

CITIES AND SUSTAINABLE URBAN PLANNING IN TRANSITION

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Abstract

Sustainable development is advancing through cities that contribute to reducing pollution and energy consumes, managing efficiently energy uses, and behave as drivers of urban sustainability by rethinking an approach to redesigning urban planning. Cities are transitioning towards urban sustainability, meeting the needs of communities without compromising the wealth of future generations. Cities are playing a leading role in advancing towards urban sustainability, designing and implementing urban planning that has a positive impact for urban and natural environments, leading to environmental, social and economic benefits within urban ecosystems, and enabling citizens as responsible consumers and agents of social change. The future of sustainable urban development relies on cities redesigning urban planning, making healthy and efficient energy-led urban spaces, encouraging behaviours and actions for clean energy production, zero waste and emissions' reduction, promoting responsible consumption.

Keywords: urban planning, efficiency in energy use and consumption, sustainable urban development

1. Introduction

Demographic, environmental, economic and social transitions are leading cities to rethinking a renewal in models of urban development and urban planning (Amado, Poggi and Amado, 2016; Cajot et al., 2017; Islam, 2011). Driving more green, responsible and sustainable behaviors is both a social and economic challenge that cities are facing in order to shape future healthy and wealthy communities and society where current projections indicate that two in every three people will live in urban areas by 2050. Managing municipal energy consumption is both a relevant aspect and theme of energy management and an issue of urban planning policies (Pereira and de Assis, 2013). Cities play a key role in reducing emissions and mitigating long-term climate change impacts (Yazdanie and Orehounig, 2021). It is time that cities aim to develop adequate urban planning policies by tailoring fit tools for energy services coherently with goals and purposes of urban energy planning (Ferrari, Zagarella, Caputo and Bonomolo, 2019) in order to ensure better quality of life for citizens, and to support people and business to assume responsible behaviors about energy use and consume, enabling innovative, green and sustainable urban

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communities. Today, cities aim to rethink sustainable urban planning policies, promoting a smart energy city development (Mosannenzadeh et al., 2017) in order to achieve better quality of life for people, also supporting the proactive participation of citizens and enable them to have responsible behaviors in consumption. Sustainable urban development relies on meeting the needs of future generations. The twenty-century brain-based economy has changed the nature of production and consumption as less oriented toward manufactured products (Cohen, 2018). Promoting initiatives for driving sustainable urban development aims to do more with less, privileging an efficiency approach to managing energy use and consumption, reducing pollution and degradation of natural resources and promoting lifestyles, preserving the needs of future generations and communities (Amado, Poggi and Amado, 2016; Cajot et al., 2017). Cities are consuming three-quarters of the world's energy and causing three-quarters of global pollution. As communities living within urban spaces, cities are becoming responsible actors for addressing more sustainable and efficient energy use and consumption behaviors. Cities have a great potential in reducing urban pollution and addressing a pathway for sustainable and high quality of life (Jayne, 2006). Cities are rethinking the urban future with regards to the renewal within development and consumption patterns, adopting the vision of an experimental city which is redefining urban planning and driving effective urban social and economic change and innovation (Bourne, 1971).

Urban planning is considered as a means to enhance sustainable development within urban communities and spaces. Managing energy efficiency relies on rediscovering the urban scale. Cities are rethinking urban planning choices beyond the dominant approaches that focus on efficiency energy at local scale (Amado, Poggi and Amado, 2016). Designing urban planning helps to shape healthy urban spaces where people, groups, communities and businesses work, produce and gain, and live overall. Today, as agents of sustainable urban development, cities are planning healthy urban places, promoting efficiency of energy use and consume (Satterwaithe, 1997) in order to reduce the negative externalities and contribute to quality of life, improving urban ecosystems (Yigitcanlar and Teriman, 2015) coherently with the ambition to shape a green, renewable source use-led society and economy (European Commission, 2019). Cities play a key role, designing sustainable urban planning in order to achieve social, environmental and economic goals (Islam, 2011), reducing negative environmental impacts, shaping energy efficiency, overcoming the obstacles that hinder sustainable urban transitions, fostering cleaner production and better urban design (Puchol-Salort et al., 2021; Cajot et al., 2017; Li, Beeton, Sigler and Halog, 2016), developing renewable energy and improving urban eco-efficiency for a multi-dimensional change of urban spaces (Hens, 2010; McCormick, Anderberg, Coenen and Neij, 2013).

