

Received: 13 November, 2023

Accepted: 17 November, 2023

Published: 18 November, 2023

***Corresponding author:** Hülya Coskun, MSGSU, Mimar Sinan Fine Arts University, Faculty of Architecture, Istanbul, Turkey, Tel: (0090). 542 313 78 12; E-mail: her_222@yahoo.com, hulyaer222@hotmail.com

ORCID: <https://orcid.org/0000-0001-7123-622X>

Keywords: Ecology; Eco-cities; Green-design; Housing; Sustainability; Multi-disciplinary design

Copyright License: © 2023 Coskun H. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

<https://www.peertechzpublications.org>



Research Article

Eco-City Planning; concepts and contemporary models

Hülya Coskun*

MSGSU, Mimar Sinan Fine Arts University, Faculty of Architecture, Istanbul, Turkey

Abstract

This research is specifically centered on the concepts and contemporary models of eco-city planning. In the current era, there is a notable emergence of innovative city models with a focus on addressing climate-related issues. The drive to create new urban forms and models that concentrate global warming and climate challenges has resulted in the development of contemporary and innovative models, prominently exemplified by the eco-city. Previous studies have underscored the technological, socio-economic, and political aspects of eco-cities. While eco-cities are recognized for their highly technologically innovative approaches, the development of new architectural concept considered a crucial aspect of their design.

Beyond technological development, there is a significant emphasis on developing an architectural concept that considers climatic adaptation and sustainability features within a holistic approach. Therefore, the importance of crafting a technologically advanced city conducive to eco-city planning dynamics, especially with a sustainable architectural concept, is highlighted and deemed worthy of research exploration. The study delves into different contemporary eco-city models from diverse climatic regions worldwide to examine their architectural concept development challenges. Notable examples on a global scale, such as the Sino-Singaporean Tianjin Eco-city in China, Masdar City in the United Arab Emirates, and the proposed Istanbul Küçükçekmece Eco-city in Türkiye, are scrutinized.

The findings of the research underscore the significance of eco-cities in terms of architectural design and the use of sustainable materials for both sustainability and climate adaptation. These models, which align with technological advancements, emerge as sustainable and climate-sensitive city models. They serve as crucial examples in developing a more sustainable architectural model. Ultimately, the research emphasizes that designing a contemporary eco-city that addresses climatic privileges and without an sustainable architectural concept will not yield a sufficiently effective result.

Introduction

The research provides a comprehensive exploration of the contemporaneous eco-city concept, delving into various facets of sustainable urban planning and presenting diverse global examples. A notable surge in efforts towards sustainability, particularly before the through the development of eco-cities, began to gain momentum in the 1980s. While the idea shaped around that time, many of them have only recently found the opportunity for substantial development. Despite the relatively short period, the number of eco-cities has been on the rise, and they have been evolved adopting diverse ecological models.

The acceleration of these initiatives in recent years reflects an increased global awareness and commitment to sustainable urban development. The contemporary relevance of this topic is underscored, specifically in the context of addressing climate-change and promoting sustainability on a global scale. The 20th century witnessed a notable shift in urban planning dynamics, particularly transitioning from car-centric cities to more sustainable models, a transformation that gained momentum in the 1990s. While discussions around climate-change have permeated urban planning theories and discourse, the practical implementation of sustainable practices has been relatively slow.

The research highlights a re-evaluation on contemporaneous eco-city models, emphasizing that incorporates comprehensive climate and environmental considerations. Indeed, the history of sustainable design and eco-city concept has not rooted that extend far into the past. In the early 21st century in 2008–2009 the pioneering China's eco-cities gained prominence as recently by the Ministry of Environmental Protection (MEP) and the Ministry of Housing and Urban-Rural Development (MoHURD) developed “eco-cities” to address environmental agendas in cities [1]. Contemporary eco-cities are recognized in academic circles as an innovative solution to address the challenges posed by climate-change. These cities not only showcase advanced technological features but also provide a sustainable environment aligned with climatic conditions. The research underscores the significance of a multi-disciplinary holistic approach in urban and architectural planning and emphasizes the pivotal role of a sustainable architectural concept in shaping eco-cities.

While prior research has predominantly focused on technological and socio-economic-political aspects of eco-cities, there is a growing recognition of the need to design a more sustainable architectural concept that aligns with environmental compatibility. The examples of the Sino-Singaporean eco-city Tianjin in China, Masdar in Abu Dhabi, Arab Emirates, and the eco-city proposal in Istanbul, Türkiye emerge as leading illustrations in this regard. Consequently, the research critically examines these examples, assessing their harmony and contribution to the design of a sustainable architectural concept.

The research methodology is centered on the development of a contemporary eco-city architectural concept development. While the previous search mostly concentrated on technological, socio-politic, and economic consequences of eco-city planning, a sustainable architectural concept development is come to fore as another specific and not well-known research areas. Adapting a holistic approaches and technological advancements are pivotal in eco-city planning, there is an increasing emphasis on a sustainable architectural model in the design process. The study adopts a focused approach by reviewing three prominent eco-city models selected globally. It employs a research method that delves into developing specific sustainable architectural design concepts and details, examining their contributions to ecosystem enhancement, mitigation of marine and other forms of pollution, technological innovations, and efforts toward eco-friendly, zero-carbon energy.

