2016). Spain too has created a network of cities, the *Red Española de Ciudades por el Clima* - RECC, which produced a series of guidelines to help local authorities promote adaptation and identify their vulnerabilities to climate change. Some of these networks are the result of international projects, others have been created by national government bodies. Many involve research institutes and NGOs, in addition to gathering local institutions. For example, in France, Club ViTeCC is a network of policy-makers and local scientists created by CDC Climate Research, ONERC, and Météo France, to make research on climate change economy understandable and employable by decision-makers and service providers.

Other cities have developed, or are developing, adaptation plans and strategies specific to determined key sectors, focusing on the most relevant vulnerabilities of specific regions. Brussels, for example, is developing a plan for rainfall management, the *Plan Pluie* (Bruxelles Environnement, 2008). Hungarian cities have plans for water management and early warning systems in case of abnormal temperature rise (Wilhite & Svoboda, 2007). Many Estonian cities have developed adaptation plans for storms and floods. Coastal towns like Tallinn, Pärnu, and Haapsalu, which have suffered the heavier effects of extreme weather events, have been the most active in implementing adequate adaptation measures.

MUNICIPALITY	COUNTRY	PLAN	NETWORK
Alba	**Italy**	Local Adaptation Plan to Climate Change	Agenda 21, EU Cities Adapt, Mayors Adapt
Almada	**Portugal**	Almada's Adaptation Strategy	ICLEI, Agenda 21, CCP, EU Cities Adapt, Mayors Adapt
Hamburg	**Germany**	Climate Action in Hamburg	ICLEI
Amsterdam	**Holland**	Climate Change Adaptation Action Plan (AAP)	C40, CCP, Agenda 21, GRaBS Project,
Ancona	**Italy**	ACT- Adapting to Climate Change in Time	ICLEI, Agenda 21, ACT Project , EU Cities Adapt
Antwerp	**Belgium**	Implementation of EU Commitments: Covenant of Mayors and Mayors Adapt, A Tailored Approach 2015-2020	ICLEI, Mayors Adapt
Arnhem	**Holland**	City Structure Vision 2020-2040	Mayors Adapt,
Arnsberg	**Germany**	Integrated Climate Protection Concept	Mayors Adapt
Barcelona	**Spain**	Barcelona Resiliente	C40, ICLEI, 100 Resilient Cities, Agenda 21, GCCC, CCP, EU Cities Adapt, Mayors Adapt
Birmingham	**England**	Birmingham Climate Change Strategic Framework	ICLEI, CCP, Agenda 21, EU Cities Adapt,
Bologna	**Italy**	Bologna Local Urban Environment Adaptation Plan for a Resilient City – Blueap	ICLEI, CCP, Agenda 21, EU Cities Adapt,
Bratislava	**Slovakia**	Adaptation action plan Bratislava	EU Cities Adapt, Mayors Adapt
Bullas	**Spain**	Local Adaptation Plan to Climate Change	ACT Project, Mayors Adapt
Copenhagen	**Denmark**	Copenhagen Climate Adaptation Plan	C40, ICLEI, Agenda 21, GCCC , CCP, Mayors Adapt
Dresden	**Germany**	Regional Climate Change Adaptation Programme Dresden Region	ICLEI, CCP, Agenda 21, EU Cities Adapt
Dublin	**Ireland**	Climate City Plan	ICLEI, EU Cities Adapt, Mayors Adapt
Edimburgh	**Ireland**	Resilient Edinburgh: Climate Change Framework 2014-2020	ICLEI, Mayors Adapt
Frankfurt	**Germany**	Climate Change Adaptation Strategy	Mayors Adapt
Freiburg	**Germany**	Action Plan for Climate	ICLEI, CCP
Gibraltar	**England**	Adaptation strategy for Gibraltar	ICLEI, 100 Resilient Cities, Agenda 21, Mayors Adapt
Glasgow	**Scotland**	Climate Ready Clyde Vision	Agenda 21
Greater Manchester	**England**	Greater Manchester Climate Change Strategy (GMCCS) / Climate Change Strategy Implementation Plan (CCSIP)	ICLEI, CCP, Agenda 21, Mayors Adapt
Hannover	**Germany**	Climate Change Adaption Strategy for the City of Hannover	ICLEI, Agenda 21, CCP, EU Cities Adapt
Lahti	**Finland**	Lahti City Strategy 2025	CCP, Agenda 21, Mayors Adapt
Leicester	**England**	City of Leicester Climate Change Strategy	C40, 100 Resilient Cities, Agenda 21, CCP, GRaBS Project
London	**England**	Managing risks and increasing resilience Plan	C40, Agenda 21, Mayors Adapt
Madrid	**Spain**	Plan de Uso Sostenible de la Energia y Prevenciòn del Cambio Climatico	ICLEI, EU Cities Adapt, GRaBS Project
Malmö	**Sweden**	Malmö Climate Plan	Mayors Adapt
München	**Germany**	Strategic Guidelines on Climate Change Mitigation and Adaptation	ICLEI, Agenda 21, Mayors Adapt,
Newcastle	**England**	Climate Change Strategy and Action Plan 2010-2020	ICLEI, Mayors Adapt,
Nijmegen	**Olanda**	Water and Sewer Plans Nijmegen	Agenda 21, EU Cities Adapt
Padua	**Italy**	Piano clima	C40, ICLEI, 100 Resilient Cities, GCCC
Paris	**France**	Plan Climat de Paris	C40, ICLEI, 100 Resilient Cities, Agenda 21, EU Cities Adapt, Mayors Adapt,
Rotterdam	**Holland**	Rotterdam climate proof	ICLEI, Agenda 21
Zaragoza	**Spain**	Zaragoza Strategy for Adaptation to Climate Change	Mayors Adapt
Stuttgard	**Germany**	Climate Change Adaptation Concept (KLIMAKS)	C40, Mayors Adapt
Stockholm	**Sweden**	Stockholm action plan for climate and energy 2012–2015	ICLEI, Mayors Adapt
Växjö	**Sweden**	Climate Change Adaptation Plan 2013	ICLEI, Agenda 21, EU Cities Adapt
Vitoria-Gasteiz	**Spain**	Plan de Adaptación al Cambio Climático de Vitoria-Gasteiz	ICLEI, Mayors Adapt

