

Contemporary city as an organism –green city strategies

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Cities can be regarded as organisms, and analyzed as such, in an attempt to improve their current environmental performance and long-term sustainability.

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Abstract

The modern city is the residence of various organisms. Therefore, the city becomes an organism that has a metabolism. This metabolism creates waste that is fatal so the city becomes both a criminal and a victim. Although quiet and shy, the idea of developing a green city began as early as the late nineteenth century; the self-sustainability of cities, viewed through the prism of today as the technology and possibilities of the modern age, is a popular topic in the last few decades. This paper looks into with the issue of green city, green urbanism as well as self-sustainability. Demonstrated through the classification of degradation, history, vision and principles, the paper gives examples of the possibilities and achievements that a green city has.

Key words: *green city, self-sustainable city, eco city, sustainable urbanization*

1. Introduction

The future of urbanism and the development of the city itself largely depends on new technological achievements and primarily the understanding of new urbanism. The new urbanism is based on the theories of eco-cities, and in the last few decades, urban planners, architects and many other scientists have been actively dealing with this issue. The Archigram Group (Figure 1) bases its theories on the New City on the theories of Technical Utopianism; also called techno-utopia, it is a theory that refers to an ideology that is based on the assumption that science and technology will lead to utopia and that the utopian ideal will be fulfilled [1].

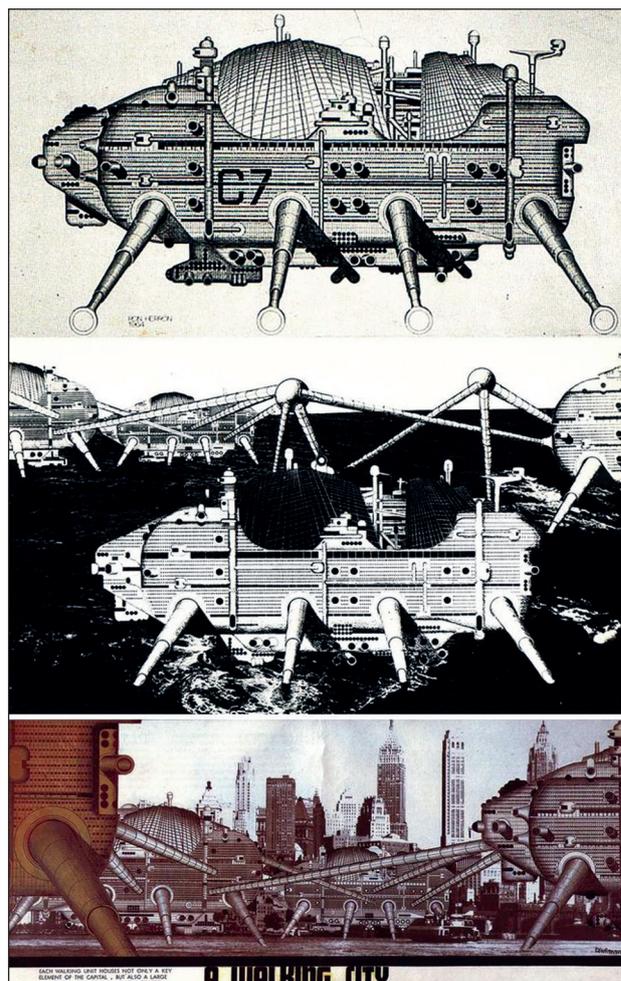


Figure 1. Archigram, Walking city, 1964 [2]

Hypothetically speaking, techno-utopia is an ideal society in which, with the help of science and technology, ideal conditions for social welfare have been created. In Britain in the late nineteenth and early 20th century, Ebenezer Howard founded the Green City movement. This type of city is bred as an independent community surrounded by a green belt and containing proportional areas of housing, industry and agriculture. Garden City theory has become very popular in many ways.

the last century, this situation began to change with the development of the global city; rapid population growth in cities and the globalization of the economy. Cities have become hubs of materials, waste, and labor [8]. Thus, environmental problems have become both local, and regional and global; and cities became the main causes of it.

