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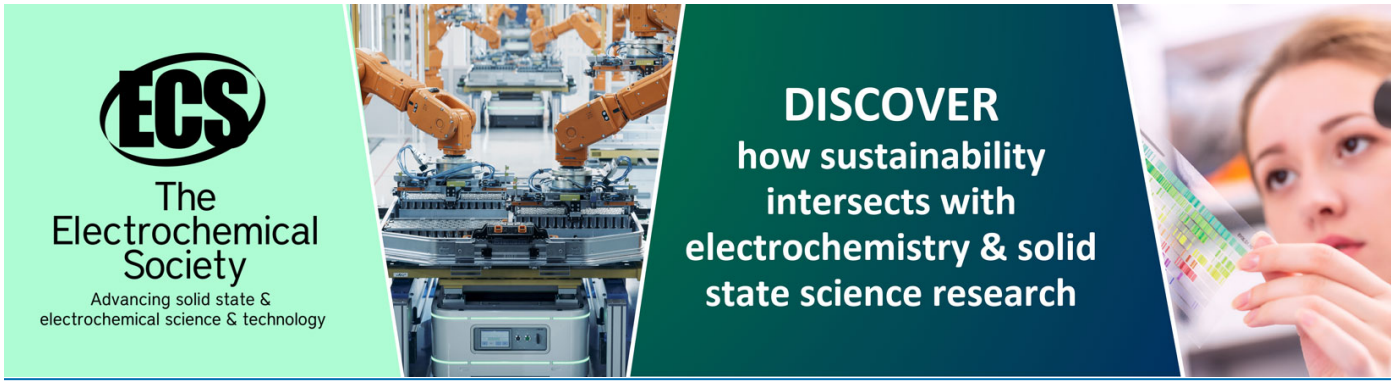

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Theoretical structure of Eco-cities: subject review

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Abstract. Given the importance of ecology and its entry into various fields in general and the urban environment particularly; ecological cities take wide ranges of application at multiple regional and global levels. However, it repeatedly noted that there was a state of cognitive confusion and overlapping in the term ecology comes from the diversity of implementation within several disciplines. Architects, designers, and planners have instilled biological development directly into the formal principles as well as the social structures of the ecological cities. Therefore, the research presents a rapid review of the most relevant areas that dealt with the ecological cities by research and analysis at various levels, from the concept and definition of the term, architecture, direction, design, planning, and housing to know the most significant similarities and differences of ecological cities within the various urban specialties. The findings reveal the application of the term Eco-city is branched and fallen under several names within one main goal to preserve the ecosystems and the natural environment while developing an appropriate microclimatic zone and achieving sustainable and healthy comfort levels for their residents through different urban indicators and techniques.

Keywords: Ecology; Urban; Sustainability; Eco-cities; Healthy.

1. Introduction

It is detected that the origin of ecological design is unclear in many respects. Many of the studies and theories included within the historical background of ecology focus in practice on the origins of the transmission of various ideas from ecology, biology, physiology, and the natural history to design. From the mid-nineteenth century until the end of World War II, tireless documentation of plants and trees began as well as the intensification of ideas to increase bonding with nature, and in this period the term ecology was coined by the German zoologist Ernst Haeckel (1834-1919). He once used the word oikology to refer to "the animal's relationship with both its organic and inorganic environment" in his book (The General Morphology of Organisms, 1866 [1] .Hegel then defined Oikology as: “the study of the relationships between organisms and the biological and non-biotic environments in which they live”. Since then, various definitions of ecology have appeared in the same direction. Historians Peder Anker and Oliver AI Botar used the terms biocentrism and bio functionalism to refer to the existence of functional requirements in biological organisms and complex systems. This idea was published in Bauhaus, and adopted by both Oskar Schlemmer, Mies van der Rohe, Paul Klee, Johannes Itten, and Wassily Kandinsky in their treatises[2].

Humboldt linked the organism and the environment through images in a way that had never been seen before. He photographed scenes and phenomena like volcanoes and mapped the thermal regions. Humboldt's article "An Essay on Plant Geography" in 1805 includes many of his most famous drawings The Chimborazo Map-Picture of a volcano whose equally heated map indicates a global ecology linked to a world of patterns and processes of environmental flows with distributions of plant

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patterns [1]. On the other hand, attempts have been made to invest in Humboldt's studies related to the distribution of living organisms and their representation in relation to the ecosystems and the urban green areas they provide, which are one of the most important ecosystem services from the perspective of urban residents. Paul Duvigneaud became particularly well known for his visual depiction of the ecosystem through a new method of mapping regional relationships, which gained these complexities and graphic qualities, making it an excellent reference for the education and vulgarity of environmental knowledge [3]. For example, the distribution of green areas (including parks, forests, meadows, marshes, grasslands, rocks, waterfronts, water areas, and even small green areas) differs in urban areas, as they are located in ecological environments affected by human actions, which can be important for human entertainment, especially when it comes to young people [3]. In a study on the impact of public green areas or elements in the residential environment on the experiences of adolescents in the outskirts of Helsinki, their use was primarily shown for hiking or weekend excursions and for daily outdoor recreation and recreation [4].