Climate-change problems first emerged in the 1980s, and these innovative ideas have been developed until today and have become significant and widespread. Post-1980s climate with Register's book specifically on eco-cities signified the the birth of new term and it has created a new awareness on eco-cities and have brought studies on climate to the fore [2]. The urban and housing planning ideas at the intersection of the climate-crisis were first brought to the agenda in Brazil in 1992 and subsequently gained importance after the Istanbul Climate-Summit in 1996. With these significant conferences,

the global community emphasized the significance of climate-change and the later stages of the Paris Climate Agreement in 2016, the efforts on on climate has entered a different path. The purpose of these summits was to be held with an empowering approach [3].

Such a dense population in cities now defined as megacities has caused the existing urban ecosystems to change and degraded. The earlier in the 21st century, urban models have also changed and evolved significantly, breaking away from the traditional explanatory paradigms that have hitherto limited our understanding [4]. More recently, this has resulted in a global movement advocating a “green design revolution” and it has created a new green influence on cities around the world [5]. The transformation of the idea of “climate-change” into a newly introduced and widely accepted term in planning and design since the 2000s has led to transformative processes in existing urban centers. These changes are characterized by a shift observed in emerging urban theories [6].

The cities around the world are grappling with the negative impacts of global warming, climate-change, including extreme urban pollution, the gradual degradation of existing ecosystems, and other climatic challenges such as extreme weather events, heavy rainfall, floods, hurricanes, and heat waves. Also United Nation declared that; “Cities, urban areas and metropolitan areas must protect their nature and environments” (United Nations, 1996). This transformation led to a paradigm shift in urban planning, fundamentally changing the planning dynamics and resulting in the emergence of new city models. In addition to new climate-focused plans, new laws and regulations have been developed and implemented in many cities such as Beijing, Shanghai, and Singapore. Thus, people witnessed the birth of the new urban models such “eco-city” concept. Indeed, specifically this concept is a developed model based to earlier E. Howard's “garden-city” urban form at the beginning of the 20th century [6,7], The newly developed ecological models such as eco-city are just come to the fore and due to need to develop new urban forms and models emerged like; eco-city, green-city, sustainable-city, smart city etc (Figure 1).

The eco-city concept although it was first suggested as a solution to excessive climatic conditions like rainfall, later it was envisaged that it could be adapted and developed as a solution to different climate types. In this study Chinese



Figure 1: New Sustainable Urban Forms Depend on Centered to Eco-Systems.

pioneering eco-city models like Sino-Singaporean Tianjin, in China (Figure 2), as well as the Masdar city in, Abu Dhabi, United Arab Emirates, (Figure 3) and the Küçükçekmece eco-city proposal in Istanbul, Türkiye considered in this context. (Figure 4), The Sino-Singaporean Tianjin Eco-City, model

and initiated and implemented in recently in 2008- 2009, a master plan was developed with a sector plans and feasibility studies [1]. Although, eco-city is known in the context of a new “eco” model as environmentally friendly concept as well as the technological and innovative, also developing a sustainable eco-city architectural model also significant.



Figure 2: Sino-Singapore, Tianjin, Eco-City Model, in China. Photo, www.sino-singaporean.com.



Figure 3: The Masdar City, United Arab Emirates, a Sustainable Mixed-Use Contemporaneous eco-city Model. Photos, Foster and Partners web.page.



Figure 4: The Eco-city project proposal, in Istanbul, by Ken Yeang, for degraded old Marine System, Marmara Sea&Küçükçekmece Lake. Photos, Arkitera.

Furthermore, the other concept of eco-cities has come to fore been developed in response to the degradation of urban ecosystems caused by environmental and industrial pollution. One perspective on eco-city planning focuses not only on addressing climate-related challenges but also on rehabilitating existing urban ecosystems. An example of this approach is seen in a proposed eco-city planning project for Istanbul in the 2010s, due the city's ecological problems (Figure 4) [8,9], which aimed to rehabilitate degraded urban ecosystems affected by industrial wastes and uncontrolled urban sprawl [10,11]. While the project was not implemented, it brought attention to the need for addressing environmental pollution and ecosystem deterioration in urban areas.

In broader meaning in the eco-city design and planning emphasizes prioritizing climatic condition and existing ecosystems in urban areas. Thus, in the cities it is necessary to focus primarily on the natural environment and eco-systems [12]. In this research to develop eco-city and architectural design concept in ecological context and sustainability is a central focus. Thus, the concept of eco-cities is explored in terms of design and scope also adaptability in climatic conditions. Different proposals for eco-cities may emerge based on the climatic conditions of a particular region. For example, China may focus on eco-city models suitable for wetter climates, while countries in the Arabian Peninsula, with sunny and arid climates, may propose different approaches. The adaptability of eco-city concepts to diverse environmental conditions highlights the need for context-specific solutions in urban planning.

The methodology

The research methodology is centered on the development of a contemporary eco-city architectural concept. While holistic approaches and technological advancements are pivotal in eco-city planning, there is an increasing emphasis on crafting a sustainable architectural model in the design process.

