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Urban Issues and Sustainability

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Abstract. This paper's focus is to reflect on the global growth of urban areas, according to number and size of inhabitants and also according to the environmental, social, cultural and economic impact of this phenomenon. If city growth is an issue which addresses mainly developing countries such as China, India or the states in South America, the features acquired by urbanisation in the OCSE countries, currently undergoing economic and demographic contraction, lead towards a territorial dispersion of the built up areas with serious consequences especially in terms of soil use, pollution and loss of site identity. Thus, the solutions proposed by the various national and supranational programmes intended to guide global urbanisation to a greater sustainability must be differentiated between countries with fully developed economies from those whose economy is currently on the rise, and must also actively involve the local communities.

1 Foreword

This time of ours is characterised by an unprecedented increase of urban areas. According to recent estimates made by the UN, more than 50% of the world's population lives in cities, most of which are larger than anything ever seen before in human history.
In 1975 there were 195 urban concentrations housing more than a million inhabitants; that number had grown to 430 by 2005. Between 1975 and 2005 the number of urban concentrations with 10 million inhabitants had grown fivefold, going from 3 to 21, 15 of which are located in countries with developing economies.
Contextually, urban populations went from 1.5 billion in 1975 to the current figure of 3.5, with a rate of increase and dynamics which differ according to the city being of more ancient urbanisation or characterised by an emerging economy. For the former, demographic growth has been steadily decreasing since the '80s, settling on a current urban yearly rate of growth of 0.60%. On the other hand, developing countries began their growth in the '70s and their urban population went from 813 million in 1975, to the current figure of 2.5 billion with an average rate of growth – it too currently decreasing – of about 3.5/4% with occasional peaks which are significantly higher in certain Asian or African megalopolises.[1] Today Mumbay (Bombay) in India hosts about 15 million people concentrated on a surface area of about 350 square km (about 34,000 people per sqkm), with a growth rate in the last decade which has increased by 14% and does not appear to want to slow down. Mexico City went from 4 million people in 1955 to 24 million today, insisting on a surface area of about 1500 sqkm, and with a density of 24,000 people per square km; in 1979 Shenzhen in China was a sleepy farming town, Bao'on, of about 30,000 inhabitants, when Deng Xiaoping chose the regional district of the Pearl River delta where the city is located for one of the special projects for rapid economic development. In 2005 the city had already 12 million inhabitants, all internal migrants. According to the Daily Telegraph, the next six years will see the start-up of 150 new projects intended to integrate

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the transportation, telecommunication, service, water supply and power networks for a cost of 2 thousand billion Yuan (more than 220 billion euro). Nine cities along the Pearl River delta will be stitched together, making them into a megalopolis of 42 million inhabitants and covering almost 26 thousand square km[2].

In the so-called developed countries, city dwellers do not grow in number but rather spread out on the territory, giving birth to the so-called *sprawled city*, where "the city border was once definite and clear-cut; it established the demarcation between the city and the country, and was in antiquity identified by the city walls and until only very recently also by the compact nature of the built-up area; it now no longer exists: the city is dispersed within the *sprawl*, it engulfs other settlements, it is directly connected to its neighbours" [3]. The urban fragmentation of the dispersed city configures itself as "a mosaic of sites without identity, featuring low density and mainly single family residential buildings, where relations are fleeting, relationships with the neighbours are poor, daily commuting is 'tailor made' with an increased importance given to non-systematic mobility within territories which are defaced, disfigured and colonised by the 'non sites'"[4].

Among the most important environmental and social costs connected to urban sprawling, we can list: waste, consumption of free soil, growing water usage, impermeabilisation of soil, dependence on tyre-based mobility, increased specialisation of areas of the metropolitan territory, aesthetic pollution, persistent destruction of natural ecosystems, loss of biodiversity.

