

Green Economy for Sustainable and Adaptive Architectures and Cities: Objectives, Guidelines, Measures, Actions

F Tucci¹, A Battisti²

¹Full Professor in Environmental Technological Design, Sapienza University of Rome

²Associate Professor in Environmental Technological Design, Sapienza University of Rome

E-Mail: fabrizio.tucci@uniroma1.it, alessandra.battisti@uniroma1.it

Abstract. Several analyses and reports in the world of Sustainable and Adaptive Design are pointing in the direction of what is known as a ‘Green City Approach’: an integrated, multisectoral approach to the planning and implementation of improvements that aim to increase levels of well-being, social inclusion and long-lasting development in cities, based on the now decisive aspects of the high environmental quality, efficiency and circularity of resources and on climate change mitigation and adaptation. In Italy, this new approach has been supported by significant contributions. The PRIN Research (Project of Relevant National Interest) “Adaptive Design and Technological Innovations for the Resilient Regeneration of Urban Districts in System of Climate Change” funded by the Italian Ministry of Scientific Research, has developed these themes for three years (2016-2019). In addition, in coordination with PRIN Research developments, in early 2017 the “*La Città Futura*” Manifesto, presented by lecturers from a dozen universities in the world, was launched as part of the initiatives of the *State’s General of the Green Economy*, and over the past year the development of this new approach has been boosted by the international *Green City Network* promoted by the *Sustainable Development Foundation* (2017-2019). The basic aim was to launch a debate - with a close confrontation with the international design experimentation scenario - and elaborate guidelines fostering future developments as regards the relationship between the main principals that lie at the heart of the Green Economy and Adaptive Design, architectural and urban growth, regeneration, and development, attempting to bring all the cities closer to the development approach of many cities in the world that have already achieved significant results as regards ‘green’ growth and redevelopment.

1. Issues

It was stated that cities are not only the backbone of national economies; they are also the place where resource availability for future generations, as well as justice and equity, will be decided. Following the growing relevance of such topics, contemporary urban environmental conditions have become a determining attractive and distinctive factor of overall quality: an aspect towards which cities with the ambition of becoming the most advanced worldwide are diligently investing.

There are no doubts cities play a decisive role both in the unsustainable aspects of current development and in the changes dictated by the transition to a green economy. On a European level – according to the *Eurostat Urban Audit 2017*- the economic activity of Ue28 is mainly concentrated in



urban regions, which represent the engines of the economy: 59% of the world population lives in urban areas, where 62% of the jobs and 67% of the GDP is concentrated.

In 2016 the Dual Citizen di Washington research centre carried an international survey on 50 major cities, employing a Global Green Economy Index based on four parameters (air quality, water availability and treatment, biodiversity, and vegetation), attraction of green initiatives (web visibility of the green initiatives, green business opportunities, initiatives to favour green interventions, environmental data accessibility), sector efficiency (energy certified buildings, renewable energy share, sustainable tourism initiatives, transport emissions, waste recycling percentage), climate change and leadership (greenhouse gasses' reduction progress, media coverage on green thematic, participation to international forums on climate issues, CO₂ emissions per capita, per GDP unit, and per primary energy consumed).

The research was published in Italy by the *Relazione sullo stato della Green Economy 2016* by the Sustainable development Foundation: it places Copenhagen, Stockholm, Oslo, and Helsinki in the first four places, but also New York at the sixth, Berlin at the seventh, Paris at the ninth, Tokyo at the tenth and London at the eleventh. Unfortunately, Rome is at the end of the list, and it occupies the forty-fifth place [1].

2. Green City Approach

Also browsing through the sectors of the green economy we realize that on the one hand they have a key role in determining the quality of contemporary cities, and on the other, that they grow towards a green direction if the city offers a suitable ground. The relationship of key sectors related to green economy transition and city is relevant and obvious when it comes to energy, dwellings, transport, waste, and tourism. However, in order to better understand how the city can offer fertile ground for a Green Economy and an Adaptive Design to develop, it's not enough to examine the key sectors, we need to consider a reference model capable of proposing, guiding, and qualifying solutions to ecological problems in contemporary cities, in an unitary and integrated fashion.