The data supplied for this study from the various detailed literature research on generally eco-city concept and specifically. In the broad context and general scope of the research, significant sources were consulted, spanning from the inception of climate issues to influential works such as Register's pioneered eco-city works and the other urban theorists on theoretical base. Additionally, more research conducted on specific sources that were examined as case studies like, numerous publications of architect Ken Yeang who specialized on the eco-cities and Norman Foster specifically as well as relevant sources from China, were explored to the extent they were available and accessible.

The study adopts a focused approach by reviewing three prominent eco-city models selected globally. These specific case-studies selected due to their features and different regions in the world also diverse climatic condition and architectural model development. They employ a research method that delves into specific architectural design concepts and details, examining their contributions to ecosystem enhancement, mitigation of marine and other forms of pollution, technological

innovations, and efforts toward eco-friendly, zero-carbon energy.

The examination of the emergence of the eco-city concept is conducted under the main heading, providing insights into its theoretical background and the foundational theories that underpin it. The theoretical exploration of this model eco-city form serves as the basis for its conceptual expansion to its contemporary usage. The study investigates the theoretical foundations and presents examples from around the world, including the Sino-Singaporean Tianjin Eco-city, China Eco-City, Abu Dhabi Masdar, and a proposed Küçükçekmece Eco-city in Istanbul.

The concepts and models of contemporary Eco-City planning

At the beginning of the 21st century, a significant change in urban and residential design and planning began with the emergence of new ideas, terms and theories, climate-change, ecological scope, sustainable and green design, and planning. Thus, the urban planning landscape of the 21st century has undergone radical changes, breaking away from old explanatory models and embracing new design paradigms [4]. These innovative planning concepts aimed to establish a harmonious relationship between the city and nature [6].

Climate-based concepts first emerged only in the 1980s, when new planning terms and techniques were integrated into urban development. The theories and discourse on climate concerns came to the fore during the Earth Summit in Rio de Janeiro, Brazil, in 1992. Focusing on sustainable development, the United Nations initiated discussions that later resulted in the creation of Agenda 21. This agenda operationalized sustainable planning by emphasizing the importance of environmental considerations in urban development strategies. The changing and evolving planning strategies of the 21st century have placed significant emphasis on addressing environmental challenges and promoting sustainable practices. Environment and Development tools have implemented the sustainable planning discussed in this Conference [13].

The 21st century marks a new era in urban planning, necessitating the creation of new and innovative city models with forward-thinking approaches, and different concept which we need to create new city models [6]. The planning of cities and housing now varied and involves innovative concepts such as green-cities, eco-cities, smart-cities, and digital-cities [14]. The emphasis is on creating sustainable and resilient urban environments that respond to the challenges of the contemporary world.

First time published in a book by Register the eco-cities were defined as some human settlements which modeled on the self-sustaining resilient structure as natural eco-systems and later these are discussed as eco-city solutions [2]. As a among this new climate-based model is explained by the term of an eco-city explains that an ecologically planned healthy city and the juncture of urban planning, ecology, and public helping newly formulated innovative designs centered housing



environmentally [15]. The World Bank brought a new definition about eco-cities referred as new urban planning term; these cities planned enhance the well-being of society through the integration of the innovative urban planning the benefits of ecological systems protecting assets for future generations [16].

In the last three decades, the concept of eco-cities gained popularity, initially emerging through pragmatic theories and discourse in academic circles focused on urban sustainability. Richard Register, in his book on eco-cities, introduced the term, emphasizing ecological and sustainable principles for livable housing settlements and community development (Register, 2002) [2].

Also, another problematic surfaced: could early planning theories serve as the foundation for future city planning, particularly in the context of green-urbanism and architecture? Prior to the 21st century, quasi-innovative green urbanism theories were pioneered by E. Howard in his 1902 book *Garden-cities To-Morrow*. Almost half a century later, in 1969, Reyner Banham introduced a new idea that integrated human needs and environmental concerns as integral parts of architecture [6,7],

In the 21st century, existing urban planning theories were revisited, considering earlier versions and derivatives of garden cities. These evolved into different urban planning models, eventually manifesting as eco-cities in response to uncontrolled urban sprawl into the countryside's green-areas. This new eco-city model was like a modern-climatic focused version of the old model proposed by E. Howard. Such as locating factories and agricultural activities outside the city, establishing the tertiary sector in the center, and surrounding it with inalienable rural green belts [17]. However, these models were designed based on the dimensions of 20th century cities in terms of scale and optimum conditions Figure 5.

The eco-cities which have become a widespread and developed over the past two decades the challenge of the current global climate-change established separately from the city centers due to ownership regulations. As one of the significant model eco-cities, some classification may be considered, recreation of eco-systems or rehabilitation of existing eco-system the reasons likewise due to the industrial degradation and pollution with a focus on the natural environment and ecosystems [12]. Also, eco-cities depend on some assets that not only enable the eco-city to be designed, but also make it viable and applicable. In addition to climatic and technological difficulties in eco-city concept models, there are also various technical difficulties that arise in the process such as design and urban design plans. [18].

This points to a broader meaning and the need to consider "eco" cities in a extensive context, ranging from a definition focused on sustainability and climatic problems, to the rehabilitation of ecosystems, to technological development. Some large-scale eco-city projects such as Masdar are planned with a specific set of performance indicators integrated into

the plan for these new urban areas and the Tianjin eco-city and are based on plenty of quantitative and qualitative indicators [19].

