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Towards Sustainable Urban Planning In Times of Climate Change

Rosalba D'onofrio

***Abstract*—**It is not easy to imagine how the existing city can be converted to the principles of sustainability, however, the need for innovation, requires a pioneering phase which must address the main problems of rehabilitation of the operating models of the city. Today, however, there is a growing awareness that the identification and implementation of policies and measures to promote the adaptation, resilience and reversibility of the city, require the contribution of our discipline. This breakthrough is present in some recent international experiences of *Climate Plans*, in which the envisaged measures are closely interwoven with those of urban planning. These experiences, provide some answers principle questions, such as: how the strategies to combat climate can be integrated in the instruments of the local government; what new and specific analysis must be introduced in urban planning in order to understand the issues of urban sustainability, and how the project compares with different spatial scales.

***Keywords*—**Climate change, urban sustainability, urban planning.

I. Introduction

AS of 2008, more than half the world's population now lives in cities and starting in 2025, our planet will house more than 5 billion people in urban contexts. According to the United Nations, almost 80% of energy consumption occurs in cities; in addition to energy, cities need a concentration of food, water and materials that nature cannot provide at current growth rates. The moment has come to start thinking about how to avoid leading tomorrow's city into collapse by activating a lifesaving procedure. We have probably arrived at a point at which even urban planning should start to take account of climate changes, above all when the search for better urban efficiency requires cities themselves to actively contribute to a possible response to local and global impacts. However, one should not fall into the error of refining the concept of sustainability with reference only to energetic terms and thereby err in evaluating the complexity of questions in the field with the risk of compromising development choices and the city's future itself.

For some years now, the theme of sustainability in urban development has actively entered the urban planning debate; but if even societies that seem, at least apparently, more prepared and more experienced in the pursuit of this objective are repeatedly thrown into crisis by devastating and unexpected environmental and climactic variations, it is necessary to ask what has worked only partially or not at all. In fact, in ordinary practice, the urban planning discipline has managed to reduce the complexity of urban systems, considering them substantially stable and deceiving itself that the transformations were preventable and controllable; it has thought about sustainability not as a process and constantly evolving course, but as a stable final state. The temptation has sometimes prevailed to limit intervention to a small scale, for circumscribed environments, for timely projects, for single architectures, imagining the reconstruction of the urban mosaic possible when starting from single pieces. Lastly, in many cases the urban planning discipline has delegated to other disciplines the search for possible solutions to contrast the effects of climate changes, favouring responses of a sectoral approach and with rather limited efficiency.

A series of experiments has descended from this cultural structure, of which only a few cases have produced mature results and concrete applications for improving the environmental and social quality of our cities. In fact, the experiments have often concentrated above all on technological innovations directed toward building sustainability and saving energy, omitting broader and more complex reflections on the contemporary settlement model and the lifestyle of the inhabitants.

The modest success of politics experienced up to now (primarily compared to the existing city), the global economic crisis and above all the energy crisis and environmental catastrophes, necessitate a radical rethinking today on the contents and means with which to trigger real environmental, social and economic sustainability processes in cities. The same uncertain success of international politics, emerging after the failure of the recent climate conference in Durban, obliges those dealing with city projects to examine new principles of responsibility implicit in a broader view that is expanded to look for new configurations and the modification of current operational models. In the awareness and hope that cities can and should become places in which to experiment with new, more sustainable forms of living and working, new social relations, smarter ways of using one's time and a better quality of life – not necessarily associated to the growth of material consumption – and in the awareness that the effort necessary to improve urban performance will lead to obtaining cities transitioning to sustainability rather than sustainable cities, a reflection is required on the role of territorial and urban planning in managing this process and on its capacity to translate the anxiety of adaptation to sustainability into strategies, rules, and projects able to create synthesis between different disciplinary contributions.

Among the strategies to counter climatic changes, research on existing urban areas and politics defined on the local scale assume a greatly relevant role today; it is above all with

Author is a Research in Urban and Land Planning at School of Architecture and Design, University of Camerino- IT (Phone: +39- 0737-404253; e-mail: rosalba.donofrio@unicam.it).

reference to the existing city that a fertile exchange of different responses to sustainability objectives that cities have put at the centre of their agendas for some years is made necessary, serving as a compass to orient strategic choices for development and to achieve a rethinking of urban spaces within an ecological perspective. Starting from this heritage of experience, it is possible to identify some significant questions regarding urban planning, with particular attention to themes that seem to shift the terms of the debate and disciplinary research, opening up new occasions for learning and intervention.

