

AN ASSESSMENT ON THE ECO-TECH CITIES OF TOMORROW

YARININ EKO-TEK KENTLERİ ÜZERİNE BİR DEĞERLENDİRME

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Abstract

The first settlements were small and rural, with a lifestyle based on agriculture. Over time, developments in science, technology, communication, and the economy have laid the foundation for today's urban lifestyle. Currently, people living in densely populated urban areas shaped by technological, socio-economic, sociological, and cultural factors are confronted with environmental issues that directly threaten their lives. The intensive use of technology, rapid population growth, and the concentration of people in specific areas have made it increasingly difficult to address these environmental challenges. Urban overcrowding, irresponsible consumption of natural resources driven by capitalist competition, neglect of ecological values, poverty, and underdevelopment have rendered many modern cities uninhabitable. In response to these adverse developments, technologically advanced countries are striving to harness technology to create livable cities and to develop and implement projects aimed at building ecological urban environments. This study examines the Eco-Tech City (Ecological and Technological City) model, which is increasingly being adopted and promoted worldwide as the urban model of the future. Drawing on the existing literature, the study provides information on global applications of this model and discusses its potential for addressing urban problems in Turkey.

Keywords: City, Ecology, Ecological City, Technological City, Eco-Tech City.

Öz

İlk yerleşim yerleri, küçük ve kırsal yapıda olup tarıma dayalı bir yaşam tarzı şeklindedir. Bilim, teknoloji, iletişim ve ekonomi gibi alanlardaki tarihsel gelişmeler, bugünkü kent yaşamının temelini atmıştır. Günümüzde teknolojik, sosyo-ekonomik, sosyolojik ve kültürel etkenlerle hızla büyüyen, milyonları barındıran yüksek nüfuslu yerleşim alanlarında yaşayan insan, artık doğrudan yaşamını tehdit eden çevre sorunlarıyla karşı karşıyadır. Teknolojinin yoğun kullanımı, aşırı nüfus artışı ve bu nüfusun belirli yerlerde yığılması, çevre sorunlarının çözümünü de giderek zorlaştırmaktadır. Kentlerin kalabalıklaşması, kapitalist rekabet koşullarında doğal kaynakların sorumsuzca tüketilmesi, çevre değerlerine gereken önemin verilmemesi, yoksulluk, az gelişmişlik vb. nedenler günümüz kentlerini yaşanmaz hale getirmektedir. Teknolojiye sahip gelişmiş ülkeler bu olumsuz gelişmeler karşısında yaşanabilir kentler oluşturmak konusunda yine teknolojiden yararlanmaya ve teknoloji kullanımı ile ekolojik kentler ve kentsel yaşam oluşturulabilecekleri projeler geliştirmeye ve uygulamaya çalışmaktadırlar. Bu çalışmada, dünyada giderek bir model olarak uygulama örnekleri görülmeye ve projelendirilmeye başlayan ve yarının kentleri olarak sunulan Eko-Tek Kent (Ekolojik ve Teknolojik Kent) modeli, literatürden yararlanarak araştırılmakta, bu modelin dünyadaki uygulamaları hakkında bilgi verilmekte ve Türkiye'de kentsel sorunların çözümünde uygulanabilirliği tartışılmaktadır.

Anahtar Kelimeler: Kent, Ekoloji, Ekolojik Kent, Teknolojik Kent, Eko-Tek Kent.

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1. INTRODUCTION

From the simple lifestyle of early humans to the changing residential areas shaped by technological inventions, and ultimately to the densely populated urban centers formed by mass migration from rural areas to cities during the Industrial Revolution to meet the labor demands of the industry-urban life has undergone a dramatic transformation. After the two World Wars, populations became increasingly concentrated in cities. In response, efforts were made to create new living environments that embraced nature and utilized the opportunities offered by technology, rather than continuing with unhealthy and unplanned urban sprawl.

According to United Nations projections, by 2050, 66% of the world's population will reside in cities. Most of this urban population growth is expected to occur in developing countries. The resulting urban and environmental challenges signal that urban life may become increasingly problematic if solutions are not implemented. Overbuilding, lack of green spaces, traffic congestion, noise, and environmental pollution are just a few of the growing issues. Even today, problems such as intense air pollution, unplanned urbanization, industrialization, and the effects of climate change are already critical -and these issues are expected to worsen with continued population growth.