As Raydin suggests, cities have become both victims and villains at the same time [9]. Cities, megacities, generate huge amounts of heat (urban heat) which affects the climate cycle and thus creates unfavorable living conditions. With this, the circle of the villain and the victim is constantly turning. Opinions are divided, but it is believed that the cause of major weather disasters, tsunamis, cyclones, major storms as well as coastal erosion and sea level rise as well as instability and large changes in biodiversity are precisely urbanization and megacities. This whole scenario is in a critical state and requires urgent action in order to establish a new, ie save the existing urban ecosystem and primarily the human factor in it.

3. History of the green city

Green or eco-city is a city that was created with the aim that housing in it has a minimal impact on the environment and whose inhabitants minimize pollution and use of water, air and land. Although “green urbanization” began in the late 19th century with the introduction of drinking and sanitary water systems, the term green city or eco-city was first used in the 1970s [10]. There is no fully defined theory of what a green city really is and what paradigms are included in its framework. In general, experts agree that a green city should respond to the needs of today without compromising the needs of future generations. The ambiguity of this idea leads to many variations in the ways of sustainability in cities. A green city, in that sense, should be able to sustain, feed itself with minimal reliance on the environment. The core of this is the creation of minimal waste as well as the efficient use of land and the use of recycled materials. In this way, all municipal waste will be reduced and thus the impact on climate change will be reduced.

It is assumed that half of the world’s population today lives in cities and urban centers [11]. These large urban jungles are the basis for devel-

oping new environmentally sound theories and approaches. Due to the fact that people are social beings and tend to cities as centers of social development and life, these are the places where interactions and ideas come to the fore. These urban systems can be sustained even more easily than in rural eras. The fact that cities and urban eras are densely populated goes in favor of saving energy, transporting certain things

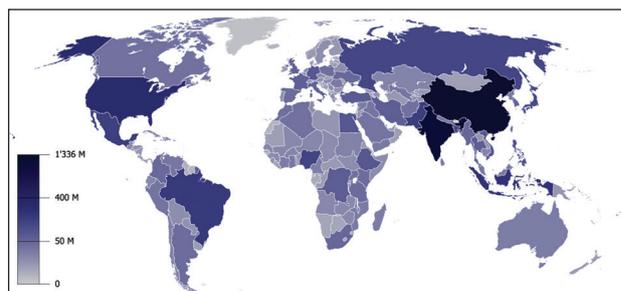


Figure 4. Mapping of the worlds population [12]

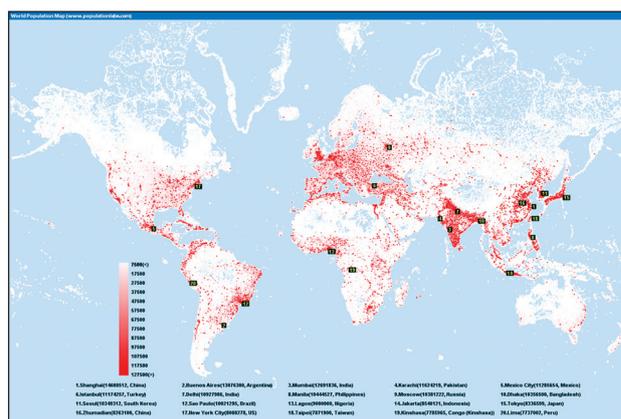


Figure 5. Urban centres [13]

With the arrival of the new urbanisation, the global city is in competition with itself, as well as, with each other. Lehmann believes that there are three basic parameters on the basis of which cities compete; first they must be attractive, beautiful, creative and cultural centers in order to attract a qualified population; secondly they must be recognized as a place of secured investment and thirdly they must have a vision of a green city and an eco-friendly approach to lifestyle [7].