The key to unlock the door of sustainability is the city. As safe and resilient human settlements, cities are transitioning to the sustainable city which is able to build human settlements, minimizing the environmental impact and damage within urban areas, integrating social and economic development, environmental management and urban governance. Focusing on the cities helps to support and achieve sustainable economy and planet. As spaces of consumption, cities are the main drivers and *influencers* of responsible sustainable behaviors. There are still few studies that

elucidate the role and task of cities in promoting sustainable urban planning by enabling wealthy urban environments, and rethinking current urban planning policies, approaches and practices in order to achieve energy use and consumption efficiency and good management of energy by renewable sources (Amado, Poggi and Amado, 2016). The aim of the paper is to elucidate how cities are rethinking how to redesign a sustainable urban planning, enabling a pathway for addressing urban transformations and transitions to urban sustainability, playing a strategic role in designing urban environments that support the efforts for advancing sustainable lifestyles and energy use and consumption. Today, cities are rethinking strategy and policies about urban planning, designing a strategic renewal towards a sustainable vision, by managing efficiently renewable sources, reducing pollution and degradation. In Italy, cities are designing and implementing the *PAESC (Action plan for sustainable energy)* coherently with Majors' Agreement for Climate and Energy), in relation to the objectives set by the Italian *PNIEC (Piano Nazionale per l'Energia e il Clima)* and emerging within *The European Green Deal*. The study relies on analysis of documentation about a case study on urban planning initiatives with regards to Mantova *PAESC* in which the re-design of urban planning helps the city to rethink the future of urban social ecosystems and spaces in transitioning to sustainable, efficient, and green pathways that drive the city into a healthy future. Selecting the case study of Mantova urban planning helps to understand the pathway of urban sustainable and efficient energy urban transition within a city which is rethinking the urban potential in terms of energy efficiency and environmental degradation reduction, redesigning urban spaces, bringing together both the historical and cultural vocation and the productive one, shaping livable, healthy and resilient urban spaces, working for reducing pollution and wastes by efficiently managing energy use and consumption. The remainder of the study is structured as follows. After the introduction, in the second section the methodology section is briefly presented. In the third section, theoretical background is elucidated. In particular, as communities advancing for sustainable urban development, cities are redesigning urban planning policies for achieving the goal of sustainable energy efficiency and consumption. In the fourth section, the case study related to Mantova urban planning about energy efficiency use and consume is presented. The main issues and initiatives of Mantova *PAESC* urban planning are reported and described. Finally, conclusions are set out.

2. Methodological section

The study is qualitative, exploratory and descriptive. Methodology relies on a single case study's analysis related to the urban planning design and policies structured within the Italian city of Mantova. The case of Mantova *PAESC* related to urban planning redesign is reported and described. In the case study the municipality is rethinking about sustainable urban future of the city, designing urban planning policies that focus on making efficient and sustainable energy use and consumption. Following a case study view helps to provide a comprehensive understanding of the phenomenon without the rigidity of a predefined structure for observations and analysis (Yin, 2009). Specifically, with regards to studies on urban planning and

sustainability the methodology based on case studies refers to research concerning the policies and initiatives that city aim to define and implement in order to drive the transition toward urban sustainability and design of urban spaces for a minimal impact on natural environment (Li, Beeton, Sigler and Halog, 2016; Lopeffler, Österreicher and Stoeglehner, 2021), using analytical tools to select satisfying solutions to improve energy efficiency, use and consume from a both economic and environmental view, by policy decisions that pay attention to energy availability in terms of impact on pollution (Sampaio, Dias and Balestrieri, 2013).

3. Theoretical background

3.1 The role of cities for achieving sustainable urban development

Cities are redesigning urban planning and formulating equitable strategies to ensure the highest quality of life, and the efficient use of natural resources, supporting sustainable consumption and production patterns, reducing greenhouse gas emissions in order to achieve the sustainable management and efficient use of natural resources, and taking urgent actions to combat climate change and its impact (United Nations, 2015). Cities contribute to the ecological and social function of land, fostering a sustainable transition to green deal and production (United Nations, 2017), identifying a sustainable way to address green transition towards responsible consumers' behaviors, making resilient and sustainable human settlements and urban communities (European Commission, 2020).

Sustainable development refers to capacity to meet the needs of the present generation by preventing and reducing environmental pollution, breaking the linkage between economic growth and environmental degradation (Council of the European Union, 2006). Cities aim to achieve sustainable urban development in order to improve the quality of life and well-being of people, meeting the needs of future generations (Islam, 2011), redesigning urban planning policies, and rethinking on sustainable and environmental choices (Nash, 2009), making an efficient use of all natural resources, implementing sustainability-led policies to prevent undermining improvements in the production efficiency, achieving sustainable lifestyles about energy use and consumption, increasing efficiency resource management (Norwegian Ministry of Environment, 1995).