According to another approach, Eco-cities have emerged discursively as beneficial formations to ecologically improve living conditions for their residents rather than as landscapes for the broader socio-environment [20]. In this context, rapid developments, and the recent realization of the reality of new living and settlement conditions have forced humanity to seek innovative planning models that will require completely different experiences from the past and quickly adapt to changing conditions.

Typical cases and future planning of contemporary Eco-Cities

Various criteria play a crucial role in determining the planning and implementation of major concept of contemporary eco-city initiatives worldwide. The International Eco-Cities commission for instance, has identified several global eco-city initiatives based on specific principles. To be included in this assessment, they had to encompass at least a district-wide scale, cover various sectors, and possess official policy status. These models, developed in diverse regions under different designations, offer valuable insights for future eco-city research. (Table 1) Also, some integrated sustainable urban forms that address multiple issues simultaneously have emerged [2,21], Furthermore, the eco-cities are strategically planned to rehabilitate and protect urban nature and the environment. They adopt redesigned, eco-centric urban forms, aiming to decrease energy consumption, implement car-free planning, prioritize public transport networks, pedestrians, and bicycles, all while maintaining a high standard of living for residents without compromising sustainability [22].



Figure 5: The Different Models of the Ecological Urban Forms and Application in the World.

Table 1: The Main Principles of the Sustainable Planning and Eco-Cities.

The Main Features of Sustainable Planning and Eco-Cities,
Holistic and Sustainable Concepts for Housing Settlement Areas
Considering and Rehabilitating Ecosystems and Climate Systems
Sustainable Architectural Design and Construction Materials
The Environmentally Eco-Friendly
The Strategies for Practical Implementations
Energy Efficient and Zero Carbon Energy
Planned Road System; No Car and Pedestrian, and Cycle Friendly

Hence, in the context of the eco-cities some classifications emphasize the rehabilitation of natural environments and ecosystems [12]. Examining these considerations, the leading eco-city models globally vary in their ecological problems and environments. For instance, the Sino-Singaporean Tianjin Eco-city project, in China (Figure 2) and the Abu Dhabi Masdar City project represent more ambitious goals, including sustainable architectural design and materials zero waste and zero carbon emissions (Figure 3). Eco-cities also serve as models for revitalizing existing ecosystems affected by industrial degradation and pollution like Ken Yeang's eco-city proposal in Küçükçekmece, Istanbul (Figure 4) and simpler initiatives, such as urban revitalization, green roofs, or garden projects, are evident in Augustenborg, Malmö, Sweden. These examples showcase the diversity of approaches within the broader eco-city framework.

A contemporaneous Eco-City model Sino-Singapore Tianjin Eco-City, China

The first Sino-Singaporean Tianjin Eco-city was planned in 2007 aimed to to develop a technological base an contemporaneous eco-city which was practical, replicable, and would be environmentally conscious regarding resource and energy conservation. The city planned to develop jointly between the governments of China and Singapore was in Binhai Region, built on aimed to non-arable land with a water shortage the southeast of Tianjin's urban core, declared purpose of serving as a sustainable urbanization despite environmental challenges [23,24] (Figure 2) The area prior to the development of the eco-city, was largely comprised polluted industrial area by salt pans, barren land, and polluted water previously a center for salt mining, a site for carbon sink at wetlands, and a century-old cultural landscape [20]. Finally, developed technologically and economically, from 2014 to September 2018, the Sino-Singaporean Tianjin Eco-City experienced a remarkable surge in the number of registered companies approximately 7,000 entities.

Planning and Housing; Also, the city would be then served as a "model" for sustainable development for other cities in China in future [23,24]. The Guardian reported that the area offered relatively inexpensive apartments other areas in Tianjin, and the city would attract more resident's future [25,26]. The city's population grew rapidly, and the city reportedly have a population of over 80,000 in 2018 [23].

Also, China's "eco-cities" developed by the China's Ministry of Environmental Protection (MEP) and Ministry of Housing and Urban-Rural Development (MoHURD) [1] establish a robust research and development (R&D) ecosystem with scientists and engineers per 10,000 employed people and need to increase the affordable "public-housing" to at least 20%, addressing the housing needs of the community [23].

The Sino-Singaporean Tianjin Eco-city is describing its layout as an "Eco-valley" that cuts through the city, for the purpose of "providing a scenic trail for pedestrians and cyclists [23]. Also, three centers planned in the city: one along the southern banks one to the city's north, and in the city's south

and the four residential districts in the city's southern, central, northern, and northeastern portions where each district has different neighborhoods with individual commercial centers and public amenities divided into several "Eco-neighborhoods", which each comprise four "Eco-cells" [23].

Today, "eco-cities", despite being accepted worldwide as a new urban concept and innovative planning theories, also there are still many challenges in terms of institutional and organizational aspects. The eco-cities in China include targets related to energy and resource use efficiency, as well as urban infrastructure.

By 2023, the Sino-Singapore Tianjin Eco-City has set several goals to be achieved: [23],

- Establish a robust research and development (R&D) ecosystem a population of scientists and engineers per 10,000 employed people,
- Increase the affordable "public-housing" 20%, addressing the housing needs.
- The Eco-City has ambitious targets to further its sustainable development.
- Improve waste management minimizing environmental impact a goal of recycling rate at 70%.
- 100% city management digitalization, limit carbon emissions contributing to a low-carbon and environmentally friendly economy.
- Foster a culture of innovation by at least 75% to participate in driving economy.