4. Vision of the green city



Figure 6. Vision of the green city – Philadelphia [14]

The vision of green urbanism and thus the green city includes programs, legislation and design for renewal and environmental sustainability. As Lehmann suggests, a proactive vision of what zero CO₂ is and a future with renewable energy sources should be added: the overlap of multifunctional facilities, typologies of living and working facilities, infrastructure systems for sustainable development, public transport and effective energy efficient design [7]. Social sustainability and a healthy society are prerequisites for the vision of a green city. The basic guidelines in the framework of developing a vision of a green city are:

- to live within its ecological limits, reduces its pollution
- to operate in parallel with nature; climate, location and context, optimizing natural resources
- calm and clean with a healthy microclimate
- to reduce or no CO₂ emissions;
- to eliminate the concept of waste; create an ecosystem of recycling, composting and reuse
- has local production of food ; local gardens and urban agriculture
- to supports a healthy life
- water quality; usage
- uses green areas, gardens and green roofs to increase urban biodiversity and mitigate heat.
- uses a multidisciplinary approach as a guide to city government.
- it has facilities that are located and oriented so that the facilities are cold in summer and warm in winter.
- uses solar energy through the application of solar panels
- creates an authentic cultural experience
- uses local and regional construction materials

- has easy access and mobility; public transport on alternative propulsion
- uses new technologies such as solar cooling
- uses the principles of urban ecology

In front of these, above mentioned principles, in Graedel's words, a green city must be conceived and planned so that it can grow and develop as the population in it changes and grows [15]. This is very important from the principle of infrastructure. These infrastructural networks must be designed so that they are easy to modernize and upgrade.

5. Principles of the green city

The definition of green urbanism and thus the creation of a green city is the creation of communities that are beneficial to people and the environment. It is a way of creating self-sustaining places, communities and lifestyles in general; a way to rely less on nature and live more with it. This way of urbanization is achieved by interdisciplinarity in which urban planners, architects, engineers, ecologists, sociologists, economists and many others collaborate and are equally involved. Green City strives to minimize the use of energy, water and materials; as well as the use of materials in the construction of buildings that can be recycled once the life of the building is over. The principles of the green city are within the "three zeros"; zero use of non-renewable energy sources, zero waste and zero CO₂ emissions. According to Lehmann [7], the self-sustainability matrix contains certain principles that are important as a precondition for the creation and development of green cities:

- Climate and context

The urban development of a city must be in harmonious connection with the specific character and context as well as many other factors of the location. The process of design and urbanization should take advantage of the advantages that a particular location offers, be it cultural, historical, social, geographical, economic, political. The main element in this process is climatic conditions; they are a decisive factor in generating the form of a green city as well as in optimizing the architectural form and using materials.

- Renewable sources of energy

It is vital that the systems currently running our cities, which are based on the use of fossil stocks, grow into new ways of using alternative forms of energy; renewable sources. Optimization and balancing of energy consumption, and thus pollution and pollution, can be reduced or avoided by the use of smart technologies, the use of energy efficient standards and increased thermal insulation in buildings as well as the use of solar, wind and water power.