Since the Industrial Revolution, cities have functioned as the economic production hubs of the global capitalist system. Today, cities across the world are engaged in relentless competition. Globalization has placed cities at the heart of the global economy, concentrating multinational corporations, financial networks, and trade. Metropolises such as London, New York, and Tokyo -referred to as "global cities" are particularly notable as centers controlling international capital flows. In these cities, more buildings, higher skyscrapers, and increased housing have become essential features. A similar trend is observed in Turkey. Even the smallest cities are being concretized in an effort to attract international capital, gain a competitive edge, and become brand-name cities.

Recognizing that humans are natural beings, it is evident that they cannot survive indefinitely in such artificial environments. In the cities of developing and underdeveloped countries, green space per capita is extremely limited. Although green space is more abundant in developed nations, efforts to design cities with minimal environmental impact and strong ecological features are increasingly important. These efforts often arise in countries with young populations and a desire to combat rapid urbanization. In Turkey, notable initiatives are being undertaken, particularly by the Ministry of Environment, Urbanization and Climate Change.

Eco-cities have emerged as leading proposals for addressing the problems caused by cities becoming sources of environmental degradation and declining quality of life. Global issues such as urban overpopulation, intensive urbanization, environmental destruction, and climate change highlight the unsustainability of traditional urbanization models. Therefore, ecologically designed and environmentally friendly cities have become an inevitable necessity. The new urban model, which integrates ecological city planning with modern technological capabilities, offers a potential solution to environmental problems and the harmful impacts of climate change. While the lifestyle of agrarian societies cannot be directly transplanted into modern ecological cities, the use of technology in urban planning and development is essential.

In urban design, approaches that incorporate ecological planning-preserving natural values and respecting nature and the environment-have become increasingly widespread, especially in developed countries. Today, various models such as "Eco Cities," "Smart Cities," and "Eco-Tech Cities" are being explored to address urban challenges. In light of increasing global environmental issues, the advancement of technology and the rising demand for ecological living are key factors driving a shift in urban governance strategies in both developed and developing countries. It is essential that technology is not viewed solely as a force that harms nature and accelerates resource depletion. Instead, it should be understood as a tool for preserving ecological balance and guiding the future (Alici, 2020).

This study aims to examine Eco-Tech City applications as a potential solution to urban overcrowding, environmental problems, and irregular, unplanned development. Drawing from the literature, it explores new city models that offer sustainable solutions to ecological degradation and urban challenges.

2. CONCEPTUAL STRUCTURE

Today, cities are explained through many different and evolving concepts (or models), with their sustainability, development, and progress assessed through these lenses. This study draws on global examples of "digital cities" and "eco-tech cities," with a framework built on the concepts of "eco-tech city," "eco-city," and "techno-city."

2.1. Eco-City

Urban growth places significant pressure on energy systems and ecosystem services, giving rise to various challenges that threaten the environmental sustainability of cities. These challenges have led to the emergence of new urban concepts, one of which is the “eco-city,” increasingly seen in global and local policies as a model for environmentally sustainable urbanism (Bibri, 2020).

While the term "eco-city" is generally used with a positive connotation, it lacks a precise and universally accepted definition (Jong et al., 2013). It is derived from terms with vague conceptual meanings such as “sustainability,” “clean,” “green,” or “zero-emission living” (Premalatha et al., 2013). Richard Register (1987), often credited as the originator of the term, defined an eco-city as “an urban environmental system in which the amount of input (resources) and output (waste) is minimized.”

An eco-city is a city model designed with environmental impact in mind, inhabited by people who use renewable energy and strive to minimize environmental waste. The main goal is to integrate the environment into urban life (Jong et al., 2013). Another definition describes eco-cities as self-sustaining and environmentally friendly urban structures that replicate natural ecosystem functions, support ecologically healthy human settlements, and avoid damaging the habitats of non-human species (Ciumasu, 2013). The ecological urbanism approach is recognized as promoting more environmentally sensitive and socially inclusive urban development based on ecological principles (Mostafavi and Doherty, 2010).

Although rooted in the agricultural society and conceptualized in the 20th century, the eco-city- driven by the principle of sustainability -has gained global significance as a conservation-oriented model that evolves with technological advancements. Its origins can be traced to environmentalist movements and international efforts to balance the economy and ecology, including Ebenezer Howard’s "Garden City" concept from the 19th century to 20th-century tech-focused urban planning. These efforts reflect the broader search for green and sustainable alternatives to polluted and degraded urban environments (Meydan Yıldız, 2016).

The eco-city concept emerged in parallel with other terms such as sustainable city, carbon-neutral city, garden city, green city, and self-sufficient city. The shared goal of these movements is to integrate environmental priorities and ensure that urban development remains within the carrying capacity of ecological systems. Eco-cities, therefore, embody an approach that embeds environmental principles into everyday urban life.