Promoting sustainable urban development relies on addressing social and economic growth, enabling the capacity of social urban ecosystems to decouple economic growth from environmental degradation, improving the environmental and social performances for products and processes in order to enhance human wealth, and prosperity, shaping a long-term scenario for healthy urban future, doing more and better, with less. Today, the challenge is to integrate the sustainability-led practices in the patterns of producing and consuming efficiently energy, influencing on global warming, pollution and natural resource depletion, driving towards smarter consumption and production, making green activities and supply chains (European Commission, 2008).

3.2 Cities re-designing urban planning for sustainable energy efficiency and consumption

Today, the challenge is to make the city as an agent and driver of sustainable urban development (Satterwaithe, 1997). Rethinking urban planning helps cities to shape sustainable and healthy urban spaces, tracking a pathway to achieve urban sustainability in order to reduce electricity consumption, managing efficiently energy consumes, promoting adequate urban planning practices, integrating the energy consumption reduction with obtaining energy from renewable sources, redesigning the ecological and efficient energy vocation of urban areas (Amado, Poggi and Amado, 2016), developing smart energy solutions (Mosannenzadeh et al., 2017). The search for urban sustainability is becoming a core issue in the debate on urban policy and strategy. The future of cities as urban communities should be safe, healthy and sustainable. Sustainable urban development is seen as a means to reduce the negative impact and externalities realized by human activities on the environment, to contribute to urban ecosystems' improvement and better quality of life (Yigitcanlar and Teriman 2015). Sustainable urban planning relies on community participation and involvement of all stakeholders, and coordination among different levels of planning. Sustainable urban planning focuses both on controlling land use and policies and means of implementation that contribute to achieving social, environmental and economic goals (Islam, 2011).

Actually, the city is a complex social and economic system under stress in virtue of unsustainable urban development paradigms based on ever-increasing consumption of resources. The city of tomorrow has to assume a circular pathway and metabolism with regards to the transformation of inputs in outputs to reduce gas and make greenhouse. In the 21st century the sustainability-led urban challenge relies on cleaner, greener and carbon-neutral cities that aim to promote initiatives for developing renewable energy, improving urban eco-efficiency, dealing with climate change, urbanization and resource depletion (Hens, 2010). Cities play a key in reducing emissions (Yazdanie and Orehounig, 2021), driving sustainable urban transformation in order to develop a multi-dimensional change of urban areas (McCormick, Anderberg, Coenen and Neij, 2013).

Energy efficient cities contribute to meeting economic, social and environmental challenges (Amado, Poggi and Amado, 2016). Cities have to redefine and implement urban planning systems in order to promote sustainable urban design and development in response to climate emergency and population growth, minimizing pressures on natural environments and urban infrastructures (Puchol-Salort *et al.*, 2021). Cities play a key role in designing urban planning for achieving urban energy targets to shape energy efficient and low carbon urban spaces even if obstacles and challenges influence efficient urban energy planning (Cajot et al., 2017). Improved planning and regulation help cities to drive the transition towards urban sustainability by fostering cleaner production and better urban design, reducing negative environmental impacts (Li, Beeton, Sigler and Halog, 2016).

As redesigning the innovative potential of urban areas in terms of renewable energy sources, cities aim to promote the renewal of lifestyles and transformation, leading to sustainable urban transitions, driving changes in production and consumption patterns (Ernst, De Graaf, Peek and Loorback, 2015), empowering citizens, business

and communities to assume responsible consumption and lifestyles behaviors (Clarke, 1997). Post-industrial and post-modern cities are redesigning urban planning, enabling people to assume responsible consumption behaviors, supporting businesses and industries to move to more resource-efficient production processes, adopting more sustainable supply chain management. Sustainable urban transformation relies on cities as privileged places and key drivers of urban planning redesign, by formulating policies for incentivizing environmentally preferable behaviors, encouraging business to transform their practices for reuse and zero waste (Lehmann, 2012), and contribute to social and economic development, and public wealth (O'Brien, 1999; Yagi and Kkubu, 2020). As cities become *mobilizers* of social capital for sustainable lifestyles and social changes, encouraging responsible behaviors about consumption, municipalities have to redefine *ad hoc* policies in order to revitalize the urban environments in a sustainable way, facilitating the rise of smart behaviors about consumption, and encouraging bottom-up initiatives (Moll et al., 2005). As resilient communities, cities are re-engineering the urban spaces, enabling citizens as energy producers as well as consumers, developing responsible consumption patterns (Schröder et al., 2019).