This model, which is advancing on a European and International level, is called "green city": an integrated and multisector approach to cities, based on key aspects of environmental quality, resource efficiency and circularity, mitigation and adaptation to climate change. The green city approach has been recently wisely defined by ERBD (The European Bank for reconstruction and development) based on the OECD-ICLEI (International Council for Local Environmental Initiatives) methodology in 2017 [2]. Such model was also adopted as a basis for a green economy development program in cities with the Economics of Green Cities Programme by LSE Cities (London School of Economics), led by Nicholas Stern. The integrated approach towards green city had already been adopted, in 2010, by the European Commission for the European Green Capital Award: an award which, by promoting the green city model, aims at supporting the advanced and sustainable development of European cities. The relationship between the green economy, the green city and an adaptive design for the urban systems was the focus of the contribution of the Italian PRIN Research (Project of Relevant National Interest) "Adaptive Design and Technological Innovations for the Resilient Regeneration of Urban Districts in System of Climate Change" (original title: "Adaptive design e innovazioni tecnologiche per la rigenerazione resiliente dei distretti urbani in regime di cambiamento climatico") funded by the Italian Ministry of Scientific Research, developed these themes for three years (2016-2019).

Furthermore, in coordination with PRIN research developments, in Italy there have been important developments that led to the elaboration and presentation of the 'Future city' Manifesto, proposed by a group of faculties coming from twenty Italian and foreign universities in 2017, in the framework of the *States General of the Green Economy* initiatives [3]. On the one hand, Italian cities bare great potential, as we can also observe in a review of the key sectors, on the other, except for a few excellent exceptions, they lag behind and have a hard time positioning themselves next to the leading group composed by the most advanced European and world cities.

The extraordinary cultural, historical, and architectural patrimony composed by cities and small towns in Italy, which had great importance in the rich history that characterizes this country, remains

an important reference value also for the future and an ever important base, but not enough for the relaunch of contemporary cities. As a matter of fact, these cities and towns are not keeping up the pace on the road heading towards the transitioning to a green economy, with cities far ahead and others left behind.

In the 2017 Report on the state of green economy in Italy, the Sustainable Development Foundation presented a focus on city green economy, carrying an analysis on some of the most significant trends in the *capoluoghi di provincia* (administrative centres of the Italian provinces), strategically relevant for the development of green economy: commitment towards climate and renewable energy sources, the management of water resources, sustainable mobility, and public administration's 'green' purchases.

The emerged framework is characterized by moments of light, with some excellent initiatives, and others characterized by shadows and delays. Adopting the integrated approach of the green city, which tackled different aspects and problems jointly, and enhancing possible synergies, and in order to come up with a general framework of Italian cities' current state, we propose the evaluation of some particularly important topics: urban regeneration, building, and urban upgrading, air quality, and circular economy.

Territorial planning and urban management in Italian cities obtained scarce results because they favored, or allowed, decades of real estate expansion with low-quality dwellings, particularly in the peripheral areas of cities and with high soil consumption. Even though we are witnessing a reduction in the last years, in Italy soil consumption keeps increasing. Between November 2015 and May 2016, the new artificial roofs invested 50 km² of the territory, a little less than 30 hectares per day [4].

Moreover, the analysis of data concerning the 14 Metropolitan cities shows how the total amount of soil consumed in 2016 represents 21,4% of the national total, constituting a higher increment than the national average. High soil consumption, dispersal and sprawl phenomena recorded in most of the urbanized areas, have caused the erosion of agricultural land, extended the impermeabilization of soils, increased hydrogeologic risks, and required the employment of significant amounts of resources in terms of urban development works and increase in the time and cost of transportation.