It is clear that previous studies were not only about facilitating and managing knowledge or merely documenting the stocks of the living world. Rather, it indicated a change in nature and formation of the systems used, depending on being an interconnected network of relationships between organisms, which is actually a kind of social environmental design activity. The integration found in plants and living organisms have been expressed and counted as inspiring examples of industrialized structures, which has called for the incorporation of natural and social sciences for a greater understanding of natural cycles and an attempt to restore a balance between social and environmental systems.

2. Eco-cities approach

2.1. Ecological concept approach

After the Second World War, it had indicated the emergence of a modern environmental era [5]. It declared the building's environmental design as a machine (under Le Corbusier “machines to live” in the 1920s)[6]. It’s a tool for handling Earth stock disturbances due to elevated levels of pollution and overall environmental degradation So, if the effects of these changes that are accompanied by changes in land use are unassessed at the expense of the ecosystem, there may be significant costs that involve the loss of this natural ecosystem (for example, increased rates of natural warming Increased flood damage)[3]. Although research interests towards the ecosystem have grown significantly in recent years, the ecosystem of cities or urban areas has not been much studied[6]. At the beginning of the twentieth century, there was a shift in the link between the environmental model. So, ecologists and space specialists[8] introduced new biological science techniques within a computational theory that allows reading the world as a system consisting of electronic sub-systems[2]. Among the main contributors to this trend are the Odum's brothers and Peder Anker. They were pioneers in visualizing ecosystems as a language that can be divided into components and can be observed along the lines of electrical circuits[7]. Howard Odum invented "Energese" - the language of energy systems - to use ecosystems effectively, the representative language of environmental simulation models, derived from electronic circuits[1].

In the 1960s and 1970s, ecologists alerted to the increasing levels of pollution around the world, the explosion of cities, the physical collapse of economic growth and the production of excessive waste flows. This reality called for the mobilization of multiple specialties for the purpose of controlling global information and systems for nature conservation and for the generation of a new "artificial natural" or "artificial environment", where the functions and processes of nature are copied as microscopic analogues in artificial systems, i.e. benefiting from the repetition of periodic self-systems regulating and investing technology to emulate and thus the emergence of ecological design[8].

Today, human activity in industry and technology has profoundly changed the natural world and created new natural states present in the most polluted locations on Earth. The term *subnature* is borrowed from architectural historian David Giessen to describe what he calls the boundaries of contemporary life. For Gissen, “secondary materials such as smoke, gas, exhaust, dust, ponds, and mud are the product of human activity in the city, this industrial and technological activity that

profoundly changed the natural world[1]. According to Peeples, a professor of communication studies at Utah State University toxic toxicity, the contradictions arising from the visual representation of environmental pollution are revealed: beauty and ugliness, size and lack of importance, security and risks[1]. Instead of trying to synthesize or integrate design with nature, eco-designers are devising new ways from existing polluted conditions to detect and reduce pollution. So, the main and the secondary indicators of the ecological concept emergence extracted in Table 1.

Table 1. The Ecological concept indicators [7][2][8][6][5][3][1]

Main indicators	Secondary indicators
Integration of scientific research	Natural Social Economic Urban
Ecosystems are the language of energy systems	Using ecosystems effectively Representative language for environmental simulation models It can be divided into components Their observations can be modelled on electrical circuits
Generation of new environment	Natural environment Artificial environment
The production of human activity	Changes in land use to the detriment of the ecosystem Increased levels of pollution Cities blast Collapse of economic growth Production of excessive waste flows Increased rates of natural warming Flood damage increased

2.2. Ecology in architecture

Victor Olgyay defined the essence of climatic architecture as creating a "comfortable" microclimate by involving various architectural techniques. Victor and Aladar Olgyays' methodology in their book “Designing with a Climate: A Bioclimatic Approach to Architectural Regionalism” (1963) included climate handling, biology, technology and architecture. Then several writings and projects such as solar architecture and passive architecture appeared as eco-design strategies to create climate-friendly and human-friendly spaces[1]. Inherited previous ideas, the distinguished architect Frank Lloyd Wright, formed the essential principles of coordinating architecture with context and ecological natural environment[6]. His comprehensive ideas represented exquisite examples of ecological designs with a high level of aesthetic represented by his notable Falling water residency built in 1935 in Mill Run, Pennsylvania. Falling water House was designated as one of the most significant buildings in American architecture, and who personified as a national historic landmark in 1966. In 1939 Wright visited London and gave four lectures at the Royal Institute of British Architects, summarising the ideas expressed in his works built over the years under the title “Organic architecture"[1]. Predicting environmental movement since the beginning of the twentieth century, long before the word "ecology" was used [6].