According to Jong et al. (2013), the core objectives of eco-cities include:

- Eliminating all carbon emissions
- Generating energy from fully renewable sources
- Integrating the natural environment into the urban landscape
- Reducing poverty
- Encouraging sustainable economic growth
- Promoting high efficiency and a healthy lifestyle

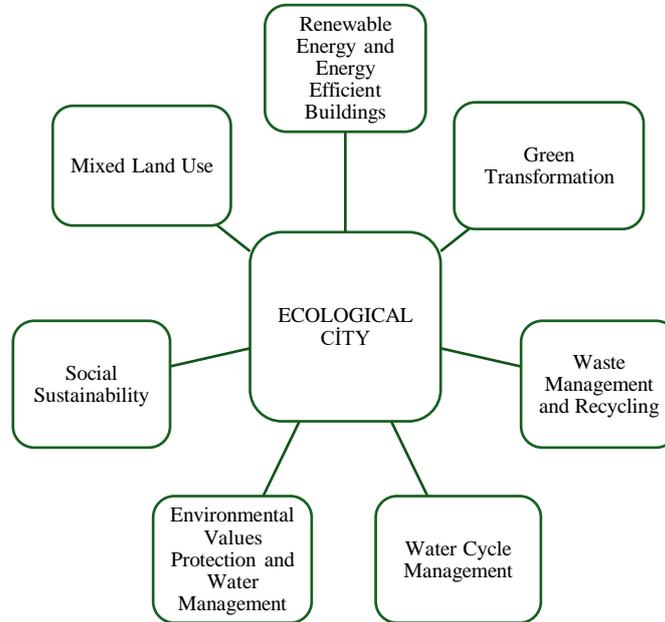
Roseland (1997) classifies the essential functions of eco-cities into ten categories:

- Reprioritizing land use
- Redesigning transportation systems
- Revitalizing aging urban infrastructure
- Constructing affordable and reliable housing
- Supporting marginalized groups through social justice
- Encouraging local agriculture, urban greening, and gardening
- Promoting recycling, appropriate technology, and resource conservation
- Preventing pollution and harmful waste
- Curbing excessive consumption
- Raising environmental awareness through public engagement projects

The success and sustainability of eco-cities rely largely on the development of ecological urban planning and management strategies, as well as heightened social consciousness. However, the capitalist system and its inherent

drive for excessive consumption -the very forces that have made cities problematic- are now seeking solutions through ecologically inspired urban models shaped by the same system.

Figure 1
Ecological City Framework and Standards



Resource: Karakurt Tosun, 2017.

2.2. Techno-City

Technology plays an important role in human life as a tool. Throughout history, it has served to overcome problems and simplify both work and daily living. Technological developments, driven by a certain dynamism, bring new forms and dimensions that affect individuals, society, space, and organizational structures. One of the most significant areas influenced by technology is the city. Technological advancements -beginning with the invention of the steam engine- have played a key role in the expansion of cities. At the same time, cities have contributed to technological development by providing opportunities and resources (Memiş, 2018).

Generally, technology is viewed as a means to enhance city functions and often leads to improvements in the quality of urban life (Konvits et al., 1990). However, literature also acknowledges that the close relationship between cities and technology which includes transportation, infrastructure, telecommunications, industry, and business organization can also result in incompatibilities and conflicts (Atkinson, 1998).

Terms such as “technopark,” “technocity,” “digital city,” and “smart city” are frequently used in discussions on how technology can be applied and sustained in urban contexts. Although “technopark” and “technocity” are often used interchangeably, they are sometimes categorized under the broader concept of a “science park.” The term “technology city” (technopole or technopolis), reflecting the integration of technology into cities, is commonly used in France, the UK, and Japan. In this study, the focus is on the concept of the “eco-techno city” a city envisioned as a living organism harmonized with rapidly evolving technology.

Recent technological advances have initiated a transformative shift in human life. Technology now permeates nearly every aspect of existence -often subtly and unconsciously. Cities and their governments are not immune to this transformation. Urban centers, with their dynamic structures, have historically served as hubs of growth, production, innovation, intelligence, and knowledge (Elvan, 2017).

Today, the planned, organized, and ecological development of cities has gained importance in efforts to build sustainable urban environments. Achieving sustainable and ecological cities requires the harmonious integration of technology, ecology, and urban planning. The current definition of “technocity” typically refers to a center for technological development stemming from university–industry collaboration. In contrast, this study redefines the term as:

“An organized research and business hub where universities, research institutions, and industrial organizations jointly conduct research, development, and innovation; create value-added products; and facilitate the transfer of knowledge and technology. These centers integrate academic, economic, and social structures” (www.odtuteknokent.com.tr, 2024).”