TABLE 5.1 Local adaptation initiatives in Europe *(Magni, 2016)*

Adaptation actions and projects have also been actuated on a local scale or as part of the political agendas of European municipalities. These initiatives focus on specific adaptation problems: reducing the heat island effect in urban areas; implementing application and design of green roofs; improving water efficiency and supply in areas subject to drought, etc. For example, Saragossa has set up awareness campaigns that combine the commitment of citizens and enterprises with the update of water costs included in the *Water Saving City programme* (Benedi, 2008). This program was launched in 1996 by the NGO *Fundación Ecología y Desarrollo* with the support of the municipality, and managed to reduce water consumption in Saragossa by 30% in only 15 years, despite a 12% increase in the population over the same period (Kayaga et al., 2008; Kayaga, 2010). The key factors behind its success were the active promotion of a water saving culture, the full participation of the interested parties and the creation of a central coordinating unit. Other examples of plans implemented by European cities are illustrated in Table 5.1.

The table above shows how such initiatives sometimes have a strong relationship with the processes launched by the Local Agenda 21 (van Staden & Musco, 2010) or other projects or networks, and now considered consolidated (if not almost obsolete).

Adaptation to climate change entails the adoption of measures aimed at facing present and future effects and vulnerabilities, as well as the variability that occurs without climate change in an ever-changing society. Adaptation doesn't only mean protection against negative impacts, but also being more flexible to the change and taking advantage of its possible benefits (Galderisi, 2014).

As some of the above-mentioned cases demonstrate, the more rapidly adaptation measures are implemented, the better the preparation to face future environmental challenges and guarantee opportunities to the cities and their communities (World Bank, 2011, 2015).

The transition or evolution from the Covenant of Mayors (established in 2008 to reduce greenhouse gas emissions) to the Covenant of Mayors for Climate and Energy (introduced in 2015 to integrate mitigation actions with adaptation actions) is an example that proves that adaptation and mitigation are increasingly considered as complementary factors as well as a priority within the EU to tackle climate change. At the same time, European society will have to face many changes, included those related to its economy, population, environment, and climate. Adapting to these changes will be a challenge as well as an opportunity for Europe, and requires the strengthening of the flexibility and adaptation capability of the economic sector, cities, and companies (Klein, Schipper & Dessai, 2005).

Some of the good practices analysed (Breil & Swart, 2015; Magni, 2016; Olazabal et al., 2014) highlight the necessity of integrating adaptation and mitigation initiatives into the wider scenario of resilient urban development by connecting long term actions and policies, which

aim at the reduction of greenhouse gas emissions, with short and medium-term strategies to reduce the impact of climate events. In fact, despite the need to develop cross-sectorial strategies, most cities have developed mitigation strategies focused on sectorial areas (e.g., Sustainable Energy Action Plans, or Energy Plans) or 'innovative projects', while only a few cities are developing plans or local integrated cross-sectorial strategies to improve urban resilience.