In Germany, Walter Gropius's aspirations appeared in his declaration of the Bauhaus in Weimar in 1919 to membership by reuniting architecture, painting and sculpture. The idea of unity with the nature declared by the Bauhaus does not go away from membership of Frank Lloyd Wright. Distinguished, it

is the belief that the unity of nature must be transferred literally and reconstructed in artificial monuments, in the complex embodiments of biological systems [2].

Design principles for ecological architecture indicate that they should be integrated with nature. In terms of planning, sites, design, function, technical selection, operating devices, materials, installation and even maintenance methods after building construction. And comprehensive life cycle, from principles of integrated and environmental improvement, pollution-free, simple resources, high efficiency, comfortable, healthy, saving with the principle of low consumption, reducing energy and material consumption, and improving energy use by smart architecture systems in buildings[9]

Therefore, starting with ecological architecture was preceded by an organic approach, and it can be concluded that this architecture is not just a nostalgic method. Rather, it is an international movement that combines respect for nature and beauty, the harmony of forms, trends and natural systems. As a mentor, this new and attractive model that permeates the world is transforming architecture and design in the twenty-first century[6].

Ecological buildings should also make reasonable use of wind, rain, sunlight and other natural resources. It should properly design according to different climate characteristics, advocate for recycling, reuse of energy and reduce waste of non-renewable resources, etc. In recent years, some buildings have made some progress in energy use, such as: the German RWE office, where natural ventilation methods are used for 70% of the total building. And thus, the full use of solar energy reduces the building requirements for maintenance and saves the needed energy for air conditioning and heating obtained from the investment of the correct climate directive of the building, which is an investment of the site's renewable energies. Another example is the British Tax Centre in Nottingham, and also the use of natural ventilation in the building, where natural ventilation is introduced around the outer walls and the indoor air polluted by chimneys is extracted. The surfaces are partially exposed to the sun's rays, so the concrete stores the solar energy using thermal inertia and thus creates an air movement. Waste incineration methods are used to provide energy to the building's thermal piping network[9]. The most relevant goals of these projects are to achieve balance, harmony with nature and healthy places as seen in Table 2.

Table 2. Ecological Architecture indicators [9][2][6][1]

Main indicators	Secondary indicators
The essence of ecological architecture	Creating a comfortable microclimate
Integration of the Ecological Architecture curriculum	Nature Society Economy
Realizing ecological architecture	Using nature's symbolism to create relationships between architecture and its cultural context Integration of architecture into the landscape Using environmental technology to create a sustainable and environmentally responsible architectural foundation (Greening) integrating or associating the object with the garden space or the natural environment of the urban context
Ecological Architecture Strategy	Organic architecture Solar architecture Passive architecture Responsive architecture Smart architecture Friendly architecture
Principles of Ecological Architecture	Minimal environmental impact Creating a healthy, workable and efficient living environment

	Making full use of the natural environment Achieving highly efficient use of resources and energy Achieving harmony between human and urbanism

In general, ecological architecture can be characterized by using the symbolism of nature to create relationships between architecture and its cultural context, integrating architecture into landscapes, integrating or linking the project with the garden area or the natural environment of the urban context, using environmental technology that creates a sustainable and responsible architectural basis for the environment, urban planning ideas that give imagination for the future, based on a general social perspective of the changes that may affect the art of building and environmental policy, and all models lead to design more wisely, smarter, economically and more environmentally. It is complex systematic engineering; its goal is to include society, nature, and the economy to create a comfortable local climate within complex artificial structural embodiments of biological systems that guarantee unity with nature. That is the coordination of architecture with context.