In this context, a techno-city can be described as:

“A city model that combines urban infrastructure (architecture, transport networks, green spaces, etc.) with present and future technologies, shaped by the implementation of technological systems in urban areas, with the primary aim of reducing environmental impact, minimizing energy consumption, and improving human life.”

A techno-city is essentially an urban approach that leverages technological innovations to positively influence city structures and residents’ lives, while supporting sustainability. However, technology alone is not sufficient to make a city more livable. What is essential is the appropriate, systematic, and coordinated application of technology to meet societal needs and improve citizens’ quality of life (Tan & Yimin, 2018). Therefore, technology must be integrated with ecological approaches to ensure compatibility with urban life.

2.3. Eco-Tech City

Cities, whose foundations were laid with the earliest human settlements, are now home to half the world’s population. They are complex organisms composed of living and non-living components, characterized by intricate interactions and relationships. Like biological systems, they require balanced and sustainable development. Factors such as rapid population growth, economic and social challenges, overexploitation of natural resources, and exceeding environmental carrying capacities have disrupted-and continue to disrupt -urban balance. This has necessitated the development of various solution proposals (Altuntaş, 2012).

One such proposal is the “eco-tech city” -a concept still relatively underexplored both globally and in Turkey. The eco-tech city seeks to preserve ecological systems through the use of technological tools. By considering ecology and technology in tandem, this approach is based on natural elements and processes and promotes the use of technology to protect nature (Alici, 2020).

Traditionally, ecology and technology are seen as opposing concepts. While ecology refers to the natural environment, technology refers to the built or artificial environment. Ecological planning focuses on initiatives such as eco-villages and eco-cities; technological planning, on the other hand, includes techno-cities, smart cities, and smarthomes. Eco-village practices often exclude electricity, energy-intensive technologies, and automobiles in favor of communities closely integrated with nature and agriculture. Technological or smart cities, in contrast, prioritize information technology, smart infrastructure, and data-driven processes -often with little attention to ecological concerns due to their high energy consumption.

However, in the concept of the eco-tech city, these seemingly contradictory ideas are harmonized and used to promote sustainable urban living (Erçoşkun & Karaaslan, 2009). Describing ecology and technology as mutually exclusive makes it harder to solve urban environmental challenges. By embracing simplicity and natural systems, resisting overconsumption, and applying information technologies, cities can achieve a more efficient economy, a well-informed and connected society, and improved management of urban resources -key elements of urban sustainability.

Urban sustainability also requires seeing cities as biological metabolisms -organic structures that function through cycles. Eco-tech cities are characterized by three core features: they are integrated (compact), green, and smart. The successful transfer of cities to future generations depends not only on being green and integrated but also on being smart, adaptable, and in line with eco-tech planning (Alici, 2020).

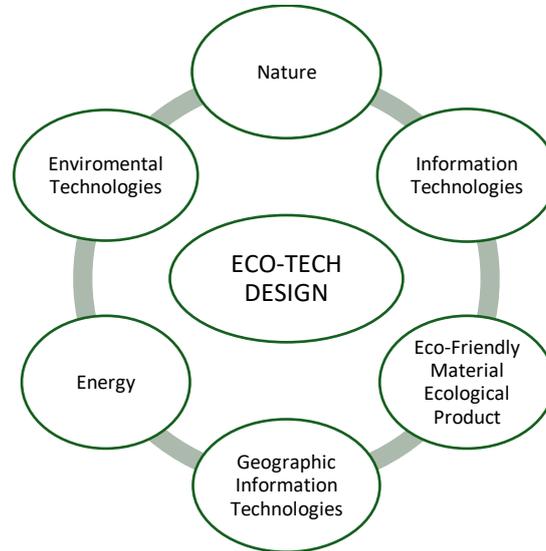
Although eco-tech cities are a relatively recent approach to urban sustainability, the term has gained prominence over the past decade -especially in industrial design for clean energy and environmentally friendly technologies. The term “eco-tech” combines *ecology* and *technology* and seeks to ensure maximum ecological protection through technological means. This paradigm uses sustainable planning to adapt natural elements and processes to modern life through the application of advanced technologies (Erçoşkun, 2007; cited in Erçoşkun & Karaaslan, 2009).