Bologna, Barcelona, and Rotterdam have been analysed in Table 5.2 as virtuous examples of climate proof processes to better understand the strong and weak points of the current adaptation initiatives responding to imbalances caused by climate change.

	BOLOGNA	BARCELONA	ROTTERDAM
GOVERNANCE CHALLENGES			
Vertical integration			
Horizontal Integration			
Integration of knowledge			
Involvement of stakeholders			
BARRIERS AND HINDERING FACTORS IN CLIMATE POLICIES			
Lack of information for decision-making			
Lack of economic resources			
Fragmentation of decision-making			
Regulatory and institutional constraints			
Absence of leadership			
Uneven risk perception			

TABLE 5.2 Comparative synthesis of climate proofing pathways undertaken by some of the local European contexts analysed *(Magni, 2016)*

The study carried out on the experiences presented in Table 5.2 and 5.3, clearly shows that the initiatives and projects currently underway seem to significantly contribute to the promotion of cross-sectorial and multi-target strategies to face climate change by paving the way for an integrated approach to climate issues. Numerous measures, especially those that increase green infrastructures, testify to this double role, by contributing to both mitigation and adaptation and reaffirming the strong connection between adaptation actions and the context (environmental, social-economic) on which they are working. Interventions and adaptation policies have been elaborated by public bodies to better respond to different necessities and specific regional and local conditions, thereby avoiding a one-size-fits-all approach for all contexts (Magni, 2016).

The peculiarity of the city of Rotterdam, for example, where 90% of the municipal area is below sea level, has led to considering urban adaptation actions to climate change as the key target of most economic development projects. In Barcelona, instead, the actions to improve city resilience focus on a broad range of targets related to the management of urban services and public assets and a better resilience to climate change. Both cases agree in allocating a driving factor to improving

urban response to climate change and increasing the involvement capabilities of citizens.

The involvement of the interested parties alone (policy makers, NGOs, companies, citizens) has been one of the central points of Bologna's adaptation experience (Caranti, Di Pietro, Fini, & Gueze, 2014). This action has also promoted an improved consistency with adaptation plans and created a sense of responsibility regarding climate policies.

The initiatives to improve the cities' capability to transform had a different consideration instead. What is becoming increasingly clear is the necessity of a great step forward towards development models with low carbon emissions to reduce greenhouse gas emissions, energy consumption, and climate impact on urban areas (Rosenzweig et al., 2015). To achieve this, a leading role must be assigned to urban planning, as it could represent a fundamental tool to harmonise targets in different spatial and temporal spheres, achieve more flexible processes to involve interested parties and, above all, integrate currently existing policies, initiatives, projects and sector instruments, thus avoiding a useless waste of resources (Desouza & Flanery, 2013).

This kind of flexibility can be also fostered by the employment of different adaptation measures. For example, integrating 'grey' (i.e. technological and engineering), 'green' (ecosystem-based approaches) and 'light' (management and political) approaches is often a good way of dealing with connections of natural and social systems.

BOLOGNA	BARCELONA	ROTTERDAM
– Bologna Local Urban Environment Adaptation Plan for a Resilient City – Strategia locale di adattamento ai cambiamenti climatici – Piano di protezione civile – SEAP – Piano Strutturale Comunale (PSC) – Piano Operativo Comunale (POC) – Regolamento Urbanistico Edilizio (RUE)	– Plans d'Acciò per a l'Energia Sostenible (PAES) – Plan de Energia, Cambio Climatico y Calidad del Aire – Plan de sostenibilidad del Area Metropolitana de Barcelona (PSAMB) – Plan de Resiliencia y adaptaciòn al Cambio Climatico	– National Adaptation Strategy + Delta programme – Rotterdam Climate Change Adaptation Strategy – Water plan 2 – Rotterdam Climate Initiative

TABLE 5.3 Examples of tools implemented as part of local adaptation practices *(Magni, 2016)*

6 Towards a Shared Methodology to Support Climate Proof Planning Tools

Most of the documents analysed in this chapter have been drafted at a moment when climate change theories and knowledge evolved faster than territorial government politics and instruments. This often meant that the so-called 'innovative' experimentations strongly contributed to improving the theoretical apparatus rather than addressing adaptation practice unlike what they were initially meant to do. In the 2000s the range of actors involved in adaptation practices and policies has remarkably expanded to include ministries (not only for

the environment) and experts (both public and private) for a sustainable territorial development. This in turn means less academic theory about adaptation in favour of a "learn by doing" approach supported by the analysis of vulnerability related to actual experimentations on a local level. Over the years, the lack of information on how to effectively implement adaptation strategies and plans became increasingly clear (Silva Villanueva, 2011; Solecki, Leichenko, & O'Brien, 2011). For this reason, the United Nations Framework Convention on Climate Change (UNFCCC), with its related activities, prepared a theoretical framework on adaptation as a practical guide to support decision-making bodies as well as those not included in the immediate application of UNFCCC. The framework includes different steps to be undertaken by local, regional, and national administrations.