2.2.1. Ecological design research

In his book The Background of Ecology, the scientist and historian of ecology, Robert P. McIntosh pointed to the cognitive confusion of the field of ecology with the rest of the sciences. This confusion in terminology comes from the confusion between actual philosophical and existential positions regarding the limits of ecological design being a mechanical or organic field, Active or passive, total or fragmented [1]. In the nineteenth century, biologists switched from historical examination to empirical research in physiology, introducing ecological design through imitation, repetition, organization, or representation of natural systems [10]. For this reason, the ecological design represents the observation of natural systems and their analysis leading to the formation of new systems that are active in the environment. The Geddes concept of co-evolution is related to Friedrich Kessler's theories, which he defined as "the dynamics of a continuous interaction between three environments: human, natural, and technological, all in a state of constant change; as well as human needs, which affected the tools of the environment. Kiesler's theoretical speculation has been translated into reality as the principles of design [1].

The term "bionic" refers to biological simulations of the use of high technology and materials to improve performance and organizational development continuously, for high efficiency and low energy consumption, with a conscious response, physical touch and environmental safety, to give the building some environmental properties[2]. Taking advantage of some natural properties such as higher resistance, higher rigidity, easier maintenance, and lower costs are first-hand experiences to translate his theories into biotech-design practice[1]. The ecological design of buildings combining "technology and ecology" represents an inevitable trend of urban development and ecological design is a necessity as a new form of humanity [11]. Kiesler has defined ecological design methods as design and construction methods in an attempt to mimic the persistent characteristics of nature[1]. The Space House & Endless House, Mobile-Home-Library projects are first-hand experiments to translate his theories into an ecological design practice[1]. Bauhaus leaders revealed the inherent function of the natural creatures and their ability to improve human evolutionary fitness, as well as environmental living conditions through ecological design. This conviction, that designing the environment may be a way to improve humankind, views biological metaphor as a model of science, society, and aesthetics[2][11].

In the fiftieth of architecture, the twin brothers Victor and Aladar Olgyay coined the term dynamic climate design, as a specialization. They proposed a design methodology to create comfortable spaces in different climatic zones using diagrams and human comfort zones. The methodology includes climate, biology, technology, and architecture. The early 1960s witnessed advances in air conditioning, humidifiers, and other devices in regulating the indoor climate, which became a major issue in building design. The passive house of Costantinos Dekavallas in Aegina, Greece, appeared completely open to the outside, creating natural breezes by regulating the upward airflow. The greatest advocates

of environmental design are striving to find ways to coordinate environmental technology and protect resources and aesthetic content. Without these three vital components, there is little chance of achieving a sustainable architecture [6].

Lately, and with the elevated energy consumption in developed countries is 25% of the world's population consumes 80% of the energy reservation, the concept of ecological design has gradually become the direction that architects are moving towards sustainable development. The eco-design promise is the appropriate solution to the problem of architectural originality [1]. especially with the acceleration of the urbanization process, the increasing density, the expansion of buildings, the complexity of jobs, and the contemporary buildings seeking through the use of new technologies, new materials, and advanced scientific methods to solve environmental problems such as improving energy efficiency, reducing the consumption of non-renewable resources, and making full use of clean energy and a low carbon life, where an ideal living environment is created [12].

There were contradictory views on the use of mechanical equipment to regulate the climate, machinery as a radical design proposal that could change architecture in an orderly fashion. The Georges Pompidou Centre and HSBC Building show the expressive integration of machines into building design, where the whole machine is revealed and colour coded as urban proposals[1]. From a practical point of view, ecological design, for developing countries and regions, is still a forward-looking view of being expensive technologies, and because of this, the use of low-cost technology, passive design techniques are still the mainstream of developing countries. In recent years, the majority of developing countries are moving rapidly to modernize, and in the absence of a strategy for environmental technology and high energy consumption, this is a heavy burden, in this case traditional technology or low-cost technology is the solution, which in turn has not been able to keep pace with the increasing demand for it. Therefore, architects and urbanists must confront and define how to reduce technical environmental problems[12].

Evidentially, two trends in eco-design have emerged. The first approach is a closed, self-organizing system that re-creates it designed its internal environment. While the second approach is an open system that deals in a specific way with the disturbances of the external environment. Therefore, the principles of eco-design can be summarized by including environmental technology strategies. From the use of building concepts integrated with the environment. Or the adoption of natural systems of ventilation and lighting to create a comfortable indoor environment. Or the trend towards implementing energy-saving building technology and reducing environmental burden loads. Projects are also directed to reduce pollution and recycle construction waste. All this includes preserving the natural resources of the environment and moving towards alternative energies.

Ecological design principles can be summarized by including environmental technology strategies through using construction concepts that are compatible with the environment; investing natural systems, ventilation system, daylight system to create a comfortable indoor environment; applying energy-efficient building technology and reduce environmental load loads; reducing pollution and recycling construction waste; preserving the natural resources of the environment and moving towards alternative energies, while the indicators of the ecological design can be seen in Table 3.