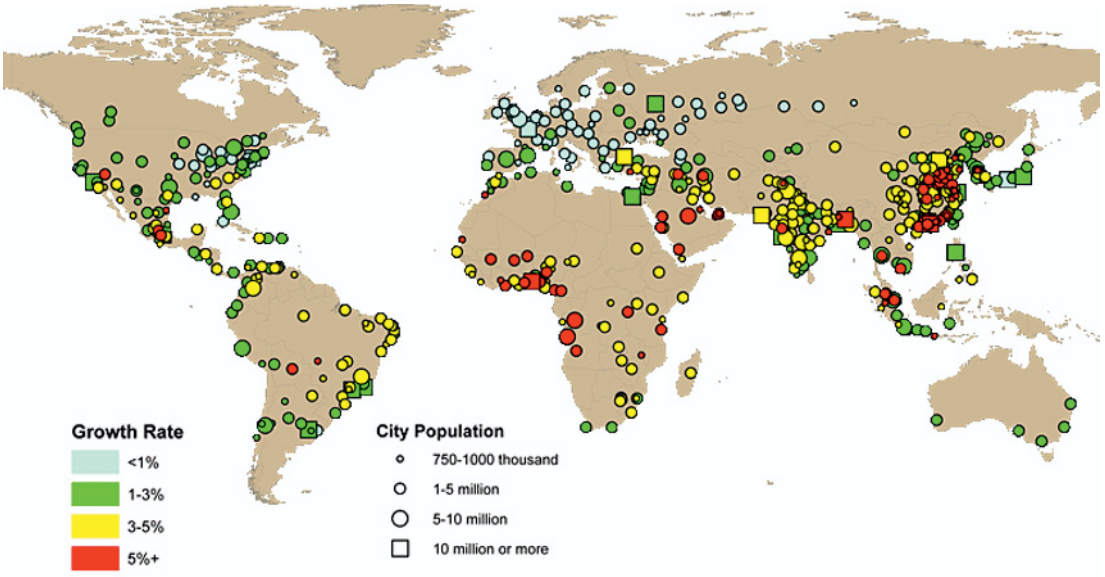

Figure 1. World growth rate city population 1970 - 2011. Data from the United Nation (2011)

In any case, the exponential increase of the population, in conjunction with a dissipative lifestyle, has led most nations – both developed and developing – towards consuming more than what their territory is able to provide. If this trend were to continue "in order to meet a moderate index of global growth during the next few years, the consumption of the most common mining resources will have to increase 5 times, while food resources should increase 4 times"[5]. Urban metabolism, meaning the flows of energy and material which go through cities in general, proceed along a single direction, towards the city.

In systemic terms, we can say that, differently from natural ecosystems, which are mainly closed and fed by solar energy, the city functions as an open thermodynamic system, dependent on the environment in which it is located and on the use of fossil fuels. In other words, it is not sustainable.