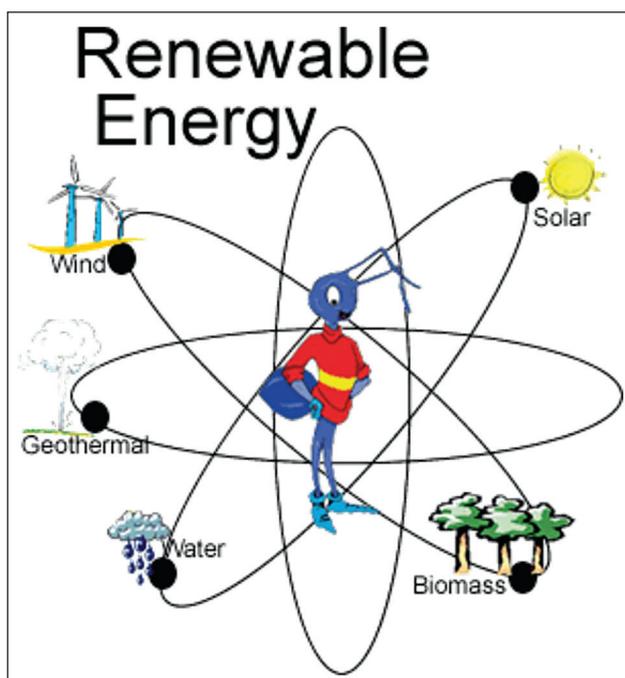


Figure 7. Renewable energy sources [16]

- Zero waste

A city with 0 waste is a city that is a closed ecosystem. Sustainable waste management means reusing waste. This includes waste reduction, recycling, reuse and composting all for the purpose of energy production. All materials including those used to build facilities and infrastructure as well as those used in everyday life should be recycled and reused. With this system, zero CO₂ emissions and thus zero waste can be achieved.

- Water

Generally observed reduction of water use as well as its reckless use are the main aspects of sustainable water consumption. Concepts such as water reuse, recycling and the use of rainwater for irrigation are just some of the techniques

that contribute to the concept of sustainable water use. Algae-based and biofilter-based water purification systems can be used to reuse rivers and lakes as swimming sites. Urban water recycling systems as well as the planning and maintenance of these systems are crucial and require appropriate infrastructure. At the level of household needs and water use, reducing the amount of water per household member can be achieved by installing a system with a lower water capacity in the bathrooms (toilet bowls), catching rainwater.

- Gardens and biodiversity

Urban planning should include and maintain green spaces; parks, gardens, green weeds. By introducing concepts such as city center gardens, urban agriculture as well as the concept of green roofs and roof gardens, biodiversity is increasing. Planting trees as the largest air purifier should become a common practice. Easy access to parks and recreation centers are the main components of a green city.



Figure 8. Example of the roof garden simbrown. wordpress.com [17]

- Sustainable public transport

The transport sector, both public and private, is responsible for much of CO₂ emissions. Changing the fuel of public transport, as well as its increased use and reduction of the use of personal vehicles, contributes to a significant improvement in air quality. Alternative modes of transportation such as using a bicycle or walking are some other ways to improve. Planning walking zones, electric cars and buses are just some of the ways a green city should have.

- Use of local materials

Use of locally produced materials that require less energy for manufacturing as well as for transportation; use of prefabricated modular systems. In order to achieve green improvements the city needs to improve and redefine material use specifications. New technologies and the study of materials and thus prolonging the durability of the building, as well as the reuse of all materials when the shelf life of the building expires are the principles of sustainability.

- Population density and reuse of abandoned parts of the city

Proper planning and urbanization of green areas are important factors in reducing agricultural land. Transforming centers into compact communities and creating flexible typologies for life and work. This is achievable through multifunctional urban interpolations, by revitalizing abandoned parts of the city in order to create housing units; self-sustaining communities.

- Green architecture; using the principle of a passive house

We need to see the importance of the city as a whole. Passive houses are individually observed as a base, the beginning of the creation of a green city through green architecture. It is necessary to create objects that are functionally “neutral” and that last longer. Facilities that, in addition to using solar energy and new technologies of facade systems (bio-climate architecture), generate more energy than they consume, which have water collection and purification systems are achievable.

- Healthy society and multifunctional facilities

Focus on affordable housing, as well as the integration of various activities (economic, cultural, social, sports ...) and avoidance of mono-functional facilities. Demographic change is key to urban planning and in this context housing projects need to meet these needs and be flexible. User diversity is key. Flexible typologies and 24-hour facility use are one option to maximize facility utilization.