3. Work in Progress: Objectives, Guidelines, Measures, Actions

Heading towards urban renewal following a green city model requires an organic and integrated design aimed at guaranteeing different urban requirements, ensuring high ecologic quality and the effective annulment of soil consumption, by reusing and using efficiently the existing dwelling patrimony and the urbanized areas, and reorganizing soil use for settlement systems following compact and efficient models [5].

As a matter of fact, today urban renewal projects require a more extended, effective, and fast approach towards the demolition of numerous unfinished and non-recoverable constructions – illegal and degraded ones without historical or architectural value - which spoil cities and territories, and the restoration and recovery the areas they occupy. In urban and peri-urban systems' renewal, it is also important to improve the safeguard and availability of natural capital, particularly multifunctional green infrastructures and vegetation.

Architectural and urban renewal following the green city model aims at improving, recovering, and reusing the existing public and private patrimony, adopting an integrated approach through energy efficiency measures and measures aimed at improving the other ecological characteristics of the buildings. Moreover, considering the increased hydrogeologic risk and the great extent of the areas subject to high seismic risks, such operations ought to be verified and integrated into preventive measures aimed at reducing vulnerability.

City Urban renewal requires suitable attention towards public spaces, both in the central areas and in the peripheral ones, as they represent a determining factor of urban quality: piazzas, boulevards, streets, arcades, urban parks and gardens, pedestrian areas and bike paths, influence greatly the city's environmental quality and how the latter is perceived and experienced. In Italian cities, it is also important to consider the direction, criteria, and standards for the conservation of the existing

historical patrimony, and the management, maintenance, and aesthetic and functional improvement of the built patrimony [6].

The safeguard and the enhancement of the urban and peri-urban natural capital – tree rows, gardens, parks and green areas, green walls and roofs, kitchen gardens and green belts – are of growing importance for the quality of cities and they are contributing to the reduction of pollution, air quality, reduction of climate change damages and risks, and the safeguard of water and biodiversity.

The too often neglected natural capital essential components for the quality of the urban landscape, and cultural, recreational, sport activity services aimed at the wellbeing of citizens. The analysis of public green in the '*comuni capoluogo di provincia*' confirms its quite reduced size, with values lower than 5% in 96 of the 119 analyzed *comuni*, and with an availability per person between 10 and 30 m²/person in half of these *comuni*, whereas only in ten cities the value is higher than 100 m²/person. The trend between 2011 and 2016 shows a slight reduction in the availability of green public spaces per person in most of the *comuni capoluogo di provincia*.

Given the situation, it would be good to define pluriannual programs, coordinated through the existing urban management and planning tools, to increment and protect urban green, paying attention to its potential in terms of urban and peri-urban open space renewal, and aiming at the creation of ecological corridors and green belts, in a circular economy perspective [7].

Also, climate adaptation measure ought to be integrated into the city's architectural, technological, and urban renewal, to reduce vulnerability and exposure to risks. It is a rather complex topic, neglected until recent times, but also in this sense it is now time to face it urgently, indissolubly integrating it with other types of interventions in the city.

Climate change causes dangerous heat waves, prolonged drought and high temperature periods, together with intense rain for short periods of time, and increase in flooding and landslide phenomena. It is now time to acquire full consciousness that such extreme atmospheric events can cause serious consequences on Italian cities, with risks for our health and great damage because, thanks to its geographical position and the characteristics of the territory, Italy is particularly exposed to such risks.

It is important to operate specific technical analyses in cities – related to local climate and territorial characteristics, but also demographic and socio-economical – to quantify the risks related to climate change and paying special attention towards extreme atmospheric events. It is important to identify, and program integrated strategies aimed at preventing and reducing the vulnerability to such phenomena and mitigating the seriousness of their consequences.