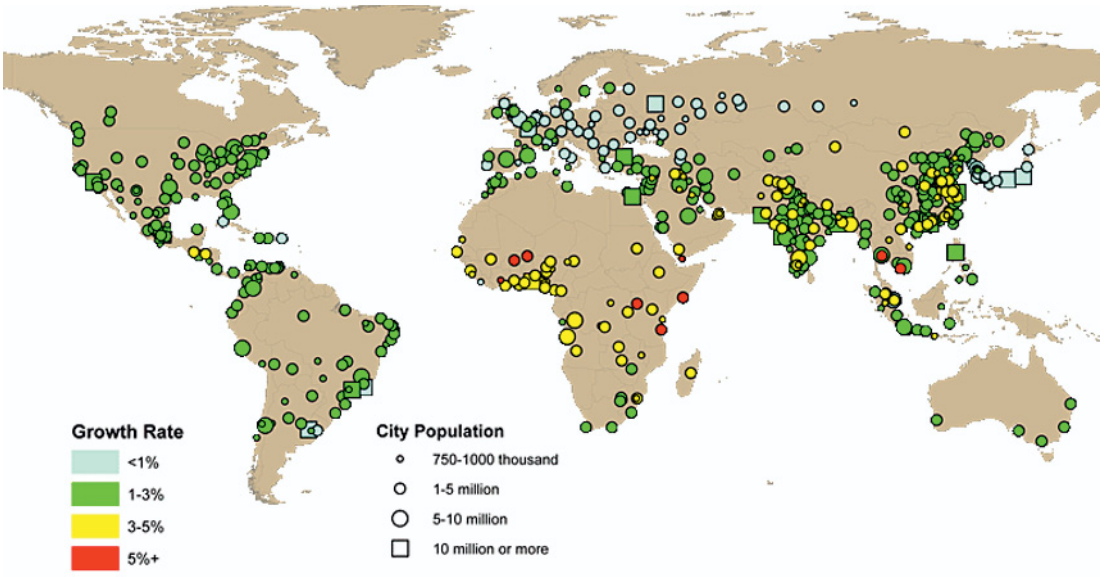

Figure 2. World growth rate city population 2011 -2025. Data from the United Nation (2011)

2 City, urban shape and energy

Ever since ancient times, in order to exist and survive, cities have always been dependent on natural resources and sources of energy which neighboured with their territory. However, given a low technological level and a demographic dynamics of low intensity, the collection of resources has been kept within the threshold of sustainability. During the pre-industrial age, cities were compact and surrounded by walls. For a long time the primary source of energy was wood, which besides being used for building was also the main resource used for heat[6]. Starting in the XIV century, technological improvements in Europe, due to the introduction of the hydraulic wheel, mounted on both fixed and mobile structures, changed the shape of existing settlements and conditioned the choice of new ones, which were placed mainly near rivers and waterways. The new 'renewable' sources of energy, together with new agricultural practices, allowed the progressive evolution from an economy of pure sustenance to one of a more merchant-like, proto-capitalistic, nature.

Between the XVI and the XVII century, wood was replaced by coal as a primary source of energy, first in England and then in other European countries. The hydraulic wheels were replaced with the first steam boilers, thus making the previously obligated dependency between place of production and consumption from the place of extraction of the source of energy obsolete. Together with innovations in the transport system, with the construction of the first steamboats and the first railways, this influenced the urban structure, changing for the first in history the dimensional and locational boundaries of the city[7].

If the introduction of coal and the invention of the steam engine began the industrialization process and laid the first foundations for early territorial urbanisation, the introduction of electricity in the last two decades of the XIX century allowed for "an unprecedented result in the field of energy innovation"[8], and consequently a further change in the urban settlement and its spatial and dimensional features.

New electrical transports replaced the last remaining horse-drawn carriages and became the structuring element behind modern urban models. The electrical system network was born only partially due to industrial production needs and instead had from the very beginning a strongly urban connotation. This helped to reinforce the centrality of XX century urban settlements as being 'push' factors for economic and social progress, favouring the birth of the large metropolises both in Europe and in North America[9]. Electricity fostered the birth of other inventions and technological innovations which contributed to completely transforming the way of living and building cities; among the many inventions, we should mention the elevator that, from its first steam incarnation to the electrical model designed at the and of XIX century, allowed the birth of the "vertical city" and of the skyscraper.

The introduction of oil as humanity's primary energy resource, however, set forth the most impressive transformations in human society since the beginning of history.

Large-scale oil extraction began in the latter half of the XIX century and its ease of transportation together with its energy density, higher by 50% than that of coal, favoured the rapid expansion of an oil-based economy and the exponential growth of the extraction industry. The association of oil with electricity stimulated the technological and productive sector, allowing for an extraordinary progress in mechanical production and in the manufacturing industry.

The years spanning between the late '800s and the early '900s saw the introduction of the invention which, perhaps, more than others, contributed to changing the cities and the manner in which humans lived their lives: the automobile.

1908 saw the production of the first mass-produced automobile, the Ford Model T, and in less than five years there were more than one million private vehicles in both America and Europe.

Thanks to the automobile, built-up settlements began to be diluted over the territory: especially in the cities in North America we can see the establishment of the first outer city suburbs, characterised by single-family homes and by wide roads, both symbols of a new idea of living modelled along the values of freedom and of individual private property. In other terms, we see the inception of the *sprawl* phenomenon that will extend its effects from America into Europe with negative consequences on the urban and natural environment and, especially, with important energy implications[10].