Table 3. Ecological design indicators [13][11][10][2][6][1]

Main indicators	Secondary indicators
Interaction dynamics	Human Nature Technology
Transforming natural properties into biotechnology	Tradition Repetition Organization Action Simulation
Ecological design evolution	Merging ecology with technology Improving human evolutionary fitness

An improving way to the human race	Improving environmental living conditions Creating an ideal living environment
The use of technologies	Improving energy efficiency Reducing consumption of non-renewable resources Making full use of clean energy Lowering carbon life

Hence, ecological design includes mimicking the functions and processes of nature, that is, adopting biological simulations of representation, imitation, and replication, organizing and adopting them as accurate analogues in artificial systems. Mechanical control relies on biological metaphor to improve and increase the efficiency of living conditions, including climate, biology, technology and architecture.

2.3. Ecology in planning

At the beginning of the twentieth century, Charles Darwin's theory of evolution contributed greatly to the development of ecological theories. Not only for natural experts and biologists, but also for architects, designers, and planners who instilled biological evolution directly into plastic principles as well as social structures. Arcy Wentworth Thompson, on his published the results of his studies of morphology 1917, Growth and Form, and arguing that the shapes of plants and animals can be analysed with extreme precision via geometry. Thompson's visual studies of growth and physical processes were of a sophisticated morphological nature and were very relevant to designers towards the end of the twenty-first century, especially at a time when digital media was involved in the design process in the early 1990s [1]**.** The typical approach to ecological urbanization is often abstracted into a biological perspective in the metabolism charts of city systems by asserting that the city is a natural being of biological structures flowing with spaces and people organized within living patterns and throughout the urban environment; Corresponding to ecological fluxes and distributions of vegetation patterns in the natural environment[5]

Research interests towards the ecosystem have grown dramatically in recent years to a situation in which land use planning and management decisions are based on adequate information about the benefits that humans can derive from parks and urban forests[8][13]. Distant urban planning ideas give an imagination for the future based on a general social perspective of changes that may affect the art of construction and environmental policy. Additionally, all urban models generate experiences in building in a more economical, smarter, wise and environmentally friendly way, the goal is to achieve balance, harmony and health[6]. Ecological planning is the process of creating complex socio-dynamic ecological systems; It consists of the mutual interaction between human and ecological systems, as a socio-environmental system, the shape and structure of a city can change over time. In fact, the durability of cities is due to their constant change. Major shifts are often seen as socio-technological transitions. Sustainability transformation theories explore the processes by which emerging innovations in technical and social systems replace prevailing and current technologies. Research has focused on the transitions of sustainability in energy and water systems to zero housing[14] . Accordingly, the savings (collected rainwater) and utilization of water resources in environmental structures, the use of recycling (desalination of sea water) and wastewater treatment, with different types of environmental techniques such as greening the roofs, and trying to create natural aquatic and green communities. The economic advantages of these various environmental technologies cannot be proven in the short term, but they still have social and environmental benefits on a large scale that cannot be ignored [9]. Still, George Perkins Patrick Gedd and Ian McHarg among the pioneers whom interrelated human being and design with nature, and contributed mostly in ecological planning[15].

Numerous attempts have been made over the past decade to assess recent developments in the urban environment from different angles. One of the most comprehensive and up-to-date reviews of the impacts of urbanization on climate, streams, soils, plant and animal life patterns and human society

has been provided. These reviews are based on an ecological perception of the urban area. An urban area is a cultural landscape characterized by a large impermeable surface area, high population density, and land cover types of neighborhoods with different land uses that together form a dynamic patch mosaic [16]. Evidently, and going back to the last century, while human ways of life and living conditions change dramatically, this change costs a lot of energy and resources. This leads to a shortage of resources and a polluted environment impacted negatively the ecological balance. In contrast, the development in urban ecological planning is seen within the development of low consumption and low pollution, since traditional development is classified as high consumption. In June 1972, the alarm rang around the world to protect the environment, and the first conference on the human environment was held in Stockholm, Sweden. It issued the famous Human Environment Declaration, which proposed the slogan of only one Earth and designated the 5th of June as World Environment Day [9]. Table 4 shows the indicators of ecological planning.