As ecology and technology converge, they manifest spatially as eco-tech cities. When a high-tech, economically efficient, and socially harmonious city is added to the eco-city model -one that is in harmony with nature- a new, sustainable urban vision emerges. Whereas different technologies were used independently in the 20th century for data and information transfer in urban development, their integration in the 21st century has accelerated the urbanization process. This integration has enabled more efficient urban economies, more informed and interconnected societies, and improved urban resource management (Erçoşkun & Karaaslan, 2009).

To ensure environmental sustainability, urban design and planning must be both ecological (green) and technological (smart). In this context, eco-tech cities use technological innovations in urban design to achieve ecological goals. The ultimate goal of eco-tech cities is to secure urban sustainability by fostering cooperation between technology and the environment- especially as environmental issues in cities become increasingly severe (Bogunovich, 2002).

Figure 2

Eco-Tech City Design Elements



Resource: Ercoşkun, 2007.

3. NEW URBAN PARADIGM: ECO-TECH CITIES AS THE CITIES OF THE FUTURE

Political events, internal and external migrations, inadequate education and healthcare opportunities, rural disintegration, and other factors have led to an increasing concentration of populations in cities. As a result of this rapid urban population growth, both environmental and social problems have emerged. Although cities occupy only two percent of the Earth's surface, they consume 75% of the world's depleting resources, emit greenhouse gases, and generate billions of tons of solid and toxic waste. Furthermore, urban populations exert destructive pressure on soil and water resources for food production, and on forests for timber and other products. If cities continue to grow in this manner, irreversible and unsustainable consequences will ensue (Herzberg, 2017).

In response, fundamental principles are beginning to emerge to improve the current conditions of cities and shape those of the future. These principles include: minimizing the use of natural resources; constructing buildings that do not obstruct air flow; increasing urban greenery, reducing wastewater usage (Şen, 2009); maximizing recycling, limiting automobile use; developing energy-efficient buildings; promoting public transportation, and organizing cities to support integrated living and working spaces, rather than separating residential, commercial, and industrial zones (Çetinkaya, 2013). Based on these principles, the cities of the future are expected to be sustainable and more environmentally compatible.

3.1. Smart City Discussions

It is difficult to argue that current policies, planning practices, design strategies, and implementation tools have been sufficiently successful in addressing sustainability and quality of life issues in cities. Advances in information technologies over the past two decades have brought the application of technology to the forefront, particularly for addressing chronic urban problems (Terzi and Ocaçcı, 2017). Today, the most frequently discussed concept in the context of technology and the city is the "smart city" phenomenon.

The smart city stands out as a newly evolving concept that incorporates the core elements of several other models (e.g., digital city, eco-city, green city) (Sınmaz, 2013). In order to manage urban infrastructure and resources effectively and meet both current and future needs, cities must become smart. Smart cities, which merge technological progress with environmental sustainability, are referred to in the international literature by various terms: intelligent city, digital city, sustainable city, technological city, and so on. While these definitions differ in

detail, they broadly align in scope (Varol, 2017). In summary, smart cities can be defined as urban areas that use information and communication technologies (ICTs) to address complex challenges that hinder sustainable development in social, economic, and/or environmental domains (Mora and Bolici, 2017).

As the world becomes increasingly digital, cities are rapidly integrating technology, and smart cities are no longer utopian ideals. They are being implemented and explored to varying degrees across the globe (Yaman and Çakır, 2018). The smart city concept encompasses planning, design, financing, construction, and the management of urban infrastructure and services. It focuses on advancing cities in terms of architecture, transportation, security, public services, and information technologies (Harrison and Donnelly, 2011). Another definition describes the smart city as a model that integrates ICT with traditional infrastructure, coordinating them through emerging digital technologies (Batty et al., 2012). Despite the many definitions in the literature, the smart city is generally understood as the application of technology to cities in pursuit of a sustainable urban life. Prominent technological solutions include water management, clean and renewable energy, smart traffic control, e-government, urban mobility, wireless internet access, and waste management. Ultimately, using technology to address citizens' real needs and enhance their well-being is more important than technology itself (Terzi and Ocakçı, 2017). As digital technologies play a critical role in urban transformation, smart cities are undoubtedly poised to become the future of urban living (Law and Lynch, 2019).

The evolution of ICT has fostered the development of smart cities, where digital systems are integrated with physical infrastructure, architecture, and everyday objects to tackle social, economic, and environmental challenges. The smart city has emerged as a strategy to mitigate the issues stemming from urban population growth and rapid urbanization. When viewed through the lens of urban challenges such as waste, air pollution, and traffic, the notion of a smarter city is increasingly seen as a necessity to ensure livable urban environments. A sustainable and livable city is the hallmark of a smart city.