In the Tianjin contemporaneous eco-city model; An infrastructure development focused on new technologies to be developed and a settlement consisting of more sustainable working and housing areas planned for those who will work within this system and contribute economically by settling in this eco-city are defined.

A contemporaneous Eco-City model proposal, Küçükçekmece Eco-City, Türkiye

Another eco-city planning in Istanbul was proposed in the 2000s through a competition organized by Ken Yeang in the Küçükçekmece region, situated at the meeting point of the lake and the sea [8,9], (Figure 4). The project, with its focus on rehabilitation the regional marine ecosystem encompassing both the sea and the lake, not only qualifies as sustainable eco-city planning but also aligns with a tourism-oriented city planning model. This dual emphasis on environmental restoration and tourism showcases a comprehensive approach to urban development that considers ecological well-being alongside economic and recreational aspects. Located in the far western axis of Istanbul, the Küçükçekmece region is adjacent to the Marmara Sea, forming a natural and distinct ecosystem at a lake area where Ken Yeang envisioned his eco-city project proposal. This proposal aimed to address the degradation of the lake due to uncontrolled urban sprawl and industrial pollution [27,28].

The surroundings of the Küçükçekmece region and the lake, connected to the Marmara Sea, are partially occupied by existing uncontrolled settlements, including multi-story buildings, slum structures, and upper-class garden-city residences. Despite being in the far-west district of the city, the region has been undergoing continuous development with new buildings for many years. The proposed environmentally friendly project design aims to protect and revive the existing ecosystem, presenting a contemporary "eco-city" concept harmonizing with the natural environment of the Küçükçekmece lake and lagoon.

The Marmara Sea has recently faced an almost irreversible environmental disaster, leading to the destruction of its entire natural ecosystem due to excessive urbanization, human activities, and industrial pollution. Known as an inland sea where the Küçükçekmece lake is located, the unique characteristics of the Marmara Sea necessitate planning within its own ecosystem. The Küçükçekmece project is designed to address this issue differently from other examples worldwide, creating optimal circumstances for planning an eco-city settlement. K. Yeang's project from the early 2000s could not be implemented. If realized, it would be aimed to mitigate the impacts of the disaster observed in the Marmara Sea today [10].

The plan aims to establish a city environment that maintains a balance between ecology and urban life, with particular emphasis on excluding the traffic network from the ecosystem [29]. The vision of the project is to create an environmentally friendly and tranquil city life, prioritizing permeable pedestrian crossings, parks, and service roads, while concealing highways. The project also includes green spaces, a car park, park areas, a marina, a 7-star hotel, and an aqua park [29]. The presence of a hotel project suggests that the proposal envisions an eco-friendlier tourist area arrangement. However, details about the housing model are unavailable, as the project remained a proposal and was not implemented. Notably, Ken Yeang designed multi-story residences and workplaces in another proposed project known as "the tulip project" in the same region.

The Küçükçekmece project focuses on rehabilitation the existing ecosystem and planning it as an eco-city in harmony with its natural environment. In this context, it serves as an exemplary model for eco-cities, showcasing a protective approach for the future planning of the region. As a novel planning technique, eco-cities hold significant potential for shaping the future of city planning, proposing innovative models tailored to the unique characteristics of cities like Istanbul.

Ken Yeang's project planned in near the Küçükçekmece Lake connected to Marmara Sea is a large-scale eco-system project located in the micro-ecology of the land itself as a far neighborhood in the İstanbul city center features as below [29];

The Main Planning Principles of Ken Yeang's Eco-City Project Proposal, Küçükçekmece Region, Istanbul;

- As an "eco-city" the priority of green theme and green-areas dominates the project.

- The land and plots which divided by the E5 Highway consolidated in the project.
- Architectural design well integrates the natural landscape and a coexistence relationship.
- Rehabilitation of beach embankment for public use creates proper ecologies.
- The primacy of public uses also has a clever mix.
- The logical positioning of the project elements allows to possibility of future developments separately.
- The project has well organized circulation system.
- The project has a realistic nature and its elements.
- Development of existing and new elements of the land and its surroundings well establish synergetic relationships [29].

Unlike Tianjin, Küçükçekmece project proposal is not a technologically focused eco-city, but an eco-city planning model that is more focused on rehabilitation of existing ecosystem environmental protection and sustainable city planning. As emphasized here, the main purpose of the Küçükçekmece project is based on the rehabilitation of the degraded existing Küçükçekmece ecosystem, and in this context, the primary aim is to create a contemporary eco-city system that is sustainable and well-integrated with the environment.