In order to face heat waves, we need to acquire evaluations on the adaptive capacity of the built environment, adopt the most effective technical and managerial solutions for buildings, outdoor spaces, and green infrastructures. In order to reduce risks and vulnerability linked to extraordinarily intense rainfall, it's important to halt waterproofing and new soil consumption and increase urban area de-waterproofing operations, to use green infrastructures also for absorbing and filtering greater quantities of rainwater, to dedicate open spaces, such as piazzas and gardens, to the absorption and retention of greater quantities of rainwater, favoring the discharge of such water from cities to peri urban humid areas; the latter can be converted into ecological reserves for welcoming biodiversity and recreational and sport activities [8].

Even though technological improvements contributed to the reduction of emissions by some pollutants, the climate change underway is significantly contributing to the deteriorating condition of air quality, making the air we breathe in our cities a danger to our health. Rainfall is less frequent and draught periods are longer, the stagnating air phenomena are more frequent and last longer, the heat waves are more frequent and intense as are the recordings on high ozone levels.

Such considerations are permanently linked with the issue of atmospheric pollution and the threats brought forward by the worsening condition of the air quality. With more than 80.000 premature deaths caused by the exposure to atmospheric pollution in 2014, Italian cities pay the highest bill of all European countries for pollution.

GENERAL OBJECTIVES	GUIDELINES	
<p>FIRST GENERAL OBJECTIVE</p> <p>ENSURING HIGH ENVIRONMENTAL QUALITY</p>	1.	 <p>AIMING AT URBAN AND ARCHITECTURAL QUALITY IN THE CITY</p>
	2.	 <p>GUARANTEEING A SUITABLE AMOUNT OF URBAN AND PERI URBAN GREEN INFRASTRUCTURES</p>
	3.	 <p>ENSURING GOOD AIR QUALITY</p>
	4.	 <p>MAKING URBAN MOBILITY MORE SUSTAINABLE</p>
<p>SECOND GENERAL OBJECTIVE</p> <p>USING RESOURCES EFFICIENTLY AND CIRCULARLY</p>	5.	 <p>AIMING AT URBAN REGENERATION AND REINFORCING SOIL PROTECTION</p>
	6.	 <p>EXTENDING UPGRADING, RESTORATION, AND MAINTENANCE OF THE EXISTING DWELLING PATRIMONY</p>
	7.	 <p>DEVELOPING WASTE PREVENTION AND RECYCLING</p>
	8.	 <p>MANAGING WATER AS A STRATEGIC RESOURCE</p>
<p>THIRD GENERAL OBJECTIVE</p> <p>ADOPTING MEASURES AIMED AT CONTRASTING CLIMATE CHANGE</p>	9.	 <p>CUTTING DOWN GREENHOUSE GASSES' EMISSIONS</p>
	10.	 <p>REDUCING ENERGY CONSUMPTION</p>
	11.	 <p>DEVELOPING ENERGY PRODUCTION AND USE FROM RENEWABLE ENERGY SOURCES</p>
	12.	 <p>ADOPTING MEASURES AIMED AT CLIMATE CHANGE ADAPTATION</p>