Table 4. Indicators of the ecological planning [22][16][13][9][8][6][5]

Main indicators	
Urban Ecological Models	More economical Smarter More wisdom More environmentally friendly
The goal of ecological planning: creating complex systems	Social Dynamic (continuous interaction between human and environmental systems) Ecological
Ecological planning development	Low consumption Low pollution
Urban ecological visualization	Cultural landscape A large impermeable surface area High population density Adopting solar energy Ground cover different types of living organisms Mixed land uses

According to said, ecological planning has been characterized by the integration of socio-cultural with the physical environment and natural sciences (Climate, geology, hydrology, soil...etc.) respecting the interrelationships between the inhabitants and their built environment. It's an interdisciplinary field and a comprehensive bridge through multiple levels (from regional to the small place of the complex system). It is the process of creating complex social, dynamic and ecological systems consisting of the mutual interaction between human systems and the environment as a social-ecological system based on planning and management decisions using information derived from parks and urban forests. That is the implantation of biological evolution informal principles and social structures. It can be considered a cultural landscape characterized by a large surface area with a cover of types of neighbourhoods, wide population density, and different uses of the land within a dynamic area.

2.3.1. Ecological housing research

For Wright, the organic movement was not just a design approach, on top, it was a distinctive American viewpoint with a societal dimension and approach to a democratic political system. Wright's modern ideas about human relationships and institutions, and the alignment of modern space with nature were clear before his announcement of Organic architecture[6]. In the 1960s and in the context of the Vietnam War and rising levels of pollution worldwide, lots of appeals were came to abandon urban life by creating alternative living communities in remote areas to reduce pollution. So, in his

project Brodker City, which he worked on throughout his career. Wright suggested offering an acre of land to each citizen to form a farm community. One of the most striking examples of these ecological concepts was Steve Baer's project, a pioneer in solar design who later founded Zomeworks in Albuquerque, New Mexico.1972- 1971, to invest solar energy for direct heating of buildings[1]. In general, this encouraged the investment of alternative energies and the integration of solar, wind energy and other renewable energy sources[6]. With the stagnation in space business in the early seventies, Grumman Corporation, one of the leading companies in the field of environmental protection and produced space technology for NASA, tried to develop and operate the so-called Grumman Lunar Module. It was the first integrated piece designed to work outside the human environment. The result was a series of innovative designs, such as a Lunar-based modular housing unit, a space-recycling-based waste disposal system, an astronaut-inspired toilet system, and an energy efficiency system for homes with solar cells. These design techniques are titled "Grumman Integrated Home System" as an ecological architectural treatment of environmental problems[2].

On the other hand, Martin Pawley cooperated with the municipality of Santiago, Chile, on the possibility of collecting the available neglected elements and converting them into residential components, as a treatment for explosive urbanization and housing problems in the Santiago metropolitan area. After the field research, he continued throughout the seventies with a research program based on investing the waste of industrial products such as cans, bottles, and corrugated cartons[2]. This came after several movements calling for investing industrial waste, including the Garbage housing movement led by the British Martin Pawley, were active. Pawley[1] has turned to the laws of nature and metabolism rather than mimicking growth in physical processes. Pawley also suggested the immediate use of the remaining materials from global consumption and the replenishment of consumer by-products in the production cycle as new building materials. He incorporated in his various writings on garbage engineering two dilemmas of the time (the housing crisis and the overflow of waste), with the hope of saving two crises by feeding one in the other. The ambition was to recycle by-products of urban environments when natural systems recycle their waste. Garbage housing was conceived as a powerful response to a broad and urgent social problem - the solid waste crisis, which has called for national-level decisions in the United States and the United Kingdom[18]. Garbage engineers did everything necessary from their point of view to complete the material cycle from feedback loops, demographic statistics, digital analyses, solid waste classifications with redirecting all garbage to industrial utility, while other aspects were forgotten, such as exploiting the nature of existing materials and without providing new housing possibilities [15]. The problem facing this trend is the difficulty of using by-products to produce high-quality housing, and meeting the technical standards for insulation. In addition to the huge obstacles by the construction industry, which was operating in a closed loop of productivity and not ready to deal as a receptor for the by-products of other industries. It was an unmarketable housing strategy and ended up with a strong rejection from the construction industry.

Meanwhile, in 1970, Soleri and his wife began building the Arcosanti community in central Arizona. Arcosanti residents are primarily artists, students and volunteers investing in community livelihoods and enhancing Soleris' archaeological mission. This community is a laboratory to test and review ways to implement archaeological principles and various concepts of planning. Architectural, ecological, artistic, agricultural and urban[1]. His passive house has a heat demand of less than 15 kW/m2, only 15% of the current standard for new buildings in Urumqi. This can be done with insulation (30 cm instead of 12 cm), high-quality windows (a value of 0.8 u), a sealed building cover and heat recovery. The design was jointly prepared by Culturebridge Architects Grünstadt/Beijing and the Xinjiang Institute of Architectural Design.[19] The passive home institute in Darmstadt/Germany provided support and the news of the project has spread across China[9] (see Table 5).