- Locally produced food

The green city should have adequate areas for growing and producing food as well as its ex-

change; in this case the transport of food is reduced. Composting is part of this process. Bridging the gap between urban and rural contexts is essential.

- Cultural heritage, identity and sense of place

The city should support a healthy life, various activities as the safety of its citizens. Cultural heritage is an integral part of new projects. Each city has a special character depending on where it is located (next to the river or the sea or in the mountains ...) depending on the climate, each situation is different. Green city design takes all these aspects into account.

- Good management

Cities are the collective responsibility of all citizens but the authorities need to play a major role in managing and running cities. The Green City Legislation should contain updated building regulations; to raise the world about the green city, to provide education, to improve the conditions for planning, to implement environmental management A city that thinks and plans on holistic principles, that implements every change harmoniously without destroying what has already been created and where decision making is the responsibility of citizens, is a city located on the path of a green city.

- Education, research and knowledge

The city is the center of institutions, galleries, libraries and museums. All these institutions are centers of knowledge. It is necessary to have good and easy access to education and opportunities for training and retraining of citizens. In this way, their knowledge will contribute to the creation of a green city. The way in which architects and urban planners have traditionally acquired their knowledge may need to be redefined.

- Strategies for cities in developing countries

Develop specific sustainability strategies for cities in developing countries, such as, training local people, creating new jobs as well as creating business structures that are in line with the impacts of rapid urban growth, urbanization and globalization.

6. Principles of efficient design

The principles for creating a green city should be based on a holistic strategy; the basis for this design is a combination of principles and solutions of traditional construction from previous experience with the principles of a passive house that have proven successful [18]. The largest consumers of electricity in buildings are technical installations for cooling, heating and lighting. Before buildings were heated, cooled, and lit in the way we know it today, architects used the principles of passive design to create interiors that were sufficiently lit and heated / cooled, without the use of mechanization. Typologies that developed in the middle of the last century, mostly public buildings and administrative blocks, changed the approach to design. Glass skewers as well as closed shopping center typologies are facilities that still dominate urban centers and require large amounts of energy for their maintenance. By considering and redesigning these types of buildings, and on the principles of passive design, the use of electricity would be drastically reduced. Green city architecture needs to go back and re-apply the principles of architecture from the past; we need solutions that can deliver the same or more with as little use of technology as possible.

The microclimate of each location can be modified. Through careful planning, optimization of outdoor and indoor spaces is possible; natural ventilation, orientation and natural space heating as well as room cooling are just some of the results of careful design. Vernacular architecture and traditional ways of building provide a good basis for this. Typologies of residential buildings of certain cultures have already been adapted to local climatic conditions and are creating optimal urban forms. Traditional courtyards in one-story buildings are a good example of cooling; for effective ventilation as well as air circulation there are several techniques for cooling the space, such as hidden courtyards and atriums, holes in the roofs, solar or thermal chimneys are just some of the ways to establish optimal design principles. The main principles of efficient design are (passive house principles): optimal orientation as well as adequate openings to control the entry of water and sun. (here one should pay attention to the

ways of obscuring the space, ie placing the blinds); the architectural form should correspond to the location; cross ventilation and maximum use of daylight (use of vertical blinds or sunshades); a building designed to increase air flow and thus air exchange in all parts of the building; passive heating in the winter months; careful selection of materials (pay attention to the thermal properties of the material); green roofs (in this way the micro climate is maintained and heat is reduced); cooling through the system of the floor labyrinth (cold night air is brought through the openings on the facade which enters the space between the floor and the ceiling, and thus cools); appropriate colors on the facade; optimal dimming systems; well insulated facade and roofs. Combined, these design principles provide a variety of variations and possibilities and provide an answer to the effective planning of architecture as a green city base.