3.2. Eco-Tech City Establishment Efforts: Examples from the World and Turkey

The increasing urban population in both the world and Turkey, the growing incorporation of technological elements into living spaces, and efforts to develop ecological habitats are all fueling new urban design initiatives.

3.2.1. Eco-Tech City Establishment Efforts

Although many cities worldwide have embraced the new urban paradigm grounded in ecological principles, only a few have successfully integrated both ecology and technology. Most of these are either conceptual projects or pilot initiatives led by major software and hardware companies in developed nations. These efforts aim not only to increase green spaces but also to implement the "smart" city solutions demanded by the 21st century.

One of the earliest examples of the eco-tech city model is the "King Abdullah Economic City" (KAEC), a megaproject initiated by Saudi Arabia on the Red Sea coast and expected to be completed by 2035. KAEC exemplifies an eco-tech city through its integration of cutting-edge technology and ecological planning. The project seeks to foster economic and social development, attract investment, generate employment, and establish a new lifestyle that harmonizes high technology with environmental sustainability through comprehensive planning. Initially, infrastructure was designed using the latest technologies, with connections to land, sea, air, and rail transportation systems. The settlement, conceived as a megacity, incorporates advanced lighting, water, sewage, and waste systems, communication networks, sports and recreation facilities, and abundant green areas. KAEC comprises both economic and public zones, with a strong emphasis on large-scale ecological planning and extensive technological integration (<http://www.kaec.net>, 2024).

Image 1

King Abdullah Economic City



Resource: <https://www.kaec.net/>, 2024 (05.12.2024).

These city models typically begin as design projects and are implemented after receiving approval from the relevant authorities. It has become increasingly evident that the majority of companies in the technology sector - especially those in information technology- will form the foundation of smart and connected cities in the coming years. Through such initiatives, the goal is to integrate all urban systems and services into a single, interconnected network, as exemplified by the case of Songdo, South Korea. The primary objectives include optimizing key urban functions and services that affect residents, such as healthcare, education, public services, water recycling, security, and telecommunications (Herzberg, 2017).

In this city model, health and education services can be accessed from home, with infrastructure in place to allow sick children to attend lessons online. The Songdo project enables remote access to control systems embedded in wall panels via smartphones, tablets, and computers. As a smart and connected city, Songdo is regarded as a significant testing ground for the Internet of Things (IoT) (Herzberg, 2017).

Following South Korea, China has also placed the creation of a "smart and accessible information" society on its agenda, aiming to mitigate the challenges posed by excessive urban population density. New urban developments in the Chengdu-Chongqing, Guangxi-Beibu Bay, and Guanzhong-Tianshui regions -designed in collaboration with major American IT firms- represent some of the first large-scale implementations of the Eco-Tech City model featured in this study.

India is another key candidate for building cities designed to foster healthier living conditions while avoiding the ecological mistakes made elsewhere. In a country where approximately 600,000 new engineers graduate each year, the ambition to produce technology and design a 21st-century lifestyle suited to a dense population becomes both a strategic advantage and an unavoidable necessity. Bangalore, in particular, stands out as a promising location for such initiatives (Herzberg, 2017).

India shares many of the economic drivers seen in neighboring China, particularly regarding smart and connected city development. In both countries, rapid urban population growth, rising middle-class consumption, diminishing rural living opportunities, overpopulated cities, and increasing strain on natural resources and the environment highlight the urgent need for smart urban planning. The prominence of smart and ecological urban projects in densely populated countries such as India and China -rather than in Western nations- emerges as a practical response to escalating urban challenges.

Image 2
Chengdu-Chongqing City



Resource: <https://subsites.chinadaily.com.cn/>, (05.12.2024)

3.2.2. Examples of Technological (Smart) and Ecological Cities Around the World

There are two types of smart and ecological city models around the world. In some cases, smart and ecological transformations have been implemented in existing cities, enabling them to gain the identity of a 21st-century city. The number of smart and ecological cities is increasing day by day thanks to the improved quality of life they offer and their ecological achievements. Below are some notable examples.

Amsterdam

The local government of Amsterdam, the capital of the Netherlands, has integrated approximately 300 smart applications into urban processes through collaboration between the public and private sectors. Aimed at enhancing real-time decision-making systems, these smart systems operate on a platform connected via wireless

devices. Combining information technology with participatory approaches and citizens' expectations, Amsterdam has developed projects in areas such as infrastructure, technology, energy, water and waste, transportation, sustainability, governance, education, and quality of life. These initiatives earned the city the titles "European Innovation Capital, 2016" and "Smart City World Congress Award, 2012." Notable projects include: "Emergency Management," "Greener Buses," "Happier Drivers," "Energy Management with the Internet of Things," "Smart City Acceleration Program," "Smart Traffic Management," "Living Laboratory," and the "Open Data Project" (Mora & Bolici, 2017; Smart Cities, n.d.).