[1] Pawley conducted his research at the Rensselaer Polytechnic Institute and Florida A&M University, and carefully studied the ways in which links could be established between the packaging, container, and construction industries in order to build his vision of parasitic housing policy[11] .

Table 5. Ecological housing indicators [19][20][18][9][11][2][6][1]

Main indicators	Secondary indicators
Dimensions of Ecological housing	A design approach Community enhancement Politician Democratic
Eco-housing trend	Create alternative living communities Abandoning urban life Remote areas investment
The vision of ecological housing policy	Reducing the housing crisis Reducing the waste crisis
Ecological housing design strategy	Investing alternative energies and integrating other renewable energy sources Solar design, and solar energy adoption Reducing pollution The adoption of geothermal energy Adoption of wind energy Minimal environmental impact Recycling of by-products for urban environments Industrial waste investment

From the foregoing, ecological housing can be considered a societal approach to a political and democratic system that aims to create alternative living societies, relying on standard housing units that work as an ecological urban treatment for environmental and housing problems. A feedback-based system to solve the problems of urbanization and explosive housing with excessive waste flows, by investing in consumer by-products.

2.4. Ecological cities

The term "Ecological City" has emerged as an umbrella term for a variety of new sustainable urban development models, and research related to defining, designing, developing, managing, and measuring the performance of Eco-cities and sustainable cities [19]. An ecological city can be defined as a city that aims to urban development consistent and respects the existing ecosystems. Currently, the concept of an Eco-city has been directed towards a low-carbon city in all its activities. Eco-city must have a controlled ecological and carbon footprint with a low impact on the surrounding areas. It also supports "green or clean" technologies and addresses it "Green development". Clean development invests in (construction, transportation, energy production, water management, waste management, industries, urban renewal, and others [21]. The eco-city works to ensure an urban presence that is not harmful to the vital natural environment. They are the cover of the organisms that provide the potential of the site's biological systems or exhaust their resources. It is a flexible city that guarantees a comfortable and safe living environment that preserves the ecosystem and operates within the same mechanics [22].

Several examples have emerged regarding the level of environmental regulation and the adoption of a sustainable approach as a lifestyle. Activating the scope of local environmental regulation and not relying on central governments are some examples. Another one and on the detailed level of green buildings technologies, dozens of the United States impose diverse levels of "greenness" for buildings (public/private). On the other hand, new urban growth systems have become based on the relationship between society and nature to make cities able to compete in a global environment and encourage investment. Accordingly, many practices are carried out, including redeveloping the infrastructure fields, water fronts, the marketing nature, and the regulation of pollution while preserving and trying to improve the existing infrastructure. This relationship between society and nature leaves room for civic

participation by urban residents to ecologically improve their cities, enhance the living environment, and reduce the waste of resources [23].

While Europe obtains much knowledge and best practices supporting solutions and spreading the ecological culture of cities. The Ministry of Human Resources and Rural Development, The European Commission, Technical Assistance Team (TAT) have identified nine specific sectors for adopting technology-based tools for Eco-cities, which have been adopted by China [21] In the first decade of the twenty-first century, more than 200 Eco-city projects were proposed, some of them under construction and others partially or completely implemented. Many of these Eco-cities have large-scale new land development projects on the outskirts of the municipalities. This momentum behind China's current Eco-cities can be seen as the third round of land development beyond Chinese domestic entrepreneurship. This characterized by multi-dimensional strategies to pursue projects formally and informally [24]. These nine sectors include compact urban development, clean energy, green buildings, green transport, water management, solid waste treatment, urban regeneration and revitalization, municipal finance, and green industries[21] [14] (see Table 6).

Table 6. Eco-cities indicators [21][24][23][21][19]

Main indicators	Secondary indicators
Ecological management	New city Liveable city Healthy city
Ecological construction	Landscape city Garden City Green city
Integrated development	Sustainable city Eco-city Environmentally friendly city
Ecological goals	Technical industrial Urbanism Cultural
Ecological ethics	Enhancing people's contribution to the maintenance of a high-quality urban ecosystem
Technological tools	Compact urban development clean energy Green buildings Green transport Water management Solid waste treatment Urban renewal and revitalization Municipal finance Green industries

From the preceding, it is possible to define Eco-cities as cities that seek to provide an acceptable standard of living for their occupants without depleting resources and preserving ecosystems. Eco-city is a natural organism from biological structures that flow with spaces and people organized within the patterns of life throughout the urban environment. It is an environmentally healthy and sustainable city. It is a vital, compact, and high-density city that can work within short distances with maximum accessibility. It leads to sustainable development through changes in production patterns, consumer behaviour, and environmental economics decision-making tools. In general, the development of ecological cities is linked to the three goals, economic, social, and environmental. In addition, it focused on the technical-industrial goal, integrated with its built environment, open spaces, and transportation, while reducing the use of resources and urban problems. And the cultural goals

(understanding the balance between man and nature, and understanding environmental ethics) in order to enhance people's contribution to maintaining a system high-quality urban environment.