MEASURES / ACTION CATEGORIES

- Identification, protection, and valorisation of the cultural assets and the identity of places
- Definition of directions, criteria, standards to improve the architectural and urban quality of the built environment
- Valorisation of the antropic-cultural ecosystems of urban areas
- Promotion of a culture economy
- Promotion of a certain degree of homogeneity and equity in the urban environment quality distribution
- Promotion/valorisation of green infrastructure, of their multi-functionality and multi-purpose
- Promotion/valorisation of ecological corridors and green belts, according to the context and biodiversity
- Promotion/valorisation of parks an gardens, trees, green facades, and roofs, according to the context
- Promotion/valorisation of urban farming and short production chain systems, according to the context
- Scheduling of green maintenance/management
- Cutting down air pollution through the management and reorganization of urban system activities
- Cutting down air pollution through focused actions aimed at increasing green surfaces in the city
- Cutting down air pollution through traffic management
- Cutting down air pollution through regulation of industrial facilities in the area
- Absorption of atmosphere pollutants within the system territory-city-building
- Limitation of private car circulation in cities and promotion of public transportation circulation
- Increase of cycling and pedestrian networks through new or existing linear infrastructures
- Regulation of private car parking areas in public spaces
- Promotion of shared mobility through technological advancement, also using ITC ad ITS systems
- Incentivisation of electric, hybrid, and biofuel car use
- Densification of the urban fabric object of study, the urban "voids" and the "non-places"
- Hybridization of monofunctional areas through the introduction of functional mix, and mix of activities and use
- Renewal of residential and non-residential urban areas in decay or abandonment through physical transformation and functional recom
- Renewal of urban infrastructures in decay or abandonment, through physical transformation and functional reconversion
- Prevention of hydrogeological risks through the improvement of surface permeability, urban drainage networks, etc.
- Planning of diffused and continued public and private dwelling patrimony upgrading
- Planning of existing dwelling patrimony maintenance to improve its quality and extend its life
- Prevention of dwelling patrimony seismic risks, also through procedural and permit facilitations
- Upgrade and reuse of the dwelling patrimony aimed at responding to new residential needs, most of all social ones
- Upgrade and reuse of the dwelling patrimony aimed at responding to new service and financial activity needs
- Employment of eco-compatible materials, nature-based, recycled-based, environmentally performative
- Prevention and reduction of waste production from building and living processes
- Separate collection and recycling of waste from living processes
- Separate collection and recycling of waste from building and demolishing activities
- Circular organization of the production-use-production processes
- Collection and reuse of grey and rainwater resources in buildings and open spaces
- Limitation of water consumption and efficient water use in buildings and open spaces
- Use of water purification networks with high purifying effluent's quality and mud treatment-recycling
- Promotion of diffusion and reuse of purified water and water from polluted sites' remediation operations
- Year-round diffusion and distribution to all citizens of potable, good quality water in sufficient quantity
- Acceleration of Deep Energy Renovation processes aimed at cutting down greenhouse gas emissions
- Adoption of performance-based design methods aimed at cutting down emissions
- Valorisation of the relationship between green (at different scales) and CO2 subtraction
- Valorisation of the relationship between sustainable urban mobility and greenhouse gas emissions' reduction
- Record of greenhouse gas emissions and evaluation of the economic, environmental, and social impact
- Energy efficiency and reduction of consumption in buildings and dwelling complexes, both public and private
- Application of passive bioclimatic solutions through natural ventilation and cooling systems
- Application of passive bioclimatic solutions through natural heating and lighting systems
- Adoption of smart automation systems, domotics, and building management to support energy performance improvement
- Adoption of design methods based on environmental Simulation and Modelling processes
- Use of energy production technologies from renewable solar sources
- Use of energy production technologies from renewable wind sources
- Use of energy production technologies from renewable geothermal sources
- Use of energy production technologies from other types of renewable sources, e.g., biomass, water, hydrogen, etc.
- Use of Smart Grid or Dynamic Smart Grid for the diffused and adaptive distribution of renewable energy
- Development of plans and/or programmes for resilience and adaptation to climate change
- Adaptation to heat island phenomena
- Increase of resiliency to heat waves
- Increase of resiliency and adaptation to droughts
- Adaptation to intense precipitation, thunders, and Pluvial flooding phenomena

Moreover, they are not in line with the objectives of the NEC (*National Emission Ceilings*) directive entered into force since the 31st of December 2016, for four of the five atmospheric pollutants considered. Italy is subject to a European violation procedure because it did not comply with the limits dictated by the air quality directive.

The percentage related to the *capoluoghi di provincia* with more than 35 days of limit excess for particulates (PM10) has improved, nevertheless, in 2016, it was still 33%. The situation is better in Central and Southern Italy, while in Northern Italy, the percentage of *capoluoghi* who have failed to respect the particulate limits in the last years remained unchanged and at a high level: 54% in 2016. Most probably the current trend will not allow respecting the current limits and the most urgent objectives set for 2020-2030.