II. Reflections for a Work Agenda

A. The Need for a Transdisciplinary Approach and the Integration between Adaptive and Mitigation Measurements

If sustainable urban development is, as numerous studies and international reports suggest, primarily a process that is enriched by collective learning, the capacity for conflict resolution and the capacity for strategic design, it is also the result of synergistic integration and co-evolution between the large subsystems comprising the city (the economic, social and physical-environmental systems). To obtain the substantial evolutionary equilibrium of these subsystems, it is necessary to promote integrated intervention politics that confront the theme of urban sustainability with a transdisciplinary approach directed toward three principal goals: technology (primarily energy and transport), the environment and urban form, and the *habitus* (characteristics of the individual behaviours) [1]. Urban planning will not be able to confront these principal paradigms of urban sustainability by making use of traditional analysis and evaluation instruments, but will have to resort to an overall dynamic analysis of the urban system, with contributions from multiple integrated disciplines, including thermodynamics, ecology, statistical mechanics, technological sciences, economy, sociology and architectural composition, making use of innovative interpretive methods such as: the analysis of environmental cycles and networks in relation to the infrastructure, energy and settlement networks in the city; the analysis of urban growth limits in relation to carrying capacity criteria applied to the urban environment; the analysis of environmental comfort in relation to the quality of life in cities, etc. Through these new interpretive methods, the urban planning discipline is asked to promote politics and action that not only allow urban organisms to mitigate catastrophic effects, but also adapt themselves to climate changes, constructing new social, economic, and environmental responses to allow the city to withstand the urging of both the environment and history in the long term. The promotion of this equilibrium is among the new tasks of urban discipline, which is therefore called to act in an overriding way on the organizational and management models of the city.

Up to now, the theme of mitigation has always been predominant; the reduction in emissions in the atmosphere has been, justly, much discussed, but there has been little about adaptation, or rather how urban organisms can absorb and counter the effects of climate change, above all with reference to existing cities. On other fronts, however, the joint application of politics for adaptation and mitigation is called for, along with the definition of a worthy strategic approach that is able to hold together different levels of management, from both the intervention and acting sectors, with the goal as well of resolving the inevitable conflicts between complementary but different measures. If, with respect to measures for climatic impact mitigation, an abundance of experience in the whole European territory is recorded, expressed through precise targets for the reduction of CO_2 emissions with respect to 1990 (the Kyoto Protocol reference year) – from Amsterdam, which foresees a reduction of 40% by 2025, to Berlin (-40% by 2020), to Barcelona (-50% by 2030) – the concrete experience relative to the operational and organic application of adaptation measures is instead still rather limited. Also, in the "SEAP"(Sustainable Energy Action Plan), the idea of adaptation is commonly only cited, whether in the scientific community or in official documents; but more importantly, programs and projects financed by the EU (for example, the GRaBS-Green and Blue Space Adaptation for Urban Areas and Eco Towns) demonstrate a growing interest in adaptation practices and the role that urban planning can play in their definition. Going further, the conviction that climate changes should be confronted in an integrated way and on different scales is spreading. This new approach has been pursued by the *AMICA* (Adaptation and Mitigation, an Integrated Climate Policy Approach) project [2], financed by the European Union within the Interreg IIIC Program. In the explanation of the program, the drafters maintain that "… choosing between mitigation and adaptation is analogous to the choice between repairing faulty brakes on a bicycle and buying a helmet. Functioning brakes helpto prevent accidents (mitigation), while the helmet is designed to avoid disasters if an accident should occur (adaptation)…".

AMICA proposes a new approach to territorial environmental politics that integrates long-term protection of the climate (a measure of mitigation) with short- and medium-term adaptation measures, improving the coherence of local development strategies and the allocation of financial resources, and promoting the projection, planning and operational capacities of local administration to confront threats of climate change and seize opportunities. From this double response method with long- and short-term measures, a different relationship with analysis and project scales also follows. If, in fact, politics and mitigation measures are similar in large part, adaptation measures should necessarily be oriented to the specific vulnerability of the territory. With such a goal, the program is aimed at motivating local governments to include climate protection and adaptation in their ordinary planning activities, favouring those synergies that are created when mitigation and adaptation measures are complementary and not alternative between themselves. For example, some interventions in land management, such as the planting of trees, act both as adaptation interventions to avoid soil erosion, and as mitigation interventions (forestation).