A contemporaneous Eco-City Model, Masdar City, Abu Dhabi, Arab Emirates

Masdar City is as a modern and contemporary eco-city, distinguishing itself as one of the few meticulously planned, specialized high-tech to align with distinct climate conditions. Masdar City's standout its climatic focused architectural characteristic, marking it as a contemporary eco-city, lies in its genuine commitment to sustainability. The city's modern redesign, incorporating traditional and sustainable materials, adds a distinctive quality to its architectural design. This approach not only sets a precedent for eco-conscious urban development but also positions Masdar City as a remarkable example of how modernity and tradition can harmoniously coexist in architectural innovation. (Figure 3) The urban design encourages walking, and its streets and courtyards are thoughtfully shaded, providing an appealing pedestrian environment shielded from the extremes of climate. An integral aspect of Masdar City's sustainability lies in its surrounding landscape which is encompassing the city is designated for wind and photovoltaic farms, research fields, and plantations [30]. This strategic planning ensures that the community attains complete energy self-sufficiency, marking a noteworthy advancement in eco-conscious urban development. Created by the British architectural firm Foster and Partners, this sustainable city model relies on solar energy and various other renewable energy sources [31,32]. It serves as an advanced and sophisticated technological model, drawing inspiration from the traditional architecture of old Arabian



cities to create cooler open spaces within the natural hot desert environment. The design team, led by Foster and Partners, visited, and gained insights from ancient cities such as Cairo and Muscat, where traditional Arab architecture effectively copes with hot desert temperatures. The design incorporates shorter, narrower streets, typically no longer than 70 meters (230 ft). The buildings at the end of these streets generate wind turbulence, creating a flushing effect that cools the street [33].

Masdar City is envisioned as a technological and exemplary model that prioritizes sustainability and showcases greener urban living for approximately 50,000 people and businesses, with a focus on manufacturing environmentally friendly products. It features the first net-zero energy office building and six additional green buildings [34]. The city is designed to efficiently use water resources, incorporating water recycling from rainwater, condensate, and acceptable wastewater streams. The city is seamlessly connected to existing urban areas through roads and a light-rail system, emphasizing a sustainable mixed-use development that is pedestrian- and cyclist-friendly [31].

Masdar City is designed, drawing inspiration from old traditional Arab architecture, and utilizing ancient materials such as terracotta. The city's aesthetic features terracotta walls adorned with intricate arabesque patterns, creating a visual impression of a cube when viewed from a distance. This design choice not only pays homage to cultural heritage but also serves functional purposes.

The remarkable cooling effect is achieved through the implementation of a 45-meter-high (148 ft) wind tower, inspired by traditional Arab designs. The tower functions by drawing air from above and circulating a refreshing breeze through the streets of Masdar, enhancing the overall comfort of the urban environment. The layout of streets and buildings is carefully planned to be clustered closely together, creating shaded streets and walkways that provide protection from the sun. This thoughtful design approach contributes to the city's commitment to sustainability and the well-being of its inhabitants.

The Main Features of the Masdar City as an Eco-City Model;

- The Architectural design specifically inspired from old Traditional Arab Architecture.
- The Architectural Design realized using old, Traditional Materials, brick, etc.
- The city planned as old Traditional Arab Street Design.
- Buildings are clustered close together to create streets and walkways shielded from the sun.
- The city designed as traditional cooling systems; wind tower modelled traditional Arab designs sucks air and pushes a cooling breeze Masdar's streets.
- The city relies on solar energy and other renewable energy sources.

- Masdar is a sustainable mixed-use development designed to be friendly pedestrians and cyclists.

Results and discussions

Concepts and models of Eco-City Planning

In this context, the global challenges and consequences of global warming and climate problems were emphasized in the research. A conceptual definition of the recently emerging term eco-city is made, and globally prominent ecologically based city planning terms, theories and models are explained. In the study, conceptual similarities or differences between newly developed eco-city models and the underlying reasons for these differences were tried to be explained. The proposed projects and models implemented in practice were also explained with examples, shedding light on the practical applications of eco-city concepts and theories.

Typical cases and future Planning of Eco-Cities

In this context, the research specifically underscored the measures implemented in response to the global challenges stemming from global warming and climate issues. It delved into the rationale behind and the outcomes of developing distinct specific selected models as solutions to the climatic challenges faced by eco-cities. The study highlighted that the Sino-Singaporean Tianjin model, in China for instance, is perceived as a solution to the drought problem, and technological developments, Masdar city in Abu Dhabi, in Arab Emirates was specifically designed to address issues arising from the hot climate, and the Küçükçekmece eco-city project, in Istanbul, Türkiye was conceptualized with the aim of rehabilitating and revitalizing the degraded marine ecosystem around the sea and the lake. These examples were considered as selected specific case-studies and analyzed in terms of their causative factors and consequences (Table 2).

Conclusion

In recent years, ecosystems have undergone significant deterioration due to climate-related issues, global warming, and the climate crisis. Cities, acting as amplifiers of extreme climate changes, experience adverse effects such as extreme temperatures, heavy rains, droughts, and diminishing water reserves. The substantial transformation and deterioration of existing ecosystems in cities necessitate urgent measures. In this context, eco-cities, recently in the spotlight and garnering increasing global attention, emerge as valuable solutions to address these challenges. While eco-cities play a crucial role in regulating and rehabilitating existing urban ecosystems, it is crucial to acknowledge that planning eco-cities solely based on environmental considerations may not be sufficient. In this context, the importance of developing an architectural concept for contemporary eco-cities emerges as main problematic. The research underscores that developing a more sustainable and environmentally friendly urban environment alone will not suffice. A more holistic approach is advocated, emphasizing the significance of formulating a sustainable architectural concept. One of the identified gaps in this research is the