7. QUIET REVOLUTION - implemented elements of the green city

Although, to date, there are no green cities in their entirety, there are cities that have adopted development strategies in the direction of a green city. In Europe, the Scandinavian countries are at the forefront of accepting and implementing these strategies. Every green city has its own rules and principles in the implementation of sustainable elements. These principles or criteria vary depending on the location and climate zone of the city, and include the reduction or zero emission of CO₂ or the revitalization of certain units and their conversion into green zones; greening of roofs, use of electric public transport and the like.

Through the presentation of the four cities and their initiatives, we will introduce ways of sustainable systems that have been implemented.

- Vancouver, Canada - use of energy from renewable sources

Vancouver in Canada is considered one of the most optimal places to live and by 2020 the city aims to become the “greenest city” in the world. The city is already a leading power in hydroelectricity where 90% of its needs are met through the use of energy from renewable sources; wind, sun and sea [19]. The city also has an extensive net-

work of bike paths (approx. 400km). As part of its 2020 target, Vancouver, although currently having the lowest CO2 emissions, has set a reduction of an additional 33%. This is supported by stricter construction legislation for the use of certain materials, as well as the construction of only carbon-neutral facilities. Although electric buses are already used in public transport, as part of the plan, the city plans to increase the network of pumping stations and the number of vehicles to 15% of the total number of buses.



Figure 9. Solar panels in Vancouver [20]

- San Francisco, USA - electric vehicles

The wider area of the city of San Francisco is classified as the number one green city in America. The city recycles 77% of waste and 20% of its area is covered by parks and other green areas. But what puts San Francisco at the forefront is the use of electric vehicles. The city owns 160 public electric pumping stations with a plan to build another 2,750. The San Francisco taxi also goes on electricity. The city has over 1,000 electric vehicles and 5,000 hybrid vehicles [21].



Figure 10. Electrical vehicles in San Francisco [22].

- Curitiba, Brazil - green areas

As part of many years of planning, Curitiba changed its legislation in the 1970s when it comes to green spaces. Unlike that period when there was only 1 m² per capita in the city, now there are 52m². Over a million and a half trees have been planted in the city, along the streets, and 28 parks and wooded areas have been created. In addition to these fascinating facts, the inhabitants of the city use a transport service that has become a world-famous example of efficient transport. Ninety percent of the population recycles two-thirds of its garbage on a daily basis and the city has even devised a system by which waste is exchanged for transport tickets or fresh produce [23].



Figure 11. Green areas in Curitiba, Brazil [24]

- Copenhagen, Denmark - bike paths

Copenhagen has set itself the goal of becoming the world's first coal-free city by 2025, and in addition, building regulations require that all roofs be greened, that all new construction include so-called pocket parks or pocket parks that are about half the size of a football field. All residents were allowed to be in the park in less than a 15-minute walk. Due to the check, Copenhagen tops the list of green cities is the fact that more than the weight of the city's population (approximately 1.2 million inhabitants) uses bicycles as their main means of transport. The city has over 350 km of bike paths and another 70 km is planned by the end of 2015. In addition to this, the whole of Norway uses 19% of the energy generated from wind power [25].



Figure 12. Cyclist in Copenhagen [26]

Conclusion

In concluding this text, it is important to emphasize that the several initiatives presented do not constitute a green city; they are just a sign that we are on the right path. Innovative solutions are the beginning because the problem of creating a green city is complex. The problems that every potential green city is facing are deeply rooted in all its structures. According to Girardet, as long as the city thinks linearly (input of raw materials into the city and output of raw materials, ie waste from the city) and not circular (input of raw materials into the city and recycling and output of waste from the city), the future of the green city is uncertain [15]. As mentioned earlier, city planning requires holistic principles and a layered approach as well as adapting green city strategies and principles to the context in which it operates.

Much of what makes a green city essentially simple and subtle urbanism. Such urbanism should become the basis for spatial planning in the future. A behavior matrix is needed to facilitate this type of design. With additional research and implementation of existing occupations, as well as more understanding and assistance at the local level, the green city is not far from us.

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