Fig. 1 Lyon, Charte de l'Arbre

Another meaningful example in such a direction is given by water conservation (adaptation intervention), which also translates into energy savings (mitigation intervention). Understanding possible synergies between adaptation and mitigation measures can soften conflicts and, in such circumstances, good planning can become very useful. For example, if it is true that a higher living density is a means to improve the overall energy efficiency of an urban area, it is also true that responding to climate change with adaption requires space in and around buildings. In this case, good urban planning can lead to a reduction in greenhouse gases and contribute to adaptation, offering the parallel opportunities of lowering carbon dioxide emissions and the recourse to an average density of settlements, their differentiated use and green areas.

The experience of the city of Lyon is of particular interest in such a scenario. Since 2005, the Urban Community of "*Grand Lyon*" [3], [4] began preparing a Climate Plan scaled to its territory (55 towns and 1,300,000 inhabitants). Three original aspects are immediately evident:

- the commitment of the urban community to the AMICA European Program;
- the search for adaptive solutions and innovative practices, above all in matters of managing green areas in the city;
- the commitment to synthesizing all of the objectives of climate effect reduction contained in long-term planning documents (PDU, PLU, SCoT).

The originality of the experience of Lyon lies mainly in the importance given to adaptation and the willingness to promote public action in climate matters that are not limited to emission reduction measures. In fact, a study was promoted that aimed to measure the vulnerability of the urban area in its entirety with respect to three types of risk: water resources, heat islands and flooding. This study showed that heat peaks caused the greatest vulnerability in the territory. With this in mind, the "*Charte de l'Arbre*" (Fig. 1), created by the "*Arbres et paysages*" service in 1994, on the occasion of its revision in 2005 decided to consider climatic warming on nature in the city through a deepening of knowledge related to the impact of vegetation on the urban climate. The case of Lyon, in addition, testifies to the variability of the reference scale in the definition of adaptation measures; if management on short timescales is undoubtedly favoured in the "*Plan Canicule*", the need to draw on long timescales passing through extensive urban policies is highlighted, where for example, the redefinition of the urban form occurs with the support of vegetation.

In addition, city governments can take a range of planning decisions related to urban development to reduce greenhouse gas emissions. They can be proactive in regulatory and educational measures and apply mandatory density and energy efficiency criteria. Cities can make a substantial long-term contribution to the prevention of motor traffic if they consider this aspect early in the planning process. Urban development planning is a key factor in the demand for mobility: whether it is a compact city where the various functions – residential and commercial, services, education and recreation – are located and how they interconnect, or whether public transport is available for newly developed areas, etc. For example, the State of California is currently a pioneer in what could be the next step against global warming: filing lawsuits to hold cities accountable for greenhouse gas emissions caused by poorly planned suburban sprawl.

There is, in reality, a lot of significant European experience in such a direction. One of these is in the *PTCP* (Piano Territoriale di Coordinamento Provinciale) of 2009 for the Province of Modena, Italy. In this plan, the themes of sustainability were dealt with in a participatory course on the Agenda 21 model prior to drafting the PTCP. In particular, the participatory process has lead to sharing and to inserting the

following adaptation measures into the definitive version of the plan:

- increasing the hydraulic security of the territory from flooding phenomena by reducing the vulnerability of residential and productive areas to the danger of flooding;
- stopping settlement expansion in relation to waterway flows increasing with climate changes and the impermeabilisation of the soil. With such an aim, the PTCP provides for an increase in urbanized area that does not exceed more than 3–5% of the territory urbanized as of 31 December 2006, requiring towns in the provincial territory to accomplish selected goals through the application of territorial adjustments;
- controlling atmospheric emissions of climate-altering gases by introducing rules for the energetic efficiency of buildings and the identification and regulation of provincial ecological networks.

because only progressively can some necessary preparatory steps for their effective realisation be completed.

In the *Climate Change Adaption* of 2008 [5], [6], the city of Toronto foresees two types of action for adaption to climate change: short-term operations that make reference to existing programs regarding areas of the city in which vulnerability characteristics have already been noted, and long-term actions that will need systematic elaboration with the aim of identifying and evaluating vulnerability characteristics of determined urban areas and the consequent adaptation strategies (Fig.2). The short-term actions were immediately made operational and have dealt with already-financed interventions and adaptation measures recommended by the *Several City divisions and agencies*, which were able to improve existing programs and increase their resistance to climate changes. In contrast, the long-term actions enter into a global adaptation strategy that deals with urban infrastructure