Barcelona

Barcelona, Spain, is pursuing a vision of self-sufficient, productive neighborhoods and a rapidly evolving urban environment tailored to the growing needs of its population. Through the "Sentilo Project," which began in the 1980s and now spans 500 kilometers of fiber optic network, sensors collect and analyze city-wide data through the "City Operating System" infrastructure. The city's smart and ecological innovations have earned numerous awards and are expected to yield an economic benefit of €832 million by 2015. Notable projects include: "Barcelona Project by Citizens' Decision," "Social Relations Strengthening Project," "Smart City Barcelona Website," "Digital Education Technology," "Electric Motorcycles for Tourists," "Automatic Waste Collection," "Urban Laboratories," "City OS," and "Superblock Mini-Neighborhoods" (Smart Cities, n.d.; Catalonia Trade and Investment, 2019).

Dubai

Dubai, the capital of the United Arab Emirates, began its technological transformation in the 1980s. After analyzing leading global smart city practices and adapting them to its context, the city developed a vision centered around citizen happiness. A range of smart projects have been rapidly implemented with the goal of becoming a global leader by 2021. The "Happiness Meter," the world's first live emotion capture system, measures resident and visitor satisfaction using real-time data analytics. Other initiatives include: "Dubai Smart City Index," "Smart Dubai Platform," "Dubai Blockchain Strategy," "Cybersecurity Center," "Dubai Paperless Strategy," and the "AI Lab." A key difference from other smart cities is the establishment of the "Smart Dubai Office," which coordinates all city management institutions and oversees implementation (Smart Cities, n.d.; <https://www.digitaldubai.ae/initiatives>, 2025; Bin Bishr & El Kaissi, 2019).

Copenhagen

Denmark—and especially Copenhagen—is a global leader in smart city development in response to rapid urbanization. Declared the "Green Capital of Europe" by the European Commission in 2014, Copenhagen has received global recognition for projects promoting green spaces, sustainable architecture, and renewable energy (e.g., Copenhill, Smart Store). Denmark also stands out for its high levels of education and social participation, contributing to its "smart people" profile. Key projects include: "Smart City Starts with Smart Administrations," "Smart Lighting," "Connected Cities," "Copenhagen Airport Smart Project," and "Living Laboratory." The city is among those where eco-tech city models are being practically applied (Smart Cities, n.d.; Bee Smart City, 2023; <https://www.visitdenmark.com/>, 2025).

Santander

Santander, the capital of the autonomous Cantabria region in northern Spain, exemplifies the integration of smart and ecological initiatives. A coastal city known for its natural beauty and oceanic climate, Santander emphasizes public transport and cycling, supported by extensive underground parking to reduce congestion. Recognizing that sensors alone are insufficient, the city administration employed participatory methods to involve citizens in urban improvement. With the "Smart Santander Project," it developed a governance and data management system for the Internet of Things (IoT). Real-time information on traffic, weather, cameras, public transport, and bike rentals is accessible throughout the city (Smart Cities, n.d.; Bayo, J.G., 2016).

Seoul

Seoul, the capital of South Korea, is the 13th most populous city in the world with 10 million residents. With active local government involvement, Seoul has implemented various smart applications focusing on open data, citizen engagement, and big data analytics to enhance urban services. A digital platform enables citizen participation and feedback, supported by near-universal internet (100%) and mobile phone (88%) usage. Prominent initiatives include: "Big Data," "E-cube Lab," "Smart Office," "Smart Meter," and "Digital Interaction" (Smart Cities, n.d.; <http://www.seoulsmartcityprize.com>, 2025).

Other cities successfully implementing smart city strategies include New York, Singapore, and Vienna. Their innovations include: "Bicycle for All," "Urban Transportation Open Data," "Contactless Payment Systems," "Electric Taxi Projects," "LED Public Lighting," "Idea Workshops," "Online Health Centers," and "Global Transportation Open Data."

Image 3
Bursa Nilüfer Eco City Project



Resource: <http://sbpturkiye.com>, (01.09.2024)

Image 4
Eskişehir Kocakır Eco City Project



Resource: <http://sbpturkiye.com>, (01.09.2024)

Local governments are increasingly and more widely working to restructure urban services by utilizing the opportunities offered by information technologies. However, it is not yet possible to evaluate these applications within the framework of an Eco-Tech City. Despite their contributions to improving the quality of life in urban areas, these initiatives are largely regarded as serving the technological transformation of cities rather than their ecological transformation.