Technological innovations of the First and Second Industrial Revolution promoted the supremacy of the city and "instilled in society a new image set for urban shapes similar to machines". The masters of the Modern Movement were among the pioneers of this new scientific approach in the architectural and city-planning field. Their attention was directed towards three primary aspects: the function of cities, the minimum living and urban function spaces and urban structure.

The intense urban expansion of the second post-war period was strongly conditioned by the idea of modernity and by the theories which endorsed the functional separation of the various urban areas (*zoning*). This concept identified the city as a large machine, where zoning was seen as the most effective strategy able to manage the city's growth. The parts of this machine (zones) were designed and defined according to ideal criteria, assigning each part of the territory to a specific duty or task. The various zones were thought of as being independent and connected by roadway networks, transports and so on. Each part of the city had to carry out a particular task independently from the overall function and, just like in an automobile, every part could be redesigned, replaced or modified [11]. This new urban vision, made possible by the transformation in lifestyle caused by the large scale use of the automobile, became widespread in every corner of the Earth; it allowed for the sprawling of the settlement over the territory, thus favouring the birth of residential suburbs, often just sleeping quarters, without any urban quality whatsoever, erasing most natural and traditional landscapes from the sites.

Today, most areas of newer expansion of cities of developing countries are structured around imposing road infrastructure, often on several tiers, which dominate the landscape. The new 10 lane freeways become the main (sometimes the only) organizing factor of both the territory and the city; a clear example of this are the current urban expansion areas of Dubai, in the Arab Emirates or in certain Chinese cities such as Shanghai.

For example, during the past decade, India saw the rise of one of the largest road-building projects ever devised, the construction of a 3600 mile super freeway called the Golden Quadrilateral because is connects the Country's four largest cities and a large network of secondary connecting roads.
The project also included the design of a low-cost automobile (less than 2000 euro per car), which, notwithstanding lower-than-expected sales, represents a potential environmental, economic and cultural disaster waiting to happen, since it would push India, the second most inhabited Country of the world, towards a head-on collision with our low-cost oil economy [12].
During the Nineties, even China's automobile base increased by 400%, going from 1.6 to 8 million vehicles; "with its rapidly expanding economy and its even more rapidly expanding middle class, China appears to be ready to expand its national automobile base at an unprecedented rate; it is a fact that this is one of the government's official priorities"[13].
Today (2011 data) there are 73 million automobiles in China and the average rate of growth has been 25% between 2000 and 2011.

3 Sustainability: a slogan, a utopia or a real turning point?

This is, in short, the current picture of global urbanisation; it is self-evident that 'sustainability' appears to be a utopia which is extremely difficult to envisage as being feasible.
As we have seen, in order for a urban organism to increase its sustainable character it is necessary that it establishes a 'sustainable' relationship with its supporting territory, able to decrease the incoming *input* flows (material and energy) and the outgoing *output* flows (entropy and waste).
Achieving this objective requires a transformation in urban metabolism from linear to circular. In order to avoid the consumption of the territory and to acquire a condition of self-reliance the city must reduce incoming and outgoing energy flows while, at the same time, attempt to preserve the quality of life of its population.
Regarding this objective it would appear that, overall, international program platforms are heading along two main routes:
The first is the one typical of countries of older industrialisation/urbanisation and is mainly based on urban reclamation intended to reuse existing buildings, to implement energy conversion plans, to commence densification and anti-sprawl operations, integrated with environmental and energy policies intended to support and endorse renewable sources; these plans are supported and shared by numerous associations of cities towards shared policies which go by the names of: Clean Cities, Smart Cities, European Green Cities Network, 2000-Watt Society, Energie-cités, Green Cities EU, etc.
The second appears to lead towards the creation of utopian urban models to be adopted for the building of new settlements in virgin territories within developing countries. Great international studies are designing self-sufficient cities such as the *ecocities,* like Masdar city in Abu Dhabi envisaged by the Foster + Partners Studio and Arup, or "extremely visionary projects such as the moving city, Super Star City by the MAD Chinese architects", who, by way of imagination, experiment and reflect on current and future urban design within solutions which are strongly technocratic and centralising.