If we were to apply the indications of the World health organization, which are more preventive for our health; we would have to record that even in cities that respect the European limits the air quality is not good. What emerges from the analysis of indicators for the evaluation of urban population exposure to atmosphere pollutants is, in fact, a critical condition: 82% of the population in the Italian *comuni* appears to be exposed to average annual levels greater than the reference value for the PM10 (20 $\mu\text{g}/\text{m}^3$), 79% to the PM2,5 (10 $\mu\text{g}/\text{m}^3$), and 32% to the NO₂. Air pollution in Italian cities, underestimated if not even neglected by public debate, is relevant and cause for concern. Good air quality in cities represents a decisive factor for health and wellbeing, in particular when it comes to children, elderly, and in general people that are more exposed and vulnerable.

Green cities have a crucial role for the activation of a circular economy process, which is key for a transition to a green economy, as they can stop the consumption of new soil and activate reuse and renewal operations in already built-up areas and existing building patrimony. Moreover, they play a key role for the promotion of waste production reduction, including food waste.

First of all, we need to recover the delays and increase by 75% the separate urban waste collection, increasing and consolidating the demand for recycled materials, removing technical and cultural barriers, and applying public green purchases. Also promoting initiatives aimed at isolating and collecting construction and demolition waste material and recycling it locally to satisfy a market which is increasingly oriented towards renewal and recovery of the existing building patrimony can be relevant, but also fostering the integrated design of building components and systems to favor their future recyclability.

Green cities are important to build IT platforms that work together with industries so that byproducts and waste coming out of the production process can be easily employed in other processes. They are important also to promote product reuse in preparation and repair centers and through networks for selling used goods, and to promote shared use of goods and services, activating different forms of sharing.

Green cities promote the application of technologies based on Information and Communication Technologies (ICT) for monitoring, collecting, and regulating information fluxes, and use and management modalities, tending towards the eco-innovation of strategic urban supply chains such as: public lighting, intelligent buildings, mobility, diffused generation, energy distribution and consumption, management of matter fluxes and waste recycling.

4. Conclusions

Public policies have a key role in the path towards green cities, through direct involvement of administrations on all levels: municipal, regional, and national. We can state that such path demands equally great attention to the use of available European funds and national and regional public funds, employable, in their totality or in part, to implement measures for green cities.

A green city project ought to be supported by suitable information tools, so as to be known and shared by citizens. We need to foresee punctual and recurring information and documentation tools to monitor activities, objectives, and results. It is also good to foresee broad consultation forms, which are nowadays possible thanks to digital technologies, aimed at stakeholders involved in projects and actions [9].

Also involving the private sector is quite useful, through agreements aimed at promoting the social responsibility of enterprises involved in the race towards the improvement of cities and territories, making their actions and contributes to the green city transparent. Enterprises ought to be also involved in the promotion of targeted investments, services, and other policy instruments, with the scope of improving cities' environmental performance efficiently and sustainably in terms of costs and maximizing economic and social benefits.

The implications for green city local development are quite interesting: support of a more suitable local development, promotion and development of technologies, green innovations, and tools and strategies for the exploration, identification, and application of green business and governance models, supporting identification and diffusion of new opportunities for green investments [10].

As highlighted by UNEP in the 2011 report *Towards a green economy*, the development of green cities can contribute to the improvement of social inclusion and the quality of well-being. The strengthening of public transportation systems, for instance, can reduce disparity by increasing access to the service and contribute at the same time to the reduction of traffic congestion in peripheral areas.

Cleaner fuels for transportation and energy production can reduce local pollution, which usually damages the weaker part of the population. Traffic reduction and the improvement of conditions of pedestrians and cyclists can sustain social cohesion. In fact, evidence demonstrates how children who live close to green areas are more stress resistant, less inclined to have social disorders, and have a higher sense of personal value. Green areas stimulate social interaction and improve well-being. According to UNEP, the transition of cities to a green economy can create new job opportunities. Also, the EU Green Week 2019 dedicated to green jobs, underlined the high potential of new and good job opportunities generated by a green economy.

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