**Table 2:** The Architectural Design Principles According to Examples of Eco-Cities.

The Architectural Design Principles Of Eco-Cities			
	Sino-Singaporean, Tianjin, China	Küçükçekmece, Türkiye	Masdar, United Arab Emirates
The Main Purpose	Ecological Rehabilitation, (Water Shortage-Industr. & Technological Development)	Ecological Rehabilitation (Lake, Marine Ecosystem) & Urban Development	Creating An Eco-Friendly City in Desert & Technological Development
Design Idea	Eco-City Science & Technological Development	Housing & Business & Tourism Development	Eco-City Business Env. Friendly Material Producing
Design Concept	Green-City Concept	Green-City Concept	Inspired old, local Architecture & Materials
Environmentally Friendly	Environmentally Friendly	Environmentally Friendly	Environmentally Friendly
Architectural Materials	New Materials	New Materials	Mixed Old, Local and New Materials
Sustainable and Energy Efficient	Sustainable and Energy Efficient Systems	Sustainable and Energy Efficient Systems	Sustainable and Energy Efficient Systems
Road and Street Systems	Zero Carbon, Pedestrian, Cycle Friendly	Zero Carbon, Pedestrian, Cycle Friendly	Zero Carbon, Pedestrian Cycle Friendly

challenge of developing an architectural concept suitable for contemporary eco-cities within the framework of a holistic approach. In the conducted research, the eco-cities in China, such as the Sino-Singaporean Tianjin city, are notable for emphasizing a technological structure alongside heightened climatic consideration, the Masdar, United Arab Emirates, and Istanbul Küçükçekmece projects were oriented towards the development of a more contemporaneous and sustainable architectural concept. The research also revealed that although the eco-city concept was perceived as a contemporary and technological solution, sometimes the architectural designs in these eco-cities were not sustainable and compatible with the eco-city paradigm as well as the multi-story housing and buildings in densely planning. A table based on the data obtained because of the research and describing the main specific features of a contemporary eco-city concept planning was also prepared and presented because of this research (Table 2). The other finding in this research is that eco-cities are still open to concept development and experimental applications and processes, and some of them remain in the project phase without being implemented. In this context, likewise the Masdar in United Arab Emirates, the eco-city model in Istanbul is one of the good examples, and most importantly, a holistic model and approach is adopted in terms of urban and housing planning. These models resembling eco-cities are garnering increasing attention globally, with new models surfacing regularly. Notable examples include the Eco-Island model and the eco-metaverse model in China, recently conceived by Zaha Hadid Architects, along with the innovative The-Line project in Saudi Arabia. The growing number of such examples and the rapid emergence of new eco-city models within a short timeframe underscore the significance of the subject. It is evident that new eco-city examples are being conceptualized and planned. However, it should still be underlined that the most important problem in eco-city planning is the adoption of a "holistic" approach. Although its scope is very broad, to explain briefly, the "holistic" approach will essentially develop comprehensive solution proposals between "urban planning" and "architecture". Integrating green and sustainable urban planning and housing designs is essential to ensure the future survival of ecosystems. These designs should not only support the environmental structure of eco-cities, but also

contribute to the creation of a "holistic" and "resilient" urban environment. Integration of sustainable housing practices is vital to achieving eco-cities' long-term goals of promoting healthy, balanced, and sustainable urban living.

References

- World Bank (2014) World Development Reports. <https://openknowledge.worldbank.org/handle/10986/20093>,
- Register R. Ecocity Berkeley: Building Cities for a Healthy Future. Berkeley, CA: North Atlantic Book. 1987.
- United Nations (1992) Report of the United Nations Conference on Environment and Development: Rio de Janeiro, 3-14 June 1992. New York: United Nations.
- Paquot T. Introduction Urban Planning is to Think. Rethink Urban Planning, under the direction of Thierry Paquot, Infolio, Paris, 2013.
- Grey FA. Masdar City as a Prototype for Eco-Cities. Digest of Middle East Studies. 2018; 27(2): 261-277. <https://doi.org/10.1111/dome>.
- Lehmann S. What is Green Urbanism? Holistic Principles To Transform Cities for Sustainable. 2011.
- Banham R. The Architecture for Well-Tempered Environment, London, Architectural Press. 1969.
- Yeang K. Eco Master Planning, Wiley; 1st edition. 2009,
- Yeang K, Jahnkassim S. Constructed Ecosystems: Ideas and Subsystems in the Work of Ken Yeang (ORO EDITIONS) Paperback. 2016.
- Coskun H. Re-Planning of The Future İstanbul In The 21st Century: Green Architecture", ICCAUA, Conference Book Chapter. 2021.
- Coskun H. Istanbul, The Ecology, Nature, and Disasters Designing Future Cities with Innovative Housing Projects", Urban Planning & Architectural Planning for Sustainable Development (UPADSD), 1st Edition, 14-16 September 2021, University of Florence, University of Salento, Italy. Published by Axel Springer, Switzerland.
- Mostafavi M, Doherty G. Ecological urbanism. Lars Muller, Baden. 2010.
- Nocca F. The role of cultural heritage in sustainable development: Multidimensional Indicators as a decision-making tool. Sustainability. 2017; 9:1882.
- Caprotti F. Eco-urbanism and the Eco-city, or, Denying the Right to the City?. 2014.
- Roseland M. Dimensions of the Eco-city. Cities. 1997; 14(4): 197-202. doi:10.1016/s0264-2751(97)00003-