On a government level, these steps allow the understanding of how decisions can be implemented for mitigation and adaptation to global climate change by improving the quality of life of communities. Fig. 6.1 shows some applications of this technical framework as defined by different territorial organisations.

step	UNDP Toolkit	ClimAID	ACT	SEAP_Alps	Climate-ADAPT Platform	UKCIP
1	Define Problem	Identify current & future climate hazard	Avviare il processo	Assessing Risk & vulnerability	Preparing the ground for adaptation	Identify problems & objectives
2	Identify Cause	Inventory vulnerabilities &opportunities	Stabilire una Baseline delle conoscenze	Identifying adaptation options	Assessing risks and vulnerabilities to climate change	Establish decision- making criteria
3	Identify and Articulate Normative Response	Prioritize vulnerabilities	Valutare rischi e vulnerabilità	Assessing adaptation options	Identifying adaptation options	Assess Risk
4	Identify Barriers	Identify and categorize adaptation strategies	Identificare le azioni di adattamento	Implementation	Assessing adaptation options	Identify options
5	Formulate Expected Results	Evaluate and prioritize adaptation strategies	Implementare azioni di adattamento	Monitoring & Evaluation	Implementation	Appraise options
6	Review Steps and Complete Checklists	Link strategies to capital and rehabilitation cycles	Monitorare, valutare aggiornare il piano		Monitoring and evaluation	Make decision
7		Create an adaptation plan	Coinvolgere gli stakeholders			Implement decision
8		Monitor and reasses	Integrare adattamento politiche settoriali			Implement decision

FIG. 6.1 Comparison of climate proofing planning methodologies *(Magni, 2016)*

The different steps (that vary in quantity and nomenclature) do not necessarily need to be carried out in order: some of them can happen simultaneously, but in any case, should be viewed as a cycle. The idea is in fact to launch a process that passes through each scheduled step and defines the targets achieved.

Gradually, the process should improve further and finally achieve a climate-proof or resilient community. In order to define a general and updated methodology (the UNFCCC proposal dates back to ten years ago) that steps away from specific examples, the macro-steps provided by the adaptation planning process can be summarised as follows:

D Building a knowledge base on the subject of adaptation;
E Evaluating the impacts of climate change on a micro and macro level;
F Evaluating vulnerability and related adaptation capability;
G Identifying possible adaptation options (adaptation measure planning);
H Executing measures;
I Monitoring and efficiency assessment.

6.1 Università Iuav di Venezia Methodology for Climate Plan and Policy Design

The concept of adaptation and its integration into territorial government instruments represents a rather complex issue, which takes advantage of the contribution of various disciplines and is still undergoing international debate (Béné, Godfrey Wood, Newsham, & Davies, 2012; EEA, 2012b; Mukheibir & Ziervogel, 2007; Olhoff & Schaer, 2009; Revi et al., 2014).

FIG. 6.2 Methodology to support local communities in defining climate-related plans *(Magni, 2016)*

In fact, there is no unanimously satisfactory approach, as the wide range of definitions in related literature and multiple methodological approaches testify (e.g. vulnerability analysis, risk assessment, etc.).

For this reason, choosing what works best for their needs is in the hands of the single communities (Corfee-Morlot, Cochran, & Teasdale, 2009): some may decide to implement the entire cycle of adaptation policies, while others may prefer leaving one step aside or simplifying it, or even performing only a risk and vulnerability assessment. The choice will depend on several factors such as the availability of financial resources, technical skills, observed data, etc.

In this context, a working team from the Università Iuav di Venezia, part of the SEAP Alps Project (a project organised within the INTERREG Alpine Space program and funded by the European Regional Development Fund), developed for the Metropolitan City of Venice a methodology to assist local communities in formulating Sustainable Energy Action Plans (SEAP), as well as other types of plans related to climate such as the Local Adaptation Plan (LAP). This methodology (Fig. 6.2) was built following the indications provided by the methodologies presented in Fig. 6.1 and in the SEAP Alps Methodology: Integration of adaptation in SEAPs in particular. Below is a representation of the six key steps of the local adaptation process.