Examples include Smart Intersections, Smart Public Transportation Systems, Smart Bicycles and Bicycle Paths, Electric Buses, Catenary-Free Trams, the use of Elkart and banking cards in public transportation, City Information Systems, Cemetery Information Systems, electricity production from solid waste, lighting with renewable energy sources, biogas and electricity production from wastewater treatment, the Smart Konya mobile application, among others. These initiatives are important data sources in the development of a smart city identity.

The number of provincial municipalities implementing these and similar smart projects is growing steadily. Cities such as Istanbul, Ankara, Antalya, Bursa, Gaziantep, Kayseri, and Kahramanmaraş stand out among the provinces that have adopted such technologies. There are also limited examples of smart applications in other provinces. Nevertheless, these technological implementations are not sufficient for these cities to be considered eco-cities.

When compared with global examples and definitions of the concept, it is difficult to argue that eco-tech cities currently exist in Turkey. However, it would not be an exaggeration to anticipate that eco-tech city initiatives will be introduced in Turkey in the near future as part of efforts to develop the cities of tomorrow.

4. CONCLUSION

It is well known that civilization originated in urban centers and that cities have historically played a key role in societal development. Urban spaces -important tools in the reproduction of capitalist capital- have become even more densely populated through globalization. This intense construction and population growth have contributed to rising urban and environmental challenges, prompting the search for new models and solutions.

Every day, we are confronted with news about the increasing pollution of the planet. Due to environmental problems that pose a serious threat to human and ecological life, our oceans, rivers, and the air we breathe are increasingly polluted. The ongoing degradation of these natural resources presents a growing danger to the well-being of humanity. Unfortunately, this state of environmental decay is not confined to any single nation or region; it is a global crisis. It is widely acknowledged that we are approaching a critical tipping point- one that may render large areas of the planet uninhabitable unless urgent and effective measures are taken. News reports highlighting this looming crisis appear almost daily.

The world's rapidly growing population and the increasingly complex dynamics of urbanization have made the design of sustainable living spaces a necessity. In this context, new urban models- such as eco-cities, eco-tech cities, and smart cities- are gaining prominence. These models combine technology with environmental awareness and aim to provide innovative solutions to the pressing problems of modern urban life through renewable energy systems, smart infrastructure, and environmentally friendly technologies.

The idea that technological pollution can be solved by using technology itself is being echoed with increasing frequency. It is noted that significant investments have been made to make cities more livable through advancements in information technology, and to leverage digital tools in constructing both ecological and smart (digital) urban spaces (Herzberg, 2017). In this process of capitalist reproduction, these developments could also be interpreted as a form of confession an acknowledgment of the consequences of insatiable consumption that is contributing to making the world uninhabitable.

We are now witnessing collaborations between major digital software corporations and large construction companies to build eco-tech cities. The planning of the King Abdullah Economic City in Saudi Arabia and the involvement of Cisco in projects in China, the UAE, and the United States demonstrate that multinational corporations will play a major role in shaping the cities of the future. Meanwhile, the worsening global pollution, the increasingly unbearable conditions of urban life for many, and the rising appeal of ecological values are all contributing to a race to construct cities that harness the full potential of digital technologies.

The fact that powerful companies from developed countries are leading the design and implementation of these large-scale investments- projects that require enormous capital- signals that the preferences of global capital will once again dominate the formation of new urban living spaces. How underdeveloped countries will be impacted by this process remains to be seen.

It is important to recognize that the cities of the future will not only gain ecological characteristics, but that digitalization- now almost a prerequisite for a higher-quality and more prosperous urban life- will also bring about the construction of a new social structure. New forms of social relationships may emerge as part of a broader search for meaningful living spaces for individuals and communities increasingly isolated in the digital age.

Whether in smart cities or eco-tech cities built with advanced technologies, the foundational elements are sensors, the Internet of Things, and big data analytics. These technologies enable more efficient urban services but also raise important concerns. International human rights advocates have warned that the potential for using camera and sensor networks for surveillance and oppressive purposes must not be overlooked.

The protection of personal data, bodily integrity, and individual rights -guaranteed by the constitutions of many developed nations- could be compromised through the collection and processing of sensor data. How this data is used, who controls it, and whether it serves the interests of the majority or a powerful minority will be decisive in determining the ethical and democratic future of these new urban models.

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