16. World Bank (2018) Eco-city Definition, What is an Ecocity? Ecocity Builders.
17. Choay F. Planning And Cities, Translation M. Hugo, Second Printing, Brazillier, New York. 1969.
18. Chang ICC. Failure matters: Reassembling eco-urbanism in a globalizing China. *Environment and Planning A: Economy and Space*. 2017; 49(8): 1719-1742.. <https://doi.org/10.1177/>
19. Caprotti F. Eco-urbanism and the Eco-city, or, Denying the Right to the City? 2014.
20. Caprotti F, Springer C, Harmer N. Eco' For Whom? Envisioning Eco-urbanism in the Sino-Singapore Tianjin Eco-city, China. *International Journal of Urban and Regional Research*. 2015; 39(3): 495-517. <https://doi.org/10.1111/1468-2427.12233>
21. Beatley T. Eco-city dimensions: healthy communities, healthy planet, New Society Publishers. 1997.
22. White RR. Building the Ecological City, Cambridge: Woodhead and CRC Press. 2002.
23. Ministry of National Development (2021) "Tianjin Who We Are". www.mnd.gov.sg. from the original on 20 December 2021.
24. Gaia V. China's eco-cities: Sustainable urban living in Tianjin. www.bbc.com. BBC News. Archived from the original on 29 May 2021. 2012.
25. The Guardian, (2021), Archived (<https://web.archive.org/web/20211003153642/https://www.theguardian.com/cities/2014/apr/14/china-tianjin-eco-city-empty-hospitals-people>) from the original on 3 October 2021. Retrieved, October 15, 2023.
26. Kaiman J. China's 'eco-cities': empty of hospitals, shopping centres, and people. 2014. <https://www.theguardian.com/cities/2014/apr/14/china-tianjin-eco-city-empty-hospitals-people>
27. Coskun H. Istanbul; the Planning of Residential, and Industrial Areas in the Process of Transformation into a Sustainable city. CCSE, Climate Change and Environmental Sustainability, 1st Edition, 09-10 November 2021, Conquing University, CHINA. Published by Axel Springer, Switzerland. 2022.
28. Coskun H. Sustainable and Resilient Plannings, Developed Housing Models for Istanbul. RRAU, Resilient&Responsible Architecture and Urbanism, 4th Edition, 03-05 December 2021, XIAMEN University Malaysia, Southwest JiatotongUniversity China, MA LAYSIA. Published by Axel Springer, Switzerland. 2022.
29. Arkitera (2006) 1. Ödül, Küçükçekmece – Avcılar, İç – Dış Kumsal Alanı Kentsel Tasarım Projesi. <https://www.arkitera.com/etiket/kucukcekmece-avcilar-ic-dis-kumsal-alani-kentsel-tasarim-projesi/>.
30. Foster and Partners (2023) Foster and Partners Website. <https://www.fosterandpartners.com/projects/masdar-city>,
31. Walsh B. Masdar City: The World's Greenest City?. 2011. <http://content.time.com/time/health/article/0,8599,2043934,00.html>.
32. The Economist (2013) Starting from scratch . The Economist. 7 September 2013. <https://www.economist.com/news/briefing/21585003-building-city-future-costly-and-hard-starting-scratch>
33. Masdar Institute (2023) Masdar Institute. Abu Dhabi <http://www.fosterandpartners.com/projects/masdar-institute/>.
34. Oxborrow I. Masdar City Square to feature Abu Dhabi's first net-zero energy office building. 2022. <https://www.thenationalnews.com/business/road-to-net-zero/2022/06/24/masdar-city-square-to-feature-abu-dhabis-first-net-zero-energy-office-building/>.The National.
35. United Nations (2014) World's Population Increasingly Urban with More than Half Living in Urban Areas. <http://www.un.org/en/development/desa/news/population/world-urbanization-prospects-2014.html>.
36. World Economic Forum, (2020), "7 innovative projects making cities more sustainable". World Economic Forum. 2020-09-22.
37. (2013), Masdar City -- Does It Have A Bright Future? <http://cleantechnica.com/2013/03/20/masdar-city-does-it-have-a-bright-future/>. Clean Technica. 20 March 2013.

Discover a bigger Impact and Visibility of your article publication with Peertechz Publications

Highlights

- ❖ Signatory publisher of ORCID
- ❖ Signatory Publisher of DORA (San Francisco Declaration on Research Assessment)
- ❖ Articles archived in worlds' renowned service providers such as Portico, CNKI, AGRIS, TDNet, Base (Bielefeld University Library), CrossRef, Scilit, J-Gate etc.
- ❖ Journals indexed in ICMJE, SHERPA/ROMEO, Google Scholar etc.
- ❖ OAI-PMH (Open Archives Initiative Protocol for Metadata Harvesting)
- ❖ Dedicated Editorial Board for every journal
- ❖ Accurate and rapid peer-review process
- ❖ Increased citations of published articles through promotions
- ❖ Reduced timeline for article publication

Submit your articles and experience a new surge in publication services

<https://www.peertechzpublications.org/submission>

Peertechz journals wishes everlasting success in your every endeavours.