But what should the main features of a sustainable city be?
By analysing several studies performed by various international organisations [14], the meaning of *sustainable community* acquires different meanings according to each site, but all reports show the same basic concepts and key words. For example, in the report by the Urban21 Conference we read that sustainability is *«Improving the quality of life in a city, including ecological, cultural, political, institutional, social and economic components without leaving a burden on the future generations….*
According to the Institute for Sustainable Communities: *«Sustainable communities are defined as towns and cities that have taken steps to remain healthy over the long term. Sustainable communities have a strong sense of place. They have a vision that is embraced and actively promoted by all of the key sectors of society, including businesses, disadvantaged groups, environmentalists, civic associations, government agencies, and religious organizations.*

The Development Alternatives in India states that *«A sustainable city can be defined as one that is able to provide the basic needs of the population along with the necessary infrastructure of civic amenities, health and medical care, housing, education, transportation, employment, good governance, etc. It should take care of the population's needs and all sections of society without discrimination. As it pertains to conditions in India, due emphasis would be in controlling population and providing housing to the impoverished sections of society who live in sub-human conditions in slums, eking out livelihoods below the minimum wages and creating environmental degradation.*
And according to the FARN report (Development Alternatives, Fundación Ambiente y Recursos Naturales) in Argentina "*No city can sustain itself by drawing only on resources within its boundaries. What is sought in sustainable development is not cities that sustain themselves but cities (and rural areas) where the inhabitants' development needs are met without imposing unsustainable demands on local or global natural resources and systems».*
Whilst for the Stockolm Environment Institute – REC for Central and Eastern Europe *«A sustainable city can broadly be defined as "one that has put in place action plans and policies that aim to ensure adequate resource availability and (re-)utilisation, social comfort and equity and economic development and prosperity for future generations"».*
We see that actions intended to guarantee health, social security, inclusivity, pollution containment, economic development and the sustainable exploitation of resources, also intended in a temporal sense in order to guarantee resources for future generations, are placed on the same level, notwithstanding the fact that these objectives are certainly difficult to implement at the same time.
Recently is born an international project call "Green Light Project", with Nation Unit support, that is focused on a vision of what a sustainable world would look like and be like to live in. The main idea of this project is a vision of a model of sustainable city, Sustainia City. Behind Sustainia stands a group of experts, companies, and communication experts, and they think that Sustainia is not futuristic science fiction, but it is a concrete proposal on how we could live a better life in 2020. Sustainia is based on facts, solutions, and ready and available technologies [15].

From a spatial point of view and on a scale of the individual building, several analyses referred to European and North American urban settlements starting in the Eighties have highlighted certain characteristics able to condition either positively or negatively the aspects of sustainability. Within the limits of this short paper we can mention:
the dimension of the city; a small or medium size is better for a city.
Urban size and shape are directly connected to the daily costs necessary for reaching the work place, which increase proportionately as the city's size increases. Winning urban policies are thus the ones that endorse decentralising functions and services which allow to reduce distances and commuting times; closeness and functional mixing of local services in residential areas so that they can be reached by foot and are within a radius of about 400 m; an effective and diversified system of public transportation, structured so that the citizen perceives a greater advantage in using it with respect to a private automobile, guaranteeing a dense network of alternative transport with numerous points of intersection (railway, metro system, busses, electrical trams, bicycle lanes, pedestrian lanes, etc.). Furthermore, in order for them to be competitive, their passage frequency and the trip duration must take into account a maximum optimal time of 45-60 minutes necessary to reach urban and territorial level services [16];
the inverse correlation between density and consumption; increased density favours public transport, greatly benefiting the overall efficiency of the settlement. For example, Singapore, Tokyo and Hong Kong, notwithstanding the fact that they are comparable under many aspects (wealth, size, etc.) with American metropolises, possess a much more efficient transportation system thanks to their greater density [17]; With regard to the city's correct energy operation, *control and proper proportion amongst the built-up areas*, meaning the compactness of buildings, is also very important, especially thanks to the control over the H/W ratio of the facades. If the values assigned to the geometries are properly assessed during the initial design phase, also thanks to the support of the indications