3. Conclusions

The ecological Approach represents a trend of the twenty-first century and a goal for all architects, designers, and urban planners. Its principles based on the idea of harmony between man and nature, in which environmental structures evolve from mystery to fashion, from ideal to reality. It is an innovation in the construction industry with rapid development to a wonderful performance. As a result, research related to the level of ecological architecture, ecological design, ecological planning, ecological housing, and ecological cities, and information is still being explored continuously. From the principles, classes, and methods, to the multiple levels' professions and comprehensive engineering. It needs continued global assessment and global participation. It is cross-disciplinary sciences and interrelated branches. The specialist may be restricted in various circumstances, and it may be impossible to build integrated ecological urbanization in an ecological city in which every building and every urban component meet the global standard. But every design can be reformulated in environmental thinking again, changing into an innovation-centric and equilibrium type. Eco-cities represent the pattern of urbanization in which a suitable standard for external beauty while conserving energy and preserving the environment. It is an excellent urban performance commensurate with the requirements of scientific development and reflects the progress of human civilization.

In conclusion, it becomes clear that Eco-cities represent livable, healthy cities that adopt the foundations of ecological construction (a landscape, city, a garden city, a green city) with integrated and environmentally managed development. Therefore, Eco-city is a sustainable and environmentally friendly city. While the ecological overlapping includes the creation of dynamic systems that consist of mutual interactions within the system or systems boundaries that consist of the integration of ecological architecture and ecological planning down to ecological cities as seen in Figure 1.

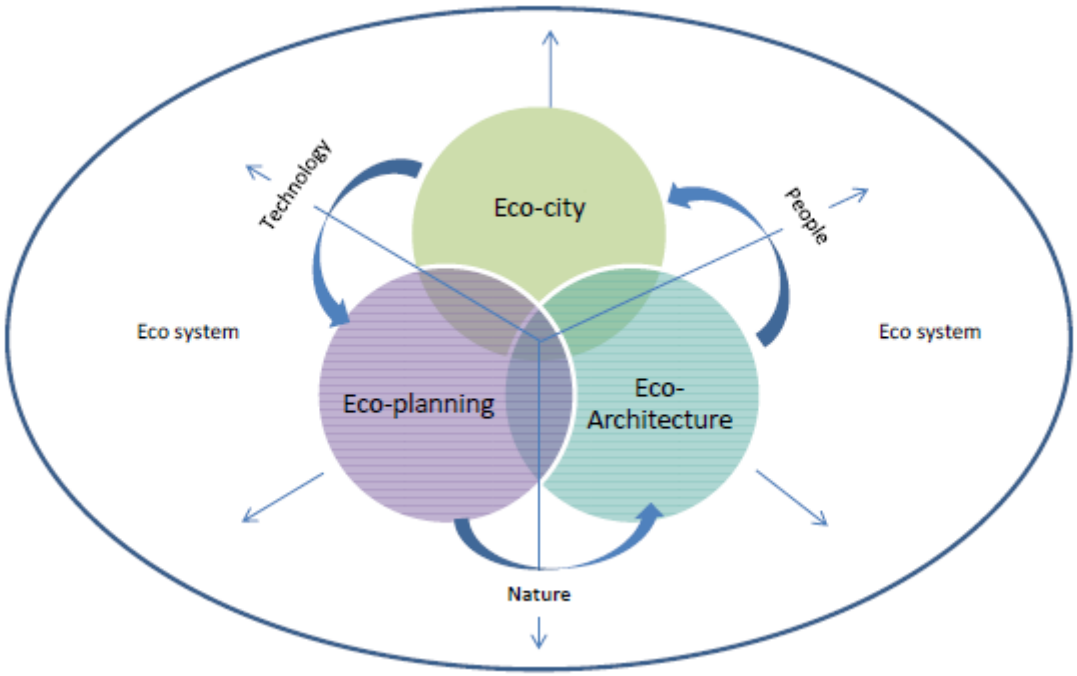

Figure 1. The ecological overlapping and the integration of ecological architecture and ecological planning with the Eco-cities.

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