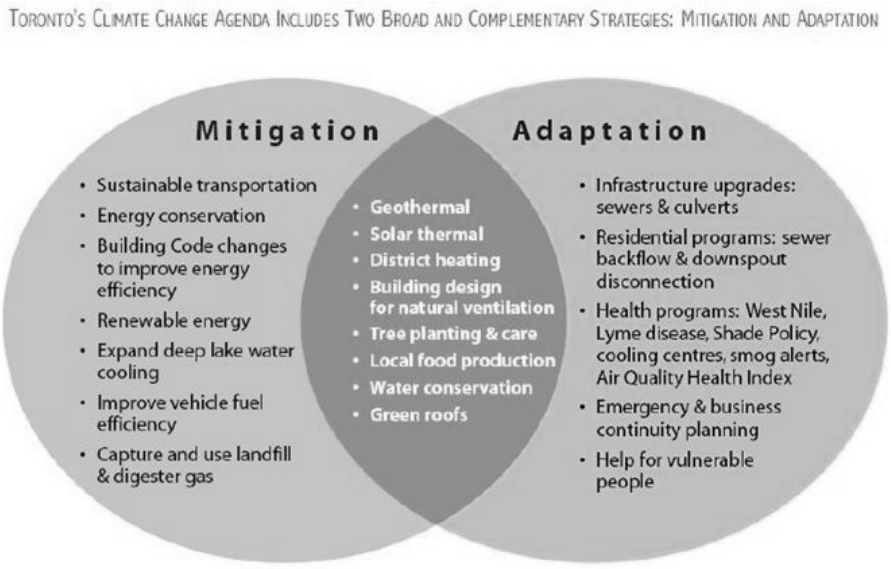

Fig. 2 Toronto, Green spaces as means to both mitigate and adapt to climate change

B. Time Variables and Risk Management

Thinking about urban planning within a global warming scenario leads to looking for responses to the impacts in solutions that are not only for civil protection and emergency, however indispensable these may be.

Within the plans, one should evaluate and consider how conditions for the security and liveability of different urban areas can change in time and, as a consequence, project any transformation hypothesis onto a scenario that considers risks and impacts linked to the climate, some already in place, others potential.

Two examples are interesting in such a sense: the *Climate Plans* of New York and Toronto, in which great importance has been given to the timely programming of operations to accomplish in relation to the hypothesised risks. Some action is identified as "short-term", to be realised immediately and without passing through the planning instruments; others are defined as "long-term" because they are more complex and and planning, and which, in the identification of risk and the measurement of adaptation, should make use of knowledge to be implemented within a time frame that is established but susceptible to modification. Nine successive steps have thus been identified, programmed in general terms, but to be elaborated in detail with time; among them, the third step forcefully highlights the fact that "… Climate change will affect nearly all aspects of Toronto's life. As a result, it is important to incorporate climate considerations into the planning of most City operations and services. A description of the challenges posed by climate change for the city, and goals for both mitigation and adaptation should be incorporated into relevant plans, strategies and programs…".

In addition, the document reports a list of the city's policies and plans that should include climate change considerations and explicit goals for adaptation.

Lastly, step eight establishes that once the city has identified and chosen overriding adaptation measures from

among the different options, it should first incorporate them "…into major infrastructure projects that are expensive, long-lived and will have to operate under changing climate conditions…".

The criteria that the city will use to identify the most-recommended adaptation measures may concern:

- the effectiveness of the adaptation action in providing protection for vulnerable populations;
- the extent to which the proposed adaptation options protect against loss of life or major economic losses;
- whether the adaptation option reduces stress on vulnerable systems;
- the cost of the adaptive action compared to the cost of alternative strategies, or to the potential cost of not acting;
- the extent to which adaptation options also reduce greenhouse gas emissions or provide other benefits that increase the sustainability and liveability of the City.

III. Diffusing a Model of Integrated Urban Planning that is Multi-Scale and Flexible to Accompany the Transition Toward Sustainability

The tendencies emerging on a global level in recent decades have required cities to confront problems through a vision that integrates the three dimensions of sustainability – economic, social and environmental – and that is shared at the same time by the highest possible number of urban actors (citizens, administrators, interest carriers, etc.).