4. Rethinking urban planning for sustainability. The Mantova PAESC

Climate change, reduction of CO₂ emissions, and energy efficiency are the driving themes that are leading cities to rethinking urban planning approaches, policies and strategies. The city of Mantova is redesigning urban planning in relation to the objectives of the Italian PNIEC (*Piano Nazionale per l'Energia e il Clima*) in terms of transitioning to energy renewable sources, efficiency and security, innovation and research, and coherently with the ambition of the *European Green Deal* to enable national, regional and local public and private actors and communities to re-define and implement a growth strategy in order to transform prosperous societies, by promoting modern, resource-efficient, green, renewable source use and competitive economies.

The municipality of Mantova has contributed to the European campaign of Majors' Agreement (2013) and approved the *PAES (Piano d'Azione per l'Energia Sostenibile)* in order to achieve the goal of reducing CO₂ (20%) emissions in 2020.

In following years, after Mantova and neighborhoods municipalities have built a sharing energy urban planning, designing a *JOINT PAES*, monitoring actions (Action e Full reporting) in virtue of the Majors' Agreement, a new inventory of consumptions and emissions has been designed. In 2018 the municipality of Mantova has defined guidelines for climate adaptation of the city of Mantova in order to help the city to prevent and effectively manage the impact of climate changes. In 2019 February, the municipality of Mantova, has renewed its commitment to Majors' Agreement for Energy and Climate, combining CO₂ mitigation and climate adaptation in order to reduce the degree of global media temperature, making urban spaces and territories as safe and resilient urban places. The objectives are: reducing (40%) the CO₂ emissions by 2030 with regards to the year of reference (Baseline Emission Inventory-BEI), integrating both the mitigation strategy and climate change adaptation strategy.

In the Mantova *PAES* the inventory BEI 2005 as a picture of consumptions and emissions due to final energy uses and to the production of energy within the territory of Mantova helped to address the objectives for reduction of emissions in 2020 and for 2030. The energy context in Mantova refers to a territory where the urban structure concerns both the historical center and productive areas where chemistry and industrial poles, and a thermoelectric plant are involved. The objective is to reduce the emissions drawn by some sectors that are strategic in relation to future challenges: public building assets, public illumination, car fleet, private buildings, urban transportation, and services industry. Some scenarios for 2030 are hypothesized and the actions of Mantova municipality are set. With regards to improvement of public buildings it is necessary to improve the efficiency of public buildings, requalifying the buildings by promoting the transition from consumption of fossil sources to the consumption of electric energy locally produced by renewable sources or to the consumption of heat by thermal heating, using heat pumps by power supply. The actions of the municipality regard: progressive energy efficiency of buildings; the adoption of monitoring tools for electric and thermic consumptions; the implementation of pilot projects for citizenship; introducing criteria that favor the reduction of the emissions by providers within public contracts.

The goal of Mantova *PAESC* (2020) is to identify the optimal mix of initiatives in terms of actions and tools that may ensure the development of an energy, sustainable and efficient system that has the potential to make increasingly the territory, the urban environment and communities as resilient to uncertainties due to climate change. In particular, there are some priorities to be defined and implemented. Improving the energy saving and reinforcing the use of renewable energy sources helps to reduce the energy needs and CO₂ emissions; promoting the conditions for developing current circular economy coherently with social and economic specific territorial and local traditions; understanding the critical aspects that regard both the sustainability and resiliency of the territory. Planning adequate initiatives and actions for climate change, emissions' reduction and energy saving relies on engaging and involving local stakeholders in the territory, and designing integrated and multi-sector strategies, policies and programs. The strategic objectives of Mantova *PAESC* are the following ones: mitigating CO₂ and reducing the emissions about the 40% by promoting systems of zero impact sustainable mobility; creating a climate monitoring network in the territory as integrated to regional systems and the control of environmental risk factors.

Implementing the *PAESC* implies three steps: involving both the governing bodies and the administrative offices of the municipality; engaging the main local stakeholders of several productive sectors working in territory as solutions takers and beneficiaries of the actions implemented by policies and initiatives set; fostering participation in the setting of actions, identifying costs, times, and cultural and normative barriers that influence the implementation of the initiatives. In particular, empowering the local stakeholders to actively develop initiatives active participation of the stakeholders is a key aspect with regards to strategies and policies that set initiatives to mitigate the impact of climate change.

With regards to the public lighting, the municipality designed and implemented energy requalification plans in virtue of technological innovation processes and

rationalization of consumptions in the period 2014-2018 by installing smart street lamps that drive the city into the future following a smart view and offer video surveillance, environmental and air monitoring, car traffic and parking check, WI-FI connection, and tools for recharging electric vehicles. The objectives for 2030 are: accelerating the efficiency management of public street lamps; providing new territorial services through smart street lamps by gathering data and information for municipal urban planning and for offering new services to the citizenry.