contained in literature, it becomes possible today to approach a city design by choosing before hand the spatial configurations considered to be the best for the organism's operation;
The integration and use of new energy sources and renewable technologies and the diversification of the supplying operations also thanks to the construction of smart grids; this means to identify the most suitable urban dimension and size intended to guarantee the creation of that quality 'city effect', able at the same time to integrate and properly and sufficiently use new renewable energy systems. Single settlements must therefore become able to autonomously produce the energy necessary for their sustenance, unhinging the current centralised distribution system in favour of a decentralised system, in which cities should become the hubs of a self-sufficient local and territorial network. With this same system, the urban districts, neighbourhoods, down to the single buildings should be able to self-produce their own energy, releasing into or withdrawing if necessary from the network the daily surplus or their missing quota [18].
Furthermore, in compliance with the principles of bio-architecture and bio-climatics, these new buildings should optimise their consumptions and their requirements by integrating technological and service solutions based on renewable sources within their structures, together with the use and rediscovery of materials which are peculiar to their territory. In regard to this, it is useful to remember how the history of architecture, especially spontaneous architecture, contains exemplary cases of employment of building techniques and practical know-how closely connected with their territory, such as the relationship between Arab dwellings and the exploitation of natural ventilation, the layout of Mediterranean cities, the thermal collection devices used in buildings in the North and the massive walls of alpine homes, etc. In a similar manner, the urban structure of sustainable cities should adapt to local climate conditions using the available renewable resources; it should pay attention to the distance between the built-up facades in order to guarantee proper room illumination, the effectiveness of natural ventilation along the streets and the containment of urban heat islands. It should pay great attention to the technical characteristics of the materials employed, to the properties of the external sheath and to the regulating effect of urban green areas (both as a protection buffer and as a passive environmental cooling system). We should operate in the same way on the level of the single building. From an 'energy' standpoint, studies performed on the typologies have declared single-family homes to be less sustainable, thus promoting forms of urban densification through multi-family typologies. The results supplied by comparing the overall performances of 3 building typologies (single-family, unit and multi-family) confirm the increased efficiency of multi-family compact models ranging between 2 and 10/15 levels.
Furthermore, from the point of view of the overall improvement of existing urban sustainability, especially in the face of dispersal phenomena, the most effective techniques of densification appear to be the adding of levels to existing buildings, the creation of border-buildings with a function of permeable horizon, or re-stitching operations.
All these elements are already present in the Italian and European territorial system. The network of small and medium Italian settlements, for example offer their inhabitants examples of urban and environmental quality very similar to the ones indicated as 'sustainable' in international and community documents.
These communities appear as compact cities with great urban and lifestyle quality. In many cases they are also very 'resilient' and their expansions have maintained a border which offers even today a very clear threshold between city and country, preserving it as much as possible from widespread urbanisation. The protection of this threshold allows us today to clearly recognise what is or what is not a city and to preserve the landscape as an integrating part of the historical and cultural heritage of our society, besides being an expression of the identity features of every region [19].

4 Conclusion

In conclusion, if the above are only a few of the main elements identified by studies and analyses of urban phenomena and by European and international policies in favour of an increased sustainability of human settlements, at the same time we are seeing, not only in the Western world, more and more

alternative lifestyles and settlement models, coming from spontaneous movements and initiatives originated 'from below'.
This genre includes the network of eco villages [20], widespread around the world, which are heading towards a voluntary reduction of consumptions, the abandonment of fossil fuels, both for transport and for heating purposes, or the network of the Transition Towns [21]; among new and community models of living and houses we should mention cohousing, or those experiments which are linked to the creation of new building typologies based on techniques or building materials which employ low environmental impact materials, such as straw, wood chippings, etc.
All these experiences are researching settlement models with a closed cycle 'metabolism', closer to the natural cycle and based on the values of cooperation and exchange rather than of competition [22].
It would therefore be hoped that, in researching and experimenting with concrete solutions intended to have an effect in the short term and in a significant manner on the containment of the more seriously unsustainable aspects of current urban structures – social and environmental degradation, pollution and use of natural resources – the policies 'from the top' and the experience 'from the bottom' might be able to find certain common points on which to discuss and which could become the objects of exchange and cooperation.

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