The need for an integrated approach is the unavoidable condition necessary to respond effectively to problems connected to the city's use and development and to ensure the joint confrontation of different but interconnected themes and problems: not only energy, transport and building, but also economic and competitive well-being, social inclusion and environmental management. These themes are normally managed in an isolated manner and by different public administrations. The integrated management model foresees interdisciplinary and sectoral cooperation capable of involving the different institutional levels – local, regional and national – and, transversely, the individual sectoral abilities involved in intervention politics. The instrument used to activate such a model is one that makes reference to a long-term planning strategy, which by putting into relation different politics and different administrative levels guarantees the coherence of development operations, improving their efficiency and eliminating the risk of contradiction. This model imposes a shift in the approach to defining politics and instruments aimed at assuring the sustainability of the transformations, calling for an approach to planning that renounces the prescriptive and deterministic vision of rationalist urban planning. The objective is to make the city able to respond to continually developing needs by forecasting flexible and adaptable scenarios, and anticipate knowledge where science still does not give reliable responses, above all regarding the possible environmental implications of land consumption, resource withdrawal, the rate of pollution, etc. In addition, sustainability dictates being ready to confront problems on different territorial scales, since problems extend from the planetary dimension, with climate variations correlated to the greenhouse effect or the effects of ozone reduction, to the continental dimension with the phenomenon of acid rain, down to the regional or local dimension with questions linked to urbanization. Identifying the most appropriate scale to deal with the different aspects of sustainability and the reading of environmental problems opens the door to personalized sustainable development solutions; this promotes the role of local administrations in the most appropriate areas for experimentation with the integrated policies of adaptation and mitigation aimed at guaranteeing the sustainability of urban organisms, thereby reinforcing the European tendency to consider cities as fundamental and favoured territorial units of reference.

A particularly significant experience in such a direction is Rotterdam, with the RAS "*Rotterdam Adaptation Strategy*" [7], which provides for the application of an adaptive strategy through continual adjustments to the definition of operations counteracting climate change as a function of changing circumstances. In particular, through the "Route Planner", the principal objectives are identified and the action and options for each task are confronted, while the measures taken are evaluated through continual monitoring action, registering the effects that they will have on the speed and extent of the awaited change. On one hand, this procedure offers the possibility to weigh the measures adopted and, on the other hand, the opportunity to evaluate the possibly positive implications of the program with the additional goal of the city's greater attractiveness and added value from the economic point of view. The path toward resilience to climate change, different for each theme, is additionally incorporated within territorial planning.

IV. Conclusion

From the most significant European and International experience, it emerges how cities today constitute one of the best opportunities to counteract climatic changes and that to advance in this direction requires adopting urban governance systems able to assume within them the theme of climate change, improve the cooperation among the different institutional levels and promote a multilevel system of governance that recognizes the role of regions and cities, entrusting them with real standardization and planning power and concentrating on them a good part of the resources destined to support the great change that awaits in the coming decades.

However, even if there is this awareness on behalf of public administration and planners, they often lack the instruments necessary to analyze and design concrete sustainability strategies. Innovative paths regarding adaptation and mitigation strategies can be constructed only starting from the integrated evaluation of urban systems in the awareness that the spreading of cities over vast areas of the territory beyond the administrative confines of the municipality, the mobility and logistics of merchandise and the contextual necessity of maintaining and protecting natural resources urge linking urban transformations to integrated territorial government.

Faced with the challenge of governing the change, the necessity and utility of urban planning as a general approach is confirmed, even if completely renewed in its form and contents in the name of flexibility and resilience. This, in fact, represents a particular capacity for favouring adaptive action to reduce vulnerability and increase the resistance of urban organisms, but the knowledge, procedures, and instruments necessary are still largely inadequate to allow such planning to acquire the key role that was attributed to it more than a decade ago by the *Green Paper* "Adapting to climate change in Europe – options for EU action" .

In particular, given the fact that traditional planning instruments are not able to adapt to new conditions, the application of more dynamic procedures is spreading today, procedures that:

- make reference to a strategic planning approach capable of constructing more sustainable adaptive measures;
- make reference to different specific time frames;
- make use of a systematic multi-scale approach;
- require profitable collaboration among the different sectors of local administration and also between different levels of territorial government.

Thus renewed, the Plan will be able to configure itself as:

- an extraordinary "director's chair" of sustainability politics that organizes strategies in a flexible and dynamic way, monitoring developments with the possibility of modifying the objectives and instruments with respect to inevitable change in contextual conditions and with the assistance of diversified analysis and project scales;
- one of the essential instruments for constructing social and environmental quality if situated, as it should be, in the framework of politics and action of integrated government and based on realizing sustainable development;
- a useful confrontation area to profoundly reform the methods and contents of public intervention and to adopt sustainable urban policies taking shape through genuine shared courses.

It is necessary, however, to be very clear that, next to the rules, clear principles, political addresses and governance at the height of the challenge of sustainable development, it is necessary and that each urban policy not be made in such a way that it is divorced from the people living, working and transiting in the territory as active users of the contemporary city.

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