In 2017 the impact of industries and productive sectors with regards to the reduction of emissions (26%) and energy uses is diminishing (27%). Involving the actors of industries and productive services in sustainable urban planning helps to reduce the energy consumes in the territory. It is necessary to accelerate the efficiency energy transition and requalification of building to NZEB (Nearly Zero Energy Building) or Zero Emissions. The scenarios for 2030 are: driving the transition from the consume of electric energy by fossil sources to renewable sources; supporting the local production by energy renewable sources; reducing emissions and wastes, electric energy consumes; monitoring the energy consumes. The actions of Mantova's municipality concern: implementing the *Bhenefit Prjoect* as a pilot project to support urban regeneration (*Piano strategico Mantova Hub/Strategic Planning Mantova Hub*); involving proactively the stakeholders in order to support efficiency energy projects, and engaging the *Soprintendenza* (Superintendence of cultural heritage) in order to plan initiatives that jointly concern energy efficiency of historical-cultural buildings.

In Mantova the impact of transportation concerns energy uses (12%) and CO₂ emissions (11%). Energy consumes, urban and infrastructural, economic and social aspects are critical elements for an efficient public transportation management. The scenario 2030 concerns: implementing electric infrastructures (tram, trolley bus) for public transportation; implementing refueling renewable sources, and installations for public and private transportation; developing electric energy refueling sites; encouraging the diffusion of low environmental impact and electric energy-led vehicles; reducing private car mobility, incentivizing cycling and walking, car sharing and bike sharing mobility, by developing the inter-modality, and reducing the road transport by promoting railway, fluvial, maritime transportation. The municipality's initiatives concern: the electrification of municipality's cars; implementing the infrastructures for sustainable mobility; reducing the private cars traffic, avoiding the circulation of vehicles that cause pollution; increasing the road security in order to foster the active mobility; promoting mobility management actions for home-school and home-office moving, integrating sustainable mobility services (car and bike sharing near bus stations and railway); better ensuring the links between parking and historical center through shuttles; redesigning the organization of public transportation, empowering the infrastructure for goods transport on railway or by sea.

With regards to the local production of electric energy, the municipality is planning initiatives for sustainable production of energy by using renewable sources. Since 2017 photovoltaic systems (8,8 MWp), hydroelectric systems (313KWe), and a biogas system (635 KWe) are installed. The scenario 2030 concerns: an increase in the electric energy production from renewable sources by self-consumption regime or

through the actions of energy communities; increasing the energy self-sufficiency of buildings and limiting the exchanges with public electric connection; distributed generation of electric energy and development of smart grid. The municipality is planning some coherent actions in relation to the future scenario: building photovoltaic installation on public buildings or buying green energy to cover electric consumes; designing permanent mechanisms of communication and coordination municipality-superintendence of cultural heritage in order to identify actions that contribute both to ensure electric energy production from energy renewable sources and protect the historical and cultural value of sites within historical center; adopting regulations to encourage of electric energy production in sustainable modes coherently with urban planning setting.

4. Conclusions

Designing sustainable urban planning helps cities to shape a healthy urban future for social and economic growth and innovation, preserving natural environments, defining guidelines, initiatives and actions to reduce pollution, CO₂ emissions, promoting energy efficiency use and consume, and decoupling economic growth from environmental degradation. This study aimed to elucidate the role of cities as key players for addressing sustainable urban transitions and transformations by designing urban planning for sustainable urban wealth, leading to responsible consumption and production, and to efficiency management in energy use and consume. The findings of this research shed light on a case study of a city which is redesigning urban planning in the attempt to preserve energy efficiency use and consumption, advancing the patterns of producing and consuming in a sustainable way in order to achieve urban sustainability. Furthermore, promoting sustainable and responsible consumption and lifestyles relies on proactive engagement and participation of citizens and local stakeholders in the decision-making processes, leading to sustainable consumption patterns that have favorable benefits for communities and society. Cities have to develop effective urban planning frameworks to encourage changes in urban consumption behaviors, to support emissions' reduction, encouraging citizens and business to become aware and responsible consumers who pay attention to common wealth, spreading sustainability patterns, and avoiding the increase of pollution and environmental degradation. In conclusion, the future of sustainable urban development relies on cities promoting effective urban planning in order to drive social and economic growth of urban areas, making healthy urban spaces. Future research perspectives rely on investigating case studies within Italian cities' planning initiatives for improving urban sustainability, dealing with sustainable consumption and production, searching for a dialogue and cooperation with citizenry and industry.

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