7 Conclusions

The critical review in this chapter identified a series of approaches to climate planning, starting with the analysis of a series of methods, tools, guidelines, manuals, and other materials related to adaptation. They were all developed by and for different territorial actors such as different levels of territorial government (local, regional, national), NGOs, universities and research institutes (public and private). It was observed that, unlike the first scientific publications and tools relating to climate change drafted in the 1990s, in which risk assessment was the main source of information for climate planning, some recent approaches (even if still considered uncertain) now also recognise social, economic, and environmental changes as essential factors to maximise the effectiveness of a real adaptation process.

Even if there is more awareness with regard to the entity of the global problem, it is clearer than ever that mitigation and adaptation will have to deal with local development, not only to face climate change, but also to deal with the fluctuations of many other non-climate factors that influence human well-being.

However, if this new approach to climate change doesn't systematically modify the planning processes, results on a local level will be barely effective at best and could even worsen the situation. The risks related to non-sustainable development and to the lack of territorial equity cannot in fact be eliminated through actions that only consider the impacts of climate change. For this reason, the methodological approach to climate-proof planning is gradually moving away from a mere assessment of impact and vulnerability towards a forward-looking approach that incorporates an inter-sectorial vision (so-called 'mainstreaming'). According to this, the various tools, methods, and approaches that have been developed and adopted over the last period also focus on information integration (horizontal or vertical) as one of their main targets. This work wants to highlight how, despite all the limitations and barriers, there are many available methods and tools to try and overcome these obstacles, and offers methodological indications on how to make cities and territories climate-proof. Among them:

- Thanks to the wide availability of adaptation methods and instruments supplied by networks such as the CLIMA-ADAPT platform, it will be possible to avoid mistakes during the methodological preparation of the measures to undertake;
- Due to the considerable gaps in the knowledge concerning adaptation, it is necessary to proceed with a serious training of policy makers before moving on to the planning phase. This will make sure that the methods and tools built will make it easier to achieve the expected targets;
- While there isn't a unique approach to support climate-proof territorial planning, there is a variety of approaches that contribute to reaching the final target;
- It is necessary to devise measures and actions according to resource availability, evaluate the co-benefits of adaptation (thus increasing the benefits perceived) and identify solutions for a more effective employment of resources;
- Monitoring is a fundamental component for the planning and application of correct measures because it allows the assessment and modification of the strategies put in place within a specific context and maximise their effectiveness.

The research path presented moves on from the assumption that urban planning and territory sciences are dealing with the consequences of climate change.

This relationship reflects the change cities are facing today, towards the improvement of life conditions. Climate imperatives intervene in this complex matter by adding tension, upsetting balances and increasing the vulnerability of these already widely stressed 'microcosms'. This in turn involves urban planning processes, even if the choices made by city and territorial governments have, up to now, neglected (or left to voluntary and punctual actions) the relationship between climate and territory planning. The initiatives applied, despite confirming the decision of some subjects (cities, states, etc.) to embrace a new path, didn't lead to adequate political responses from both a qualitative (instruments and policies) and quantitative (expansion of global involvement) perspective.

Climate-proof processes present quite uneven situations for countries where adaptation plans and strategies have been introduced, and others where risks and impacts are being underestimated in spite of the significance of ongoing phenomena (Musco & Magni, 2014).

Among the issues emerged from these first trials, there is definitely the necessity to overcome the specificity of partial planning, which is only oriented towards energy consumption, often without an actual relationship with planning. The main reasons for this can be attributed to the lack of public and shared awareness on climate variability (Kahan, Jenkins-Smith & Braman, 2011; Renn, 2011) and its territorial repercussions (IPCC, 2007), to the late response to climate disasters due to the lack of capacities and resources (Bulkeley & Kern, 2006; Corfee-Morlot et al., 2009), and to the lack of public policies and regulations on urban and territorial planning to manage the climate

change (Lebow, Patel-Weynand, Loveland, & Cantral, 2012; Winkler, Anderson, & Hatfield, 2012).

Anyway, the intrinsic potentialities of the cities can be recognised beyond these limitations (Adger et al., 2007 Moser & Ekstrom, 2010): if adequately planned and managed, cities can in fact contribute to reducing the causes of climate change (mitigation) and efficiently protect themselves from expected local impacts (adaptation) (Adger et